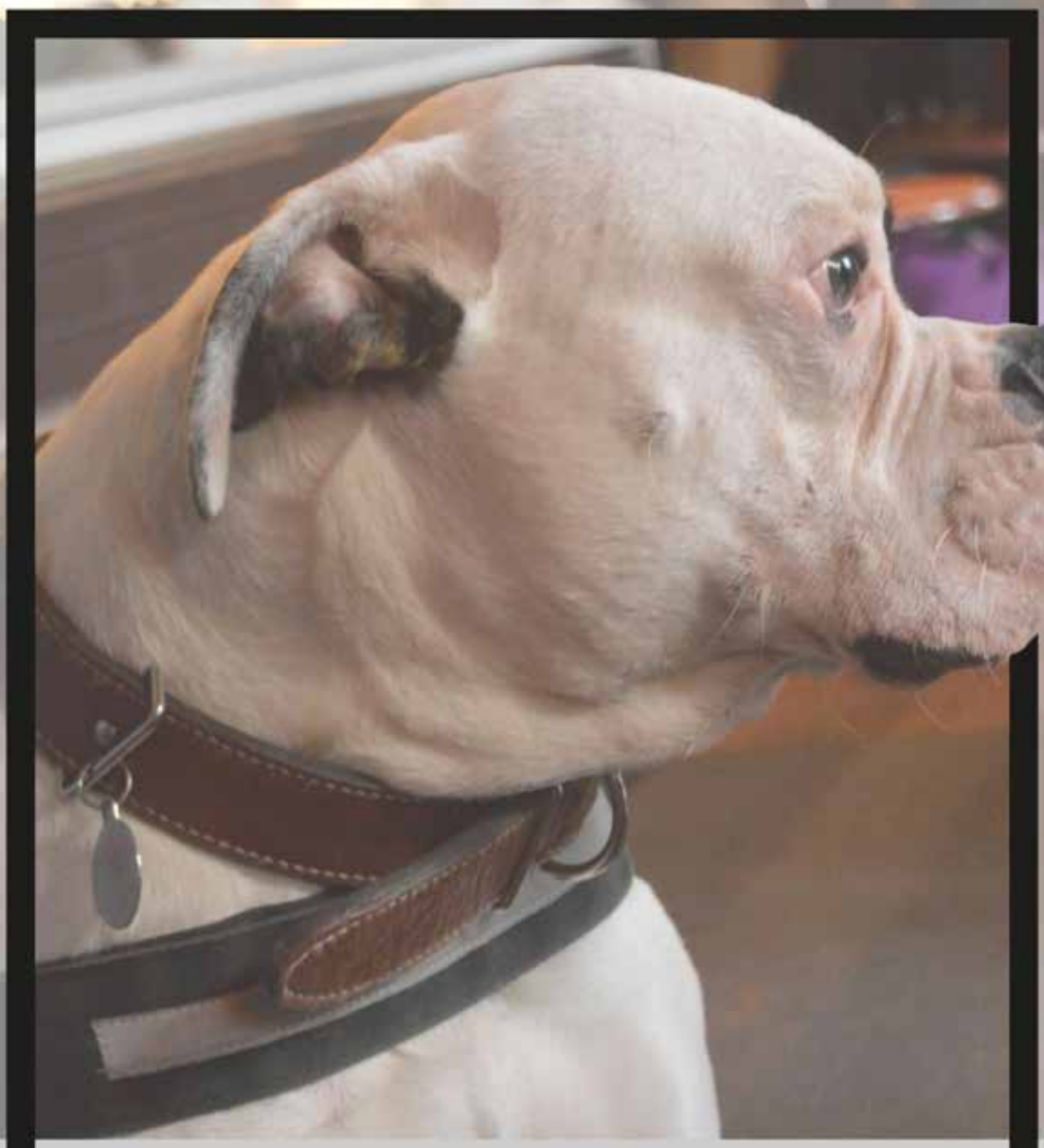
mRNA



YEAR 2 // ISSUE 2 // APRIL 2017

JOOST GRIBNAU: FROM HENGELO TO MIT // WNT REVIEW // PIPO DE KLOON // MASTER // FILM REVIEW: THE FOUNTAIN // HEGIAS AND THE ODE TO THE PIPETTE

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EDITORS

mRNA2

Editor-in-chief: Tom Aarts
Editor: Sonny Floyd de Jong
Minuting InDesigner: Tessa Vergroesen
Captain InDesign: Arielle Molina
Captain InDesign: Hielke Walinga
QQ: Jacobus Dijkman

DEAR READER,

A year consists of four seasons, and we have just entered my favourite one: spring. Although summer is great, which some of the Nanobiology students already had a taste of during the trip to Gran Canaria, spring has something special. Days are getting longer, flowers are starting to grow again and everyone is feeling happy. Furthermore, spring stands for beginning. For me, it feels like starting with a clean sheet of paper, filling it again with the latest news in the field of Nanobiology and giving updates on S.V.N.B. Hooke.

One year ago, mRNA set up this magazine, laying down the foundation of something which is indispensable for a study association. One of our goals this year is to make the mRNA available for everyone within the association, and I may proudly say that we made this possible by doubling the number of mRNAs printed for this edition! Even more, when you are lazy, you will not even have to go to a release drink to receive a copy, but you will just find it in your mail box.

This is also the first edition that is fully written in English, so we have made quite some enhancements, if I say so myself.

In this edition, we say goodbye to our sunshines Melina and Celebrity, but we also welcome our new offspring: Tessa and Sonny! Hopefully you can enjoy this magazine in the pleasant spring weather, just don't forget to study for the exams. When you have any comments on or suggestions for the mRNA, feel free to contact us on mrna-hooke@tudelft.nl.

Have fun reading!

Tom Aarts
Editor-in-chief of mRNA 2

COLOPHON

The mRNA is the official magazine of the Study Association for Nanobiology, S.V.N.B. Hooke. Printed versions will be send to and distributed among the members. The committee strives to enforce copy right laws of the texts and images used. If you believe to have the rights to used pieces, we ask you to contact us. We reserve the right to shorten, alter or reject submitted documents. We thank everyone for their contributions.

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S.V.N.B. Hooke
Van der Maasweg 9, room D0.120
2629HZ Delft
015 2781639

FROM THE BOARD

Dear members,

As I am writing this, it is almost a month ago since we came back from our surfing trip to Gran Canaria. Time has passed so by quickly! We are halfway our board year and are now finalising the plans for the coming half year. We are looking forward to a semester with, among others, the parents' day, a big symposium, the triple-day excursion abroad and, of course, the first half lustrum gala of Hooke!

Also smaller activities such as the interfaculty beerpong tournament, another pubquiz, and many more will take place. It is crazy how we started to brainstorm about all these things a year ago, not knowing whether all of our ideas would make it into the real world or not. Some of them for sure did, such as the surfing trip and the coffee machine, and others are still in the making. Each week we get closer to pushing those plans and ideas into that real world and each time we get confirmation for one of them, it gives us such a rush of motivation! Thanks to our committees we are able to realise most of them, although we always have to keep the risks in mind.

However, without taking risks it is difficult to achieve something to be proud of. This year we had many risks to take into account, some big, some small. Fortunately, everything went well. The Dies party was a big success and everyone came back intact from our surfing trip.

Besides all the important ideas and activities for our members, two remarkable events have taken place. Our study counselor Fleur has left and has been succeeded by Tanja, and Fleur and Serge have been honoured as "lid van verdienste" of our study association. We want to thank them for all the hard work and enthusiasm they have shown us the last years, for both the students and Hooke. Without them you may have never had a beautiful mRNA in your hands and would not be able to smell the scent of this newly printed paper.

I would like to end this humble 500 word piece of fiddle-faddle with a very important message to you all. I spoke about taking risks, and I encourage you to take some this year. Of course, let it make sense, but don't be afraid to do things you are not exactly 100% sure of whether they will work out or not. You will be able to laugh about it, I can assure you, eventually. At least, that is what I have experienced for the last years. Also a big shoutout to the 53 first years that passed their first semester! You will get those 60 points this year. I hope to see you all on the activities this semester and for the first students of Nanobiology that are already into their last semester ever: let's have some fun while you still can!

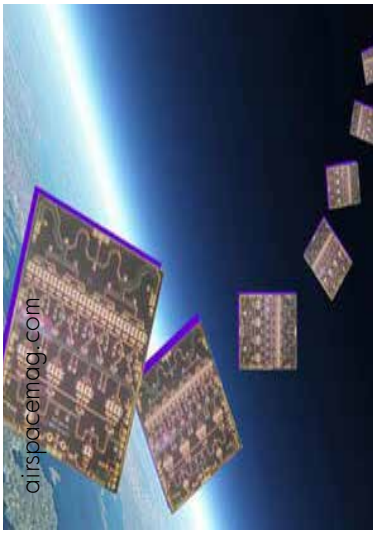
I have spoken,

Amanda van der Sijs

SUPERFAST DNA COMPUTER

GROWING BY REPLICATION

A normal desktop computer can only find one solution at the time for a certain problem, so it is deterministic. A non-deterministic computer is able to find several solutions for one problem at the same time, which makes it much faster. This technique is already used in quantum computers, but its application is very limited. On DNA computers, which store their data on DNA's four bases, this technique works much better. Researchers from University of Manchester developed a DNA computer that grows as it computes by replicating the DNA and by following several procedures. With this technique, a desktop computer could potentially utilise more processors than all the electronic computers in the world combined, since DNA molecules are very small.



NASA AND STEPHEN HAWKING JOIN FORCES

BUILDING A NANOSTARSHIP

As science proceeds, more and more applications on the nanoscale are developed. One example is the collaboration between NASA and Stephen Hawking. Their plan is to build a nanostarship that can travel at one-fifth of the speed of light. Hawking presented his plan last year at the Korea Institute of Science and Technology. The question was whether the craft could survive a two decade-long trip to Earth's closest star system, Alpha Centauri. Here is where NASA can help. High-energy radiation could damage the ship, but solutions could be an adjustment of the route, protective shielding of the electrons or a silicon chip that would automatically repair itself. Although it is still theoretical, Hawking has hope: "Today, we commit to this next great leap into the cosmos because we are human, and our nature is to fly."

OLDEST KNOWN ANCESTOR OF HUMANS

SEA ORGANISM WITHOUT ANUS

In science, there are always debates where humans came from and who our ancestors could be. Recently, researchers in China have found a fossil of a microscopic sea animal called *Saccorhytus*, which lived 540 million years ago and could be our oldest known ancestor. The fossilised remains of the little animal are not bigger than one millimetre, but when being observed through a microscope, it reveals surprisingly many details. Fun fact: it had no anus. Instead, it had an oversized mouth and his waste probably found its way out via this same hole. Not so clean in our opinion, but it represents the beginning of a huge group of species, including us. Fortunately, most of these species do have an anus.

WHAT'S NEXT?

EXPLORING YOUR MASTER'S

If you are a Nanobiology Bachelor student you might already be thinking about what Master's programme you will start after you finally passed Systems and Signals. To help you make this decision, we have selected Master's programmes, from TU Delft and Erasmus University, that do not require Nanobiology Bachelor students to take additional courses or a bridging programme.

NANOBIOLOGY

Where: TU Delft and Erasmus MC

"Using the language of maths and the principles of physics to understand the complexity of biology"

With courses ranging from Math for Nanobiology to Biology of Cancer you can be sure the Nanobiology Master's programme will be just as versatile as the Bachelor's programme. And with 26 ECTS worth of electives, you can make your Master's fit your own interests. It will provide you with the opportunity to put your knowledge of physics, maths and biology into practice during an internship or during your research project that will last the entire second year of your studies.

More information: www.nb.msc.tudelft.nl

BIOMEDICAL ENGINEERING

Where: TU Delft

If you think your potential lies with the development, design and continuing refinement of devices such as joint replacement prosthetics, microsensors or advanced medical instruments for use in minimally invasive surgery and the diagnosis of movement disorders, then the Master's programme BioMedical Engineering is just the thing for you.

It is a two year programme that consists of one year of biomedical courses and fundamental technical courses and one year of an internship and a master thesis project.

More information: www.bme.msc.tudelft.nl

SCIENCE COMMUNICATION

Where: TU Delft

Being a good scientist does not just mean you should have a solid knowledge of, and skills in, science. You must also be able to communicate this knowledge and your findings. Being a good communicator raises your employability, not just in research fields, but also in government agencies or the media. This is why Science Communication is a great option for a double Master's degree.

More information: www.sec.msc.tudelft.nl

NEUROSCIENCE

Where: Erasmus MC

This Master's programme prepares students for future fundamental research in various medical fields in which neuroscience becomes increasingly important. These fields include among others neurology, psychiatry and gerontology. The programme combines a broad range of tutorials and workshops in molecular biology and behavioural neuroscience among others. In your first year you will follow a variety of courses and decide on a topic for your second-year research project. Besides research, your second year also consists of at least ten workshops on topics ranging from Introduction to Matlab to Eye movement of mice and men.

More information: www.erasmusmc.nl/mscneuroscience

MOLECULAR MEDICINE

Where: Erasmus MC

The Master's programme of Molecular Medicine focuses on current developments in biomedical science. You will learn all about experimental design and technical approaches currently in use, such as cell and tissue culture, live cell imaging, genomics and proteomics, genetic modification and the use of small animal models. You will spend half of your first year and the entire second year working on two research projects in a faculty of your choosing.

More information: www.erasmusmc.nl/mscmolmed

INFECTION & IMMUNITY

Where: Erasmus MC

This Master's programme trains students in translational research at the crossroad of infection and immunity. This programme will combine intensive training in fundamental and advanced immunology and microbiology with extensive training in clinical and population-based research. The programme consists of two intensive summer courses and two winter courses, four weeks each, half a year of research in your first year and a year of research in your second year.

More information: www.infectionimmunity.nl

For more possible masters, visit doorstroommatrix.nl

Gerhard van Roon

LIFE OF JOOST GRIBNAU
FROM HENGELO TO MIT

You might know Joost Gribnau from the course Evolutionary Developmental Biology. Beside teaching, he primarily works on the 9th floor of the Erasmus MC tower as a biological development researcher. Since 2004, he has his own research group whose main interest is genomic imprinting and X-chromosome inactivation. We asked for an interview and got to hear the story of a little boy from Hengelo, along MIT, to the Erasmus MC tower, and wev also asked him some questions about the new chapter in his life: Nanobiology.

What was your motivation to start studying Biology?

As a kid I was raised more or less in the woods, so I was intrigued by nature. For me that was one of the biggest reasons to start studying Biology. I just wanted to know more about biology in general. Actually, when I was 8 I already knew I wanted to study Biology, and that has never changed.

What did you do after you finished studying?

After my study I went into the army for two years. In the army you have plenty of time, so I did an economics study besides. At the time, my ideas were to maybe go into a company, to work in research and development or something like that. When I came out of the army I started within a company and I thought that the link between biochemistry and economics might bring me further in pharmaceutical companies. However, when I started in that company I soon realised that it was not for me.

"I do not have pets: my pets are out there, they are alive in nature. I really like to be in nature."

How did you end up in MIT?

I worked in this relatively small pharmaceutical company. It was not interesting; nothing that I had learned so far was applicable there. I was working on the registration of the medicines, which was truly boring. The biggest problem was to get back into academia from there. If you have been out of the academia, there is no way back, more or less. It is extremely difficult here in Holland, but it is different in the United States. Through a friend, Frank Grosveld, I actually ended

up at Erasmus MC. At first he was not impressed, but in the end I convinced him that I could maybe work there as a volunteer. That worked out really well, so that is how I started my graduate school. After graduation I probably sent six letters to the East Coast of the United States. I wanted to go there, because if you have been in science and have read many papers, you realise that a lot of them come from the Boston area and San Francisco. I just wanted to feel what it was like to be in the 'Mecca of science'. One of them replied almost instantly and I decided to fly over and talk to them. It was settled quite fast actually.

"One of them replied almost instantly and I decided to fly over and talk to them."

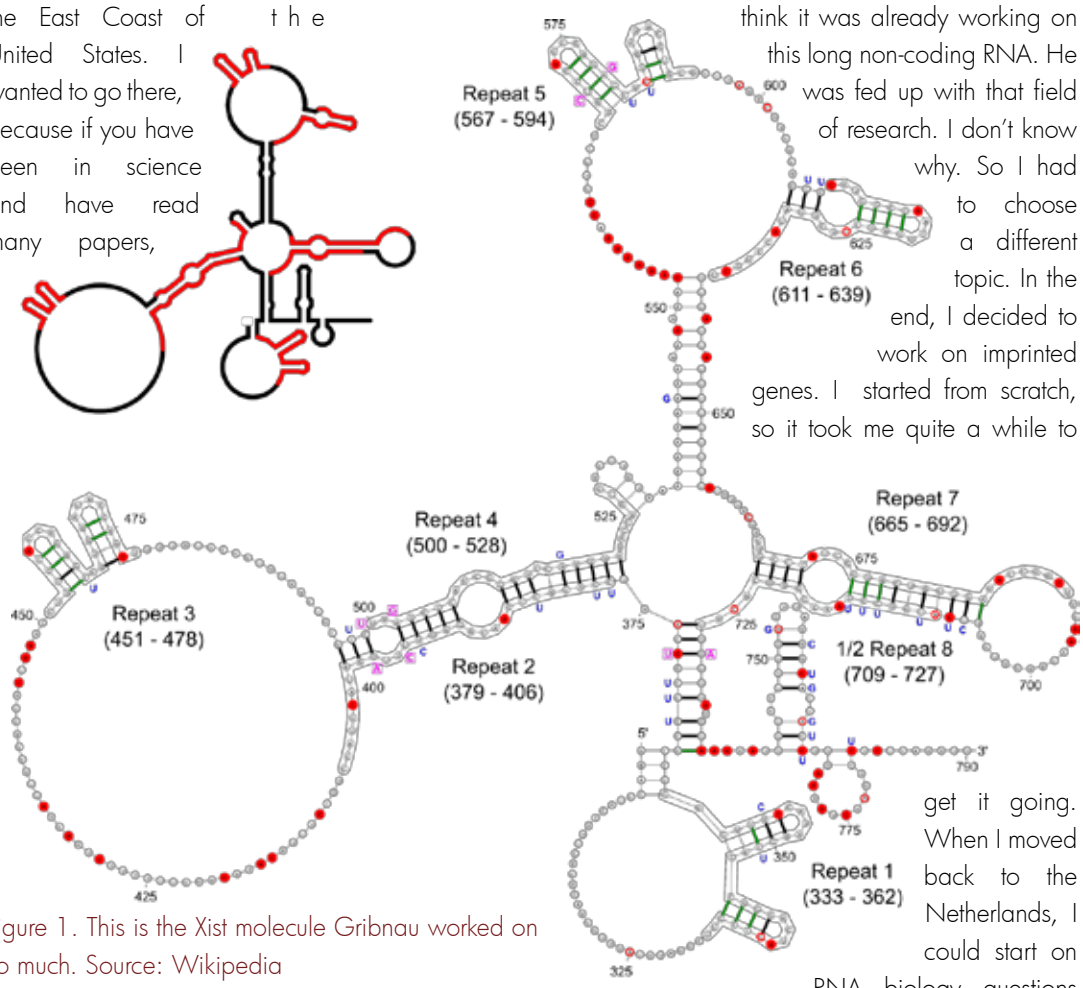


Figure 1. This is the Xist molecule Gribnau worked on so much. Source: Wikipedia

Did you know?
… that Joost wants to publish a book. It is about sex chromosomes.

How was your experience at MIT?

For me, especially in the beginning, it was rather disappointing. I went there to study RNA biology. The day I started, I talked to my boss, Rudolf Jaenisch, and he didn't think it was already working on this long non-coding RNA. He was fed up with that field of research. I don't know why. So I had to choose a different topic. In the end, I decided to work on imprinted genes. I started from scratch, so it took me quite a while to get it going. When I moved back to the Netherlands, I could start on RNA biology questions instantly. So that is how I ended up working on Xist (see Figure 2) and X-inactivation et cetera.

Figure 2. The human genome project hall. Source: nature

Were they already working on the human genome project at the time?

Yes, that is funny because in the beginning I did not notice it. However, at some point I started to realise that the office next door was Eric Lander's, one of the leading people in the human genome project. Seven months, I think, after I started there, the human genome was announced. That was also the first time I was allowed to enter the genome centre, which was normally closed. It was like a huge factory with big doors that you cannot enter if you don't work there. So at the announcement day we could finally go there and see what the facility looked like. It was just incredible. Like a science fiction movie: supercool.

"It was just incredible, like a science fiction movie, supercool."

What do you think of Nanobiology students and what can they do in your lab?

It is interesting, because I teach the medical students, I teach the molecular medicine students and the Nanobiology students, of course. They are all of a different breed. If I look at the Nanobiology students, they are the ones that like biology and modelling. So it is a pretty big audience that is listening. They are much more scientific than the students that we normally see. They are much more interested in the real questions, and the molecular mechanisms.

We already had one Nanobiology student, Guus Kolpa, who was working on methylation sequencing of single cells. The next student, I guess, will be involved in a new project on chips, for example making mini organs or making the chip to read out the mini organs.

We have now developed an assay to look at DNA methylation. We started doing this on large populations of cells and now we are moving that to single cell, to the nanoscale. We worked 14 years on this and it will be published this year. In the future, we would like to do this in an automated way. Then you can think of the connection with Delft. We need you to get it going, because most of us biologists are not able to do that. For you, guys and girls, that is different.

Did you know?
… that Joost supports D66, since he thinks that all other parties lack a long term vision.

What is your favourite cell organelle?

I would say the nucleus; it is the brain of the cell. Yeah, the nucleus.

Do you have a last message for the reader?

I would say, if I look back on my scientific career, the big word is persistence: keep believing. If you believe in it, you will do it. Persistence: superimportant.

THE STORY OF PIPO
IN THE GRAY ETHICAL ZONE OF TAKING A CLONE

One of the dogs living in snack bar *De Eekhoorn* is not a usual pet. Pup and Hans, owners of the snack bar, agreed to make a clone of Joep, who they called Pipo (de Kloon). Last autumn, they received a lot of public attention. The mRNA decided to take a look at this progressive and futuristic snack bar. We arranged an interview with Pup.

When did you hit upon the idea of cloning Joep?

I actually was approached. A researcher from broadcasting company BNN contacted me through the man whom I purchased Joep from. He asked some general questions about pets and raised whether he could come back with a camera. It was only after several talks, when he casually asked: "So what is your opinion on cloning?" And I fully opposed: "Cloning? Please, no. That is disgusting." But he carried on and asked if I knew what cloning is. Once, after Joep's castration, I decided to preserve Joep's testicles in a cabinet with the wild idea of cloning Joep some day, yet at that very moment, I felt strongly against cloning.

"Cloning may even be friendlier for animals."

"I decided to preserve Joep's testicles in a cabinet."

So, when you were asked, you were against cloning?

Indeed. But he said: "What if there would be a second Joep walking here next year?" That made me hesitate. After a while, I made up my mind and agreed. That night I could not sleep at all and I called them next morning to cancel my decision.

I asked BNN why they wanted to do this. It is just as controversial as their Big Donor Show, which received heavy international criticism. But the Netherlands is lagging behind the rest of the world. In the United States, they have been eating modified meat for ages. BNN said that we had to kick off the public debate.

Did you have any difficulties supporting a private cloning company founded by a disputed scientist?

There wasn't anything to choose from. And, you know, a lot of people are biding their time on a waiting-list for a pup of a specific father and mother. Is it judicious to breed numerous dogs without certainty of getting the desired one? Or could we better fertilise an egg and place it into the womb of a surrogate mother? Those breeding dogs are transported in lorries, hundreds at a time without food. Compared with this company, cloning might be less cruel and more animal friendly.

Why did you not take a new dog?

I have been doing that all my life. Every time when a previous dog died, the next one was, so to speak, waiting at the doorstep. I have been caring for dogs continuously and never paid for one. But Joep, we said, was a dog with humour. Such a funny pet.

But what if everyone cloned their dog?

What is wrong with that? Do you know how many dog breeders currently want to cash in on people? As I said, cloning might even be friendlier for the animals.

After Pup's and Hans's permission, employees of the cloning company travelled to the Netherlands in order to take a skin biopsy, which was processed in South Korea. The company placed the zygote in

Hwang Woo-Suk at work in his cloning factory. He lost his position as scientist after revelation of fraud on human cloning.

a surrogate mother and after several months, Pup and Hans went to South Korea for the birth of their cloned dogs. Two, because it is more secure to try twice.

How was the moment of birth?

Totally unmagical. We were staggered by the overcrowding in the birth chamber. There were a crown prince and princess of the United Arab Emirates present with their escort. After the dogs were pulled out, we could make a picture, but they were transferred to the crown prince immediately after. I understood that they had a cloned dog too. But that made the delivery very strange.

"And in the end, having children, isn't that nearly the same as cloning yourself?"

After quarantine for seven and a half month, the dog was moved to the Netherlands. How was that?

Pipo ran to us right away. Very charming. And he immediately knew the way to his basket. Perhaps that had something to do with the smell? After the second day, he waited for his food exactly at the same hour as Joep always did. With no doubt, it is exactly the same dog as Joep: its smell, its sounds. Even the colours are almost identical, although fur patterns are normally not cloneable.

"Its shuffle, its sighs. It felt so natural again."

In ten years, would you clone Pipo again?

I decided as soon as two days after bringing home Pipo: "The next one will be a clone too." Normally, when a dog passes away, it takes me at least two months before everything feels normal again. You simply miss its presence. With Pipo, it was so natural. Its shuffle, its sighs, the way Pipo eats and drinks. Mind-blowing.

What do you think of cloning humans?

I do not have children, because I am carrier of a genetic disease. I personally reckon that you are a bit selfish if you deliver a heavily diseased child. Perhaps, making children is self-centred in general, as people have them for their own joy, but willingly bringing a diseased child into the world is worse.

Now, imagine that you could create a modified embryo without a genetic disease. Yes, people would argue that you are making designer babies, but if you know that a child will get breast cancer, why not prevent it?

And what about minor diseases, like a small growth retardation?

This is where the problem starts. There are loads of ethical concerns, but in other countries, like South Korea, cloned dogs are the order of the day. We have to poke up the public debate a bit, at least BNN is trying to. And in the end, having children, isn't that nearly the same as cloning yourself?

VALEDICTORY FROM FLEUR

DEAR STUDENTS,

The final moment has come. Saying goodbye to Nanobiology fills me with a sense of sadness. It nearly feels like saying goodbye to my 'baby' who I have seen growing day in day out, whom I have taken care of with love and dedication. Now Nanobiology, my 'Nano-baby', has started walking, running even, and I need to let it go, which hurts. And trust me, being a new mum of an eight-month old, I know what I am talking about.

In May 2012 I first 'held' Nanobiology when I became involved in the setup event (accreditation) of the programme. I was asked to arrange coffee for the committee and to make sure everyone involved (mainly teachers) knew what was going on that day. These were simple tasks, but very exciting, because I got the chance to observe all these 'particular' people and listen to their ambitious plans. I thought to myself: "If these people want to make this programme start from scratch in just three months, they must be very passionate and dedicated about this." They sure grabbed my attention.

I admired the first students that came by for a basic student-for-a-day programme in June where we tried to inform them about what to expect of this Bachelor's programme, which would be different from all others. I was impressed because these must be very 'pioneering' people if they are willing to start a Bachelor's programme which is not even on the Studielink list of studies-to-be-started soon! As they were all enthusiastic and interested students, my maternal instinct that this new 'baby' would grow up to do just fine, slowly started to grow. And grow it did! From 1 September 2012 till my last day on 24 February 2017 I have enjoyed every second of working for Nanobiology and for this 'peculiar' bunch of students. Not only did you share your beautiful and personal, hilarious and sad, crazy and mad stories with me, I also saw that most of you had a lot of fun studying the courses and organising activities for Nanobiology. And this filled me with great pride and a sincere sense of satisfaction.

But it would not have been as much fun, as rewarding and as successful without my dear colleagues Claire, Serge, Roland, Jolanda, Ghazima, Willeke, Liesbeth, Anne, Inez and all the teachers: I will really miss you all, guys!

I wish to say a special thanks to Miranda, Marre, Max, Mathijs and Ilja for laying down the foundations for the Study Association S.V.N.B. Hooke, which has proven to be of indispensable value to our Bachelor's and Master's programmes. Thank you for all the 'blood, sweat and tears' that you've put into Hooke! And of course, a great thank you to your successors Valérie, Mandy, Stefan, Kees, Fiona and Amanda, and Rosanne, Jacobus, Rachel and Bas. You have all done a wonderful job.

And now I will carefully pass on my 'Nano-baby', this beautiful programme, to my successor Tanja Hilkhuijsen. I wish her the best of luck in getting familiar with the programme, daily routines and habits and of course getting to know you; the entire 'Nanobiology-family'. Please, give her a kind hand and I am sure that our 'Nano-baby' will quickly grow and develop from puberty into adulthood in the coming years.

I am moving on to a new adventure which will allow me to be closer to my real baby and continue my working career in Amsterdam. Feel free to come by for coffee if you feel like it and show me photos of how much our collective 'Nano-baby' has grown. I would really love that.

All the best, warm regards,
Fleur

INTRODUCTION TO TANJA

HELLO NANOBIOLOGY STUDENTS,

I feel deeply honoured to have some space in this edition of the mRNA to introduce myself as the new academic counsellor of Nanobiology. I hope to meet most of you in person soon. Of course, it is a challenging task to follow in the footsteps of such a good and committed academic counsellor as Fleur. Nevertheless, I will try my best and take the challenge!

You might have seen me around already in the Applied Physics building, as I have been the academic counsellor of the BSc Applied Physics, double-degree BSc Applied Physics/Applied Mathematics and the MSc programmes of Chemical Engineering and Applied Physics. It has been nice to work for different programmes as it keeps my working life varied, but I am happy to now be able to focus 100% of my time on Nanobiology. Nanobiology is not totally new to me: I organised the mentor training session in June where I trained the new mentors together with Nynke. Currently I am also involved in the selection procedure of the Nanobiology BSc programme.

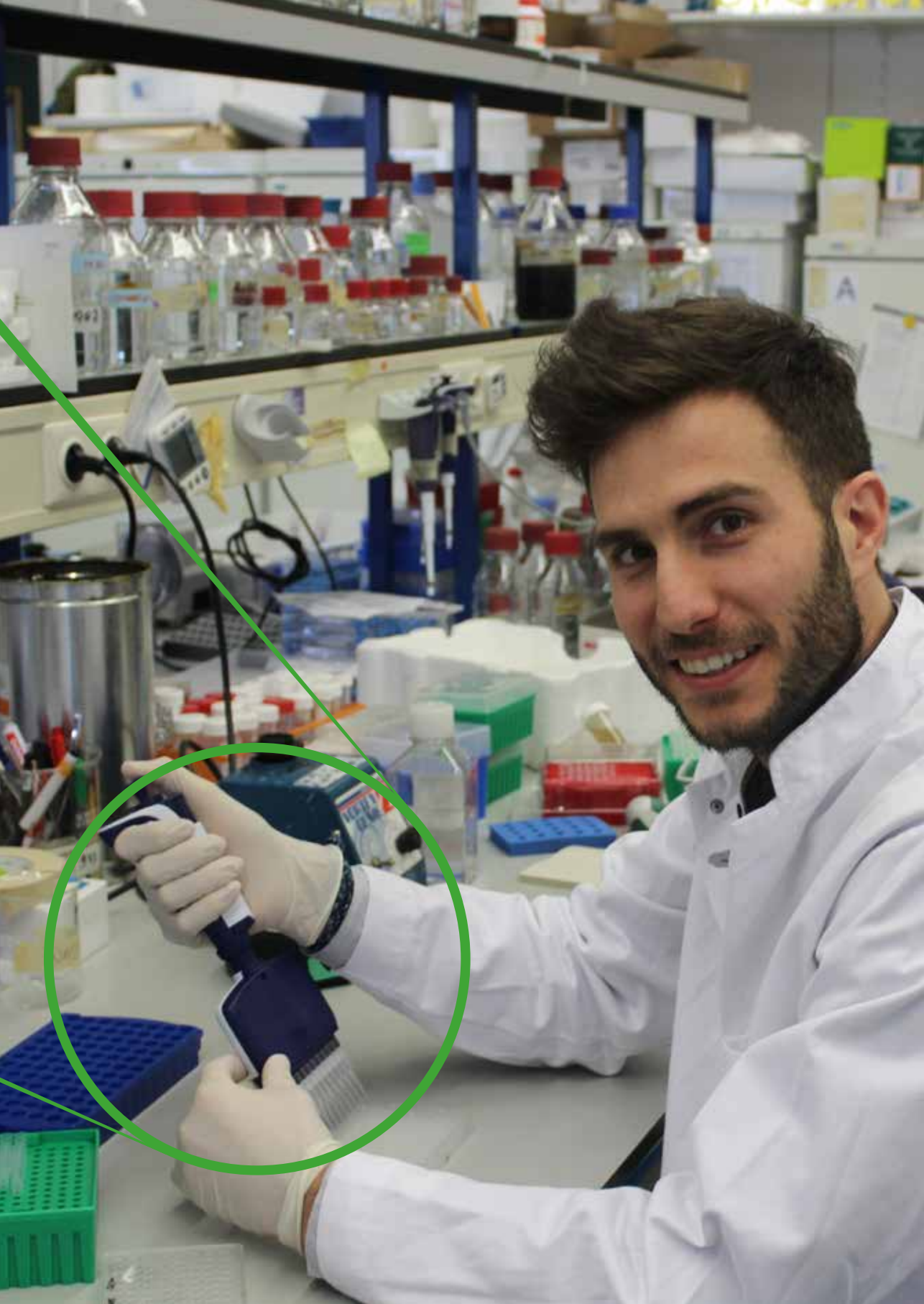
I am already enjoying being part of the Nanobiology team – the programme is very vibrant and dynamic, and it is obvious that both students and staff are energetic and eager to pioneer in this new research field. It seems that there is never a dull moment within Nanobiology! A bonus point is that I live in Rotterdam so for me it is ideal to work some days in my hometown. Like Fleur, I will be working half of the week in Erasmus MC, and the other half at TU Delft. From now on you are more than welcome to contact me if you have any questions or matters that you would like to discuss. The email address has been unchanged: Studieadviseur-NB@tudelft.nl.

And please, feel free to call me by my first name:
Tanja

HEGIAS' FAVOURITE PIPETTE

MULTICHANNEL MANUAL PIPETTE

This 12 cilindric pipette monster is the tool any self-respecting nanobiologist needs. You will never find yourself endlessly pipetting those samples in the microarray. This will improve your life and you will never want to go back. Hegias Mira Bontenbal, already a user for several concurrent years: "We have been using this thing since I started working here and I never wanted anything else!" This device is specially designed for cloning. "I created my knock-ins with this in no time, fantastic!" Did this pipette spark your interest? Order your multichannel manual pipette today at your local lab equipment deliverer.



FROM CELLS, TO IMAGES, TO NUMBERS, RELIABLY

BY ERIK MEIJERING

Breakthroughs in science often go hand in hand with revolutions in technology. This is certainly true for biology. One branch of technology in particular – light microscopy – has consistently played a crucial role for over three centuries now in unraveling the miraculous workings of living cells. Our fellow Dutchman, Antoni van Leeuwenhoek, using his own carefully handcrafted microscopes, was the first to observe microorganisms in action in a drop of rain water in the mid-1670s. And in the years to follow he continued perfecting his lenses and making one groundbreaking discovery after another. The growing scepticism about his incredible findings even made the Royal Society in London send a delegation of prominent British and Dutch clergymen to his home in Delft to see things for themselves.

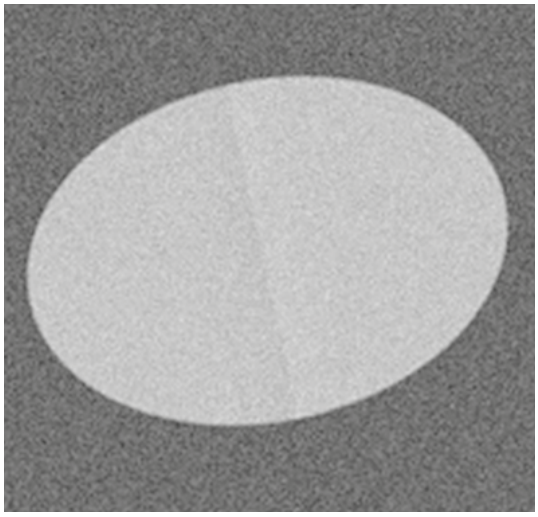


Figure 1: Which side of this 'cell' is brighter? Make a first guess, then put your finger across the centerline, and guess again.

Our reliance on visual evidence does not come as a surprise. Vision happens to be the most dominant of our five physical senses, involving more than half of our brain directly or indirectly. Thus it is only natural that we prefer to see things to get convinced. 'Seeing is believing', says the age-old adage. But how reliable is our visual system, really? It does not take many optical illusions to realise our eyes are easily deceived (Figure 1). And even if they are not, how accurate are we in estimating biophysical properties of the objects we observe in microscope images? If two persons are asked to manually measure, say, the average speed of certain fluorescently labeled proteins moving within a cell in a time-lapse recording, they will likely get two different answers. Worse, if one person is asked

ERIK MEIJERING

Erik Meijering is an Associate Professor at the Biomedical Imaging Group Rotterdam of Erasmus University Medical Center. He graduated from Delft University of Technology (cum laude), completed his PhD at University of Utrecht and his PostDoc at the Swiss Federal Institute of Technology. Nowadays, he teaches the Nanobiology course Image Analysis, which the second year students will have at the end of this year. To give the first and second year students a short preview and the senior students a refreshment, we decided to ask him about his research.

to repeat the same measurement, we still get a different result each time. And if there are hundreds of objects to measure, in hundreds of images or movies, it does not take long before we get bored, tired, and sloppy. So we tend to make selections and ignore the rest of our data. But based on what criteria? And how can we be sure these do not bias our findings? Clearly, when it comes to measuring things objectively, reproducibly, and completely, human beings (even experts) quickly fail, and more rigorous means are needed.

Enter computers. They are relatively inexpensive, to buy as well as to feed, and they can process huge amounts of data and give the same answer when asked the same question, without ever getting bored or tired. One little problem: computers by themselves know absolutely nothing about microscope images (or anything, for that matter). They need to be 'educated', and this is where my research comes in. In my group we develop computer algorithms that help biologists to get reliable numbers out of their images. This may involve many steps (Figure 2). The first is usually to preprocess the images to reduce noise, blurring, and other imaging artifacts. A next common step is to detect the presence of objects by using specific image filtering techniques. Often the most challenging step is segmentation, which aims to label and group image pixels as objects (relevant) or background (irrelevant). In the case of time-lapse

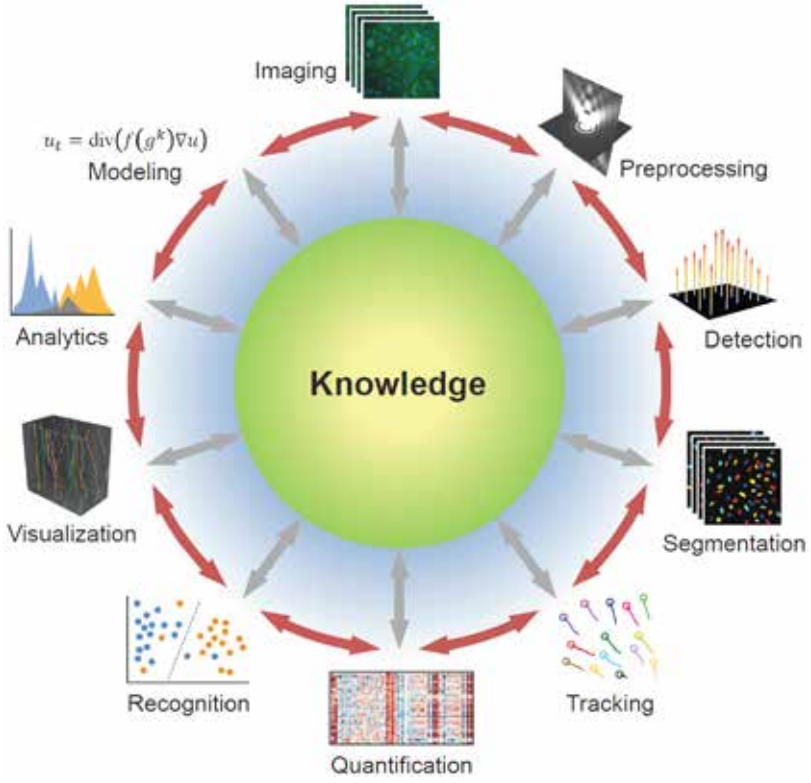


Figure 2: Common steps in computational image analysis. The ultimate goal is, of course, to increase our knowledge of biological processes. Depending on the experiment not all steps may always be needed (shortcuts are possible). Two-headed arrows are used everywhere to indicate the interrelation and possible feedback between steps.

images, a related problem is to determine the trajectories of moving objects by frame-to-frame association of image information. Once this is done, it is relatively easy to compute many quantitative descriptors of object dynamics, shape, and texture. This enables the computer to characterise and distinguish objects using pattern recognition techniques. Various visualisation techniques are available to show results to the user. And rigorous analytical techniques for statistical testing help in finally composing biophysical models of the (intra) cellular processes under investigation.

Well-designed computer algorithms for automated image analysis enable biologists to extract invaluable information from their data and make discoveries that would otherwise be impossible. For example, a few years ago, a consortium of European research groups successfully determined which of our ~21,000 human genes play a role in mitosis. In a series of RNA interference experiments they made ~190,000 time-lapse fluorescence microscopy images of in total ~19 million cell divisions. The use of state-of-the-art techniques for segmenting the cell nuclei in all images, tracking them over time, extracting hundreds of quantitative features from them, and finally classifying them into different morphological classes related to the cell cycle, cell death, or other phenotypic changes, was absolutely crucial to the success of the study. In our own collaborations with biologists, too, we have developed a broad range of powerful image analysis techniques, in particular for particle detection, tracking, and statistical processing of their intensities in fluorescence microscopy movies. Example applications include the study of microtubule dynamics (Figure 3) and of proteins involved in DNA damage repair (discussed by Claire Wyman in mRNA 1.3).

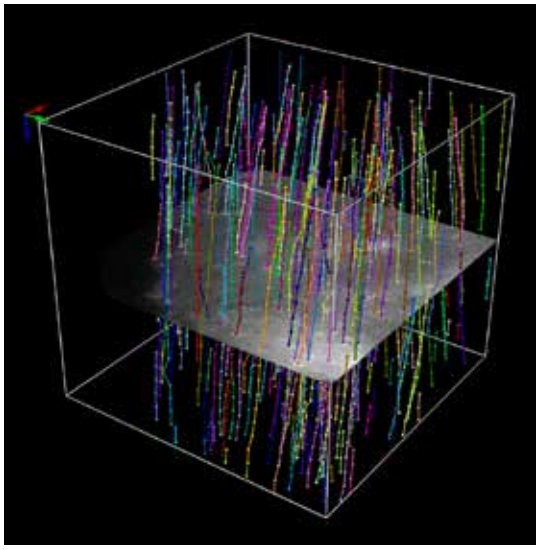


Figure 3: Spatiotemporal visualisation (time runs along the vertical axis) of the trajectories of microtubule tips moving in the cytoplasm. The trajectories were extracted completely automatically using particle tracking techniques developed in our group. The visualisation also shows one time frame of the original movie.

Where science meets technology, exciting things happen. Being part of an interdisciplinary educational programme that fully recognises this can be a challenge, but above all it is a great opportunity. No doubt you will see and contribute to major breakthroughs in your own career, improving the lives of many!

VACCIN AS CANCER TREATMENT

FROM THE LAB STRAIGHT INTO THE PATIENT

In the world of healthcare, a lot of inventions made in laboratories have a hard time finding their way to the patients. A great deal of discoveries are made in university laboratories, but the next steps are often complicated and expensive. The medicine has to be industrialised, which is a long process in which discoveries have to be confirmed and converted into a product. Researchers are often not capable of doing this.

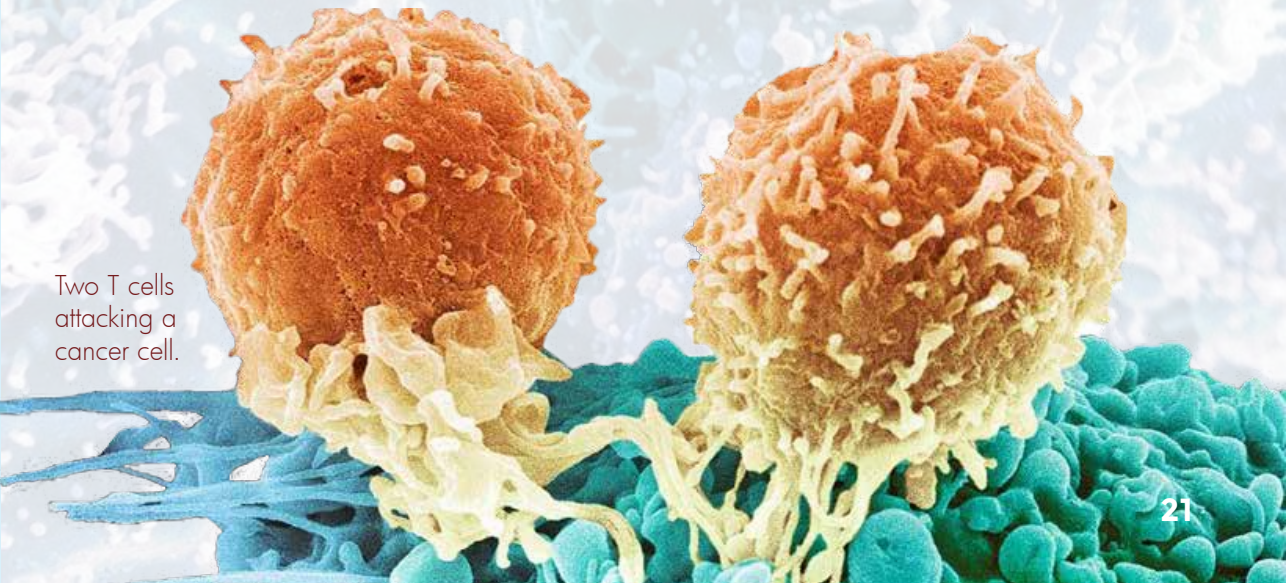
"The reason that specific treatments can avoid industrialisation, is that vaccines are commercially not interesting for industry."

In the Netherlands, an experimental treatment in which the immune system destroys cancer cells, will become available to more patients without this prolonged industrialising process. The treatment, which will be for people with skin cancer, will be in the form of a vaccine. This vaccine will be made with blood of the patient, which contains dendritic cells that will be 'activated'. The cells are, so to say, trained to detect harmful cancer cells and give the correct signals to the lymphocytes, which actually kill the cancer cells. This training happens by loading the dendrites with tumour related antigens. When the dendritic cells are activated, they are returned into the patient. The advantages of the vaccine are that it has few side effects and cancer cells through the whole body can be treated.

The reason that specific treatments can avoid industrialisation, is that vaccines are commercially not interesting for industry. There is simply no money to make with vaccines, since they are given once or twice to a patient and they are treated for the rest of their lives.

In a small group of patients the results of the treatment were very promising, so now the scientists get the chance to confirm this in a big group. Until 2021 the treatment will be covered by insurance without the proof that it really works, which makes this treatment very unique. If there is enough convincing data at that time, the treatment will officially become part of the Dutch healthcare insurance programs.

Tom Aarts & Arielle Molina mRNA



Two T cells attacking a cancer cell.

APHANTASIA AND DREAMING

A BRIEF ESSAY

Adam Zeman is a professor in cognitive and behavioural neurology at University of Exeter, England. His research mainly focuses on disorders of visual imagery, and he even found a disorder in which people are completely unable to visualise image. Data suggests that probably one of our readers might feel identified! We decided to ask the expert on the topic to reflect on this phenomenon.

'Phantasia' was Aristotle's term for the 'mind's eye'. He attributed great importance to this mental faculty, writing: 'The mind, in fact, never thinks without a phantasia.' Other philosophers concurred: St. Thomas Aquinas in the Middle Ages and David Hume in 18th century Scotland described the power of mental imagery with equal enthusiasm – and for most of us, in our thoughts by day and our dreams by night, visual imagery plays a prominent role. I had taken this ability of ours for granted until, over a decade ago, I encountered a patient who had abruptly lost the ability to visualise. Following a routine cardiac procedure, patient MX, who had previously enjoyed a rich visual imagination, found that he could no longer summon images to the mind's eye. He also noticed a change in his dreams – he continued to have them, experiencing a narrative, but they had lost their visual content. The same applied to literature – an avid reader, MX no longer entered a visual world when he opened the pages of his novel. MX's case proved interesting in many ways – among others, we were able to show that while his visual cortices came to life as they do in you and me when he looked at famous faces, those same areas failed to activate – as they would do in most of us – when he imagined faces. But one detail of his case, relevant to the topic of dreams, intrigued me particularly. About a year after he lost his mind's eye, his dreams recovered their visual qualities: although he remained unable to visualise to order, his dreams were vivid once again. This suggested a dissociation between waking and dreaming imagery.

After describing the case of MX, which attracted some publicity, a succession of people got in touch explaining that they recognised their own experience in MX's case – with the difference that they had never been able to summon visual imagery. We coined a new term to describe this phenomenon of lifelong inability to visualise, calling it 'aphantasia', adapting Aristotle's term, by analogy with a-phasia, the inability to use language, or a-mnesia, the inability to remember. Since then, several thousand people have contacted us, and our understanding of aphantasia is growing. It may affect around 2% of the population. The intriguing dissociation suggested by MX's case has proved to be quite common: many of those with a lifelong inability to visualise deliberately nevertheless dream visually. How can this be? The dissociation makes neurological sense: dreaming is a 'bottom-up' process in the brain, driven by structures in the brainstem that control sleep and waking whereas voluntary imagery is a 'top-down' process, organised by decision-making centres in the frontal and parietal lobes. It is likely that both kinds of imagery involve activity in visual cortices, but this is achieved in different ways in sleep and wakefulness, making it plausible that one process can be disabled while the other is intact. Many people with aphantasia, however, like MX during the first year after his cardiac procedure, dream without images: we hope to explore the remarkable experience of avisual dreamers in our future work.

GONE WITH THE WNT

When 4 February finally arrived, a wonderful group of 37 Nanobiologists went on a magical journey. The group of Wnthoos set sail for the sweet summer vibes of Gran Canaria. The trip from Delft to Las Palmas wnt very smoothly, except for some, who consumed a bit too much C_2H_5OH. What happened next will blow you away. Upon landing, everybody wnted to unwnt and relax at the beach while enjoying the 297.15 K heat from the sun. We consumed some sangria and cheap Dino beer (23 ct. per can!). Afterwards, we wnt out for a first party night.

Next morning, re-invigorated by a good night's sleep, it was time for the Crater Hike. In the scalding heat, we enjoyed the beautiful view: rocks in all shapes and sizes, trees and cacti. That evening, an epic happening was planned: the greatest cocktail party of all time and space. The Wnt arranged eight cocktails and a lot of beer for everyone. It escalated even more when some people wrote "lezen is adten" in the sand so everyone had to down their drinks.

Though we had a slight headache and a dry mouth, our first surfing class wnt way better than expected. Except for Djim and Stefan, who had to go to the shop and buy some balance according to the instructor, Osbalto. He thought he was a funny man. We thought so too. If standing straight up on your surfboard did not go as well as you wnted, you could always go bodyboarding instead. Nevertheless, the waves were just perfect for amateurs such as ourselves.

On Tuesday, the first mountainbike group explored the mtb-track which turned out to be very rough on some places. After some struggling and while the sun was already setting, we discovered that the track led us to the Botanic Gardens. Sadly we arrived at these beautiful gardens (so we have been told..) too late, because Marlo was too slow. In the evening we wnt out to a salsa party with the staff of the hostel.

The next day was filled with surfing, longboarding, yoga, snorkeling and local food. Did you know that there was a place where you could get two local food menus for 7 euros!? "Where?" we hear you say. Well, at Burger King! Once our stomachs were filled with nacho burgers, we wnt out to an amazing club with good vibes and beer pong. The sjaarsch were completely annihilated in a beer pong match by the senior students (this is not made up).

The final days we were still in our blissful state, despite the fact that we had to leave soon. Many Wnthoos wnt mountain biking, snorkeling or longboarding again, however the last surfing session was cancelled because the beach had turned into a jellyfish minefield.

Everyone had a great weekend, but the time for us to leave the warmth of the island had come. If we had a euro for every day we enjoyed on Gran Canaria, we could buy two Burger King menus. This holiday has been exactly what Wnt wnted and, we hope, what the Wnthoos wnted Wnt to wnt too.

JOOHHRRUUUS and Niels

PS We would like to thank mum and IntroN for making this awesome weekend possible.

THE FOUNTAIN OF YOUTH

CONTEMPLATING THE MEANING OF LIFE AND DEATH

Do the titles *Requiem for a Dream* and *Black Swan* sound familiar? Then you might know the work of Darren Aronofsky. In this production, Aronofsky again presents the struggles of young people with life. *The Fountain* focusses mainly on the quest of Thomas Creo. Thomas is a young scientist trying to find a cure for Izzy, his wife, who suffers from brain cancer. Along with two other complexly intertwined timelines, we will follow his search for immortality and in the end, we will learn what immortality truly means.

Next to the dark lab of Thomas (which is dark on purpose), you will see beautiful scenes of outer space in the Xibalba and then go back to a hidden Mayan temple at the time of Spanish Inquisition. With excellent editing Darren will show you how these timelines connect to one another. Scenes will switch back and forth rapidly, sometimes they even form part of two timelines simultaneously, which might be confusing. But this is one of the reasons why it is rewarding to rewatch. Furthermore, there is a huge amount of detail with entangled symbolism through every single timeline.

In this film you will join Thomas in his journey to eternal life.

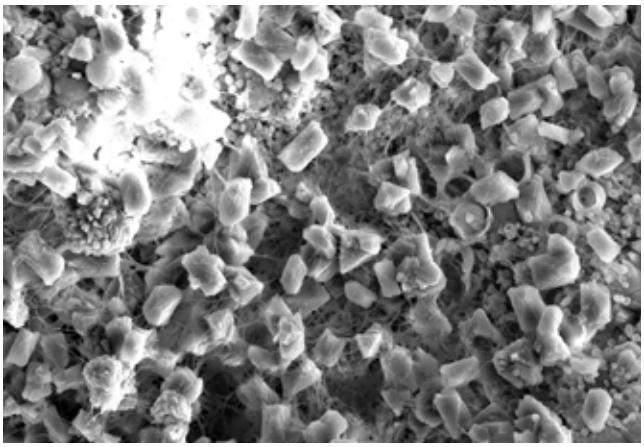
It lets you contemplate the meaning of life and death, and allows the spectator to judge the actions of the lead character. Thomas' obsession to defeat death compels him to several breakthroughs in his race against time, Izzy's time, while she claims to have lost fear and longs to spend her last moments in company of her husband. He, on the other hand, continues to work arduously, testing one sample after another on chimpanzees. The internal conflict of life versus death plays a big role in the motion picture. The way the conflict ends is at first incomprehensible and very paradoxical, but that is exactly the idea.

In times like ours where we are ever closer and ever more persevering to defeat death - we are close to curing cancer and almost understand how the aging process works — it is important to stop and think about what death actually means to us. That is the message Aronofsky is trying to convey us with his movie.

PUZZLES-'N-RIDDLES

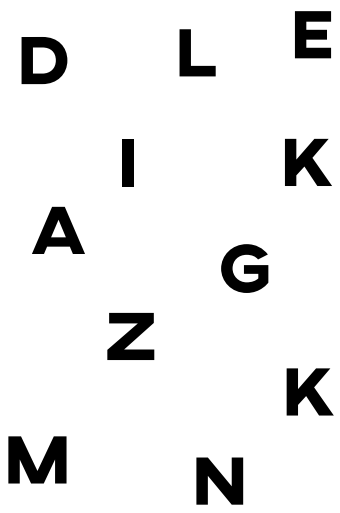
WIN A PIN

In this edition: a brand new page where you can use all your brainpower and creativity. The puzzle page contains multiple puzzles and if you can score the most points, you can win an awesome Hooke pin.



Structural problem - Level: Bachelor

For this image we are looking for what this represents, the magnification, what equipment is used to make this, and who made this.



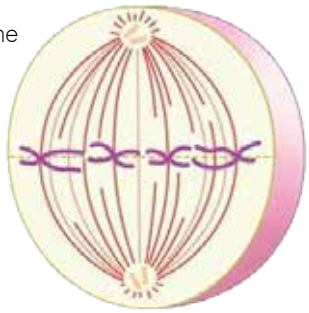
Letter problem - Level: Freshman

Make as many Nanobiology related words as possible with the large letters on this page.

Cell division - Level: Master

During mitosis, the centrosomes of a cell move away from each other such that they are a maximum distance apart. What would be the average distance between two centrosomes when they are randomly distributed over the cell?

Hint: The statistical distribution of the distance between the two centrosomes can be expressed as a polynomial.



You will get the maximum amount of points for finding the exact answer, but numerical approximations are also rewarded. You can get extra points for finding the polynomial.

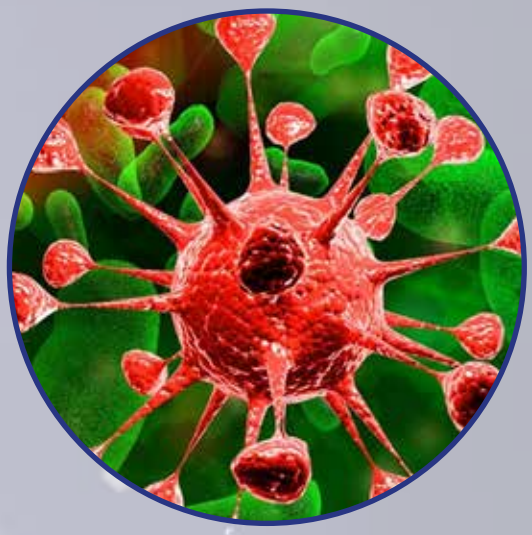
Send your solutions to:
mrna-hooke@tudelft.nl

BACTERIA OR VIRUS?
THIS NEW TEST WILL TELL

Doctors are often unable to tell whether an infection is bacterial or viral, because of their similar symptoms. Researchers of the Ben Gurion University of the Negev, Israel, developed a new blood test that can help doctors to distinguish a viral infection from a bacterial infection in just a couple of hours.

A fast and effective treatment is very important to prevent an infection from getting worse. Especially in babies, where a small infection could end up to be life-threatening. Currently, it takes a lot of time to determine whether an infection is bacterial or viral. This is why doctors often unnecessarily prescribe antibiotics to patients with a viral infection as a precaution. This overuse of antibiotics accelerates the process of antibiotic resistance. Furthermore, antibiotics kill the good bacteria a body needs.

The new test, named ImmunoXpert, combines the concentration of three marker proteins, C-reactive protein (CRP), interferon gamma induced protein-10 (IP-10) and tumour necrosis factor-related apoptosis inducing ligand (TRAIL), in a blood sample and uses a predetermined formula to compute a score.



Based on this score the infection will be grouped in one of three categories: bacterial, viral, or undetermined. This grouping is possible because even though the symptoms of the infection are similar, the immune system's response is not. The concentration of TRAIL, for example, increases during viral infections and decreases during bacterial infections.

The UMC Utrecht performed, together with five other Dutch and Israeli hospitals, a double-blind study on 577 children below the age of five to test the efficacy of the blood test. The test seems to work for around 95 percent of the cases. The test is more likely to give a false positive for bacterial infections, because overuse of antibiotics is better for the patient's health than underuse. When this test will become available for doctors is still unknown, but when it does it might decrease the use of antibiotics by fifty percent.

ASCONNECT
UNITING THE FACULTY

Have you nearly finished your Master's? Looking for an internship? Or are you just curious what your opportunities will be when you have finished your studies? Then we are very proud to present to you: Applied Sciences connect.

On 14 June, this brand new career event will take place at TU Delft. Applied Sciences connect or ASconnect for short is an initiative from the four study associations of Applied Sciences: the VvTP from Applied Physics, TG from Molecular Science & Technology, LIFE from Life Science & Technology and Hooke from Nanobiology. Together, we will organise a career event that represents the multidisciplinary background of the students of Applied Sciences.

ASconnect differs from other career events, such as 'De Delftse Bedrijvendagen', because it is specifically organised for the studies at the Faculty of Applied Sciences. This means that we will invite companies that can be interesting for multiple study programmes within the faculty. These companies will therefore have an interdisciplinary nature, just like the studies it relates to. If you are interested in working in the field of your study, connecting with these companies will be a great opportunity for your future career.

The study programmes of Applied Sciences have in common that the students are trying to understand the world around them. Where other studies learn to apply certain techniques and formulas in the real world, we all try to understand the knowledge behind those formulas. The goal is to introduce these students to their career opportunities within different companies. By connecting them at this event we hope to help many students in finding an interesting internship or even a job.

ASCONNECT

The first edition of ASconnect will take place in the evening of 14 June 2017. During this evening, about ten businesses will be present in the atrium of the new Applied Sciences building. They are all carefully chosen for their relation to the studies but are also chosen to give a view of the broad possibilities after your BSc or MSc. You can visit all the companies at their stands on the ground and first floor, and some companies will also present themselves during one of the three presentation rounds. Talk to employees about the work they do and get to know the company where you might work one day.

The event is open for everyone who is interested in the field of Biochemistry, Biophysics, Life Sciences and Biotechnology. The registration of the event is not open yet but we will keep you updated. If you want more information you are welcome to visit our Facebook page or the website of one of the study associations. In addition, you can ask us all your questions in person or via email: asconnect@tudelft.nl.

As we know, the best stories arise from spontaneous conversations. Therefore, mRNA likes to yield the floor to members of S.V.N.B. Hooke, who all indubitably have magnificent stories to share. We entered 'randi(number_of_members)' into Matlab and linked the outcome to the membership database. We asked this person to write a column about a topic of personal preference.

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ans = 36
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NATURE REVIEWS: THE PILSCHVLINDER

Days are getting longer and the temperature is rising. As always, when headed toward the summer, it feels like I am being reborn. I feel a new energy flowing through my veins (in the form of ATP). Consequently, it feels appropriate to shine light on a newly emerging species in the Delft area.

In the past 175 years, Delft University of Technology has greatly diversified the Delft population by attracting a vast supply of students to its various programmes. By bringing new dynamics, the students also changed the animal ecosystem in Delft. It has been argued that around March 1903 – what would have been Robert Hooke's 200th birthday – a C. elegansch-derived worm, the Pilschrups, came to be, causing huge excitement among the students. Admittedly taking a while, this eventually resulted in the attraction of life sciences and related disciplines, of which Nanobiology is the most recent triumph. It is this line of research that has followed the humongous leaps of development of the Pilschrups with great interest; it feels like observing evolution at an unprecedented rate.

Recent ultrastructural research has led to the discovery of tiny dedicated spieszos at the cellular membrane of some individuals, which actively transport specific types of liquid (likely including the newly found hopthee). This active process relies on building up a pressure gradient for subsequent uptake of discrete volumes from the environment in a burst-like fashion. It is suggested that this is the next step before the Pilschrups may transform into a Pilschvlinder.

Although formal confirmation is yet to come, several students already claim to have seen this masterpiece of evolution in action at their homes. Especially the JvB and ORW residential areas are currently scrutinised by several labs, hoping to get a glimpse of this majestic creature.

Jasper Veerman, BSc.

UPCOMING ACTIVITIES

HOOKE AGENDA

Hooke activiteis

22 - 28 April	The Return of B2
1 May	Interfacultary Beer Pong Tournament
2 May	Find-your-gala-date drinks
5 - 7 May	Study Trip Heidelberg
17 May	Symposium
20 May	Half Lustrum Gala

Course Evaluations

In the week of 8 May
In the week of 19 June

Exams sixth octal

Bsc Nb Year 1

Tuesday, 18 April	Lab Course 1
Thursday, 20 April	Biophysics

Bsc Nb Year 2

Tuesday, 18 April	Computational Science
Thursday, 20 April	Evolution
Friday, 21 April	Optics and Microscopy











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