mRNA

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PAST EXTINCTIONS // NIGHT OF THE LIVING ANT // INTERVIEW JOHN VAN OOST
THE MYSTERIES OF MARINE BIOLOGY // CHERNOBYL // ALTERNATIVES TO EARTH

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COLOPHON

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EDITORIAL
STEN DE SCHRIJVER

Dear reader,

Surprisingly, the editorial of the first edition of last year started off with some background on how the days grow shorter and the weather turns more typically Dutch. Priorities have shifted over the past year in which we have seen some scary scenes. Apart from seeing natural disasters striking, we had to get used to a completely different way of living.

We would like to put this all into perspective for you. We will take you through the biggest extinctions in history and some (hopefully) fictional apocalyptic scenes. Besides that, we have a lot of useful articles for you. You can find out which Plants vs. Zombies – plant you are, which faculty at the Delft University of Technology you should be at to increase your chances of survival in an apocalypse and we will inform you about the most interesting lifeforms here on earth. We also have some very interesting articles in the field for you guys, including an interview on CRISPR/Cas9.
I have to say that I am insanely proud of my fellow committee members. Without having had a single meeting or bonding activity that did not involve Zoom, we managed to fabricate a new and enjoyable edition of mRNA. And all of this with members that are all new to the committee.
Enjoy the booklet that we enjoyed making for you guys.

Happy reading!

Sten de Schrijver, on behalf of mRNA 5

FROM THE BOARD
LULU NOTSCHAELE

Dear members,

Welcome to the first mRNA of this year, and already the second one made during the lockdown. When around this time last year we were still stressing about what to wear to the gala, now we try to get out of our pyjamas. It has even happened to me that while watching a video where people step into eachothers 1.5 metre bubble, a silent alarm went off in the back of my mind: that's not what you're supposed to do. Our reality is shifting, and it has been doing so for nine months now.

> **Apocalypse** / ə-'pä-kə-ˌlips / noun
> a very serious event resulting in great destruction and change

What comes to your mind when thinking about this word? For me it's zombie apocalypse, 2012, and the meteorite strike that killed the dinosaurs. After these few obvious ones, I begin to wonder: could we call the current global pandemic a modern apocalypse as well? It certainly isn't as explosive, but I would say that it meets the other requirements. Adding this label definitely makes the oftentimes boring pandemic life sound a lot more exciting than it actually is.

That is not to say that there are no exciting things to do nowadays. It has become a new challenge for all of us to keep filling our days in a different, yet fulfilling way. This is exactly what the association has been doing as well. We may not be able to do exciting things the way we were used to, but everyone has been working hard to find other ways. Because of this, we have still been able to enjoy a lot of activities in the past few months!

We enjoyed the nice weather at the very spontaneous picnic in Delftse hout and explored the world of online multiplayer games in the various Tuesday drinks on Discord. Besides all this, the first online member dinner took place and our first online dies week with Hooke's got talent, painting, specialty beer tasting and a baking competition was a great success!

I look forward to what's to come next,

I have spoken.

Lulu Notschaele
President of S.V.N.B. Hooke 2020-2021

THE REALITY OF MASS EXTINCTIONS

ARE WE NEXT?

A mass extinction is defined as a loss of three quarters of all species in existence across the planet in a short time period of about 2.8 million years. We know of five major extinctions that happened over the last 540 million years. What caused these mass extinctions? Could it be that there is another one around the corner?

The First mass extinction: Ordovician Mass Extinction

During the Ordovician period, life on Earth was mostly large aquatic beings. About 440 millions years ago, it is suspected that the causes of the extinction were climate change and the continental shifts. It seems to have happened in two waves: first, a massive glaciation hit. This caused an ice age. Because of the colder atmosphere, the sea level severely lowered and since most of life was aquatic, it could not adapt fast enough to the cold. The second wave was the sudden end of the glaciation, and this caused the oceans to rise too quickly and the waters could not hold the oxygen that the species that survived the first wave needed to live. Approximately 86 percent of the species went extinct.

The Second mass extinction: the Devonian Mass Extinction

This extinction was very close to the previous one, only 65 millions years separated them. There is no big, one clear known cause of this second extinction, but one of the possible causes is decreased oxygen levels of the oceans that made aquatic life harder. Another one of the causes is volcanic activity. 240 000 Cubic miles of lava erupted in what is now Siberia, and the eruption would have produced a massive amount of greenhouse and other dangerous gases. It would have caused acid rains and troubled land living species. Another theory is that asteroids would have played a role in this mass extinction. None of all these probable theories can be certified to be the cause of this extinction. About 75 percent of the species went extinct.

The Third mass extinction: the Permian Mass Extinction

Also called 'the Great Dying', this extinction took place around 251 million years ago. What caused it remains a mystery, but some scientific theories point out a huge volcanic activity matched with asteroid impacts and the expulsion of deadly methane and basalt in the atmosphere all around the globe. It would have decreased oxygen levels, suffocated life and changed the climate, decimating land living species and aquatic beings alike. About 96 percent of the Earth's species went extinct. It is the greatest of the mass extinction events, and that is why it is known as "the Great Dying".

Source:Asteroids:spacestationinfo.com

Source:Asteroids:earth.com

Source:Volcano:riskmanagementstudio.com

The Fourth mass extinction: the Triassic-Jurassic Mass Extinction

After the Permian mass extinction, life took a long time to recover. 50 million years after "the Great Dying" another mass extinction struck. Its cause is a combination of smaller events. Volcanoes were at it again, and they flooded the air with basalt causing a change in global climate. It also caused the pH of the ocean to change to be more acidic and it changed the sea level. Most of the aquatic life was wiped out because of the ocean's change. The land species would have had to adapt to the raised temperature and most of them died out. It is estimated that 80 percent of the species went extinct.

The Fifth mass extinction: the Cretaceous-Paleogene Extinction

As the most recent mass extinction, it is the most commonly known because it is the one that led to the extinction of the dinosaurs. 66 million years ago, a major asteroid smashed into the earth, leaving a crater more than 120 miles wide, known now as the Yucatán's peninsula. It led to a severe global cooling. Wildfires started in a 900 miles radius of the impact and it also produced a huge tsunami. It was worsened by volcanic eruptions in what is now known as India. Both of these events made for an enormous spike of CO_2 in the atmosphere and a dropped level of oxygen in the ocean. Earth lost about 76 percent of its species and the mammals who survived became more complex beings. This led to the mammal domination of the land.

The Sixth mass extinction: Our doom?

We might be undergoing a new mass extinction right now. The overpopulation and overconsumption of humans is causing a lot of catastrophic problems. The planet has to deal with rising sea levels, chemical pollution, deforestation and overall exploitation. All of this is causing a significant increase in the rate of extinctions. The average lifespan of a species is estimated to be around one million years, so the estimated rate ranges between 0.1 and 2.0 extinctions per million species-years. This is called the background rate. Today's extinction rate is between ten and ten thousand times higher than the background rate. This rate will probably increase even more because of the ecological stress humans put on the planet. We do not know exactly how high the current extinction rate is compared to the extinction rate of previous mass extinctions and the precise value of the background rate. This means we can not yet speak of a sixth mass extinction, but there is no doubt that Earth is experiencing a decrease in biodiversity that is very concerning.

Sources: Asteroids: earth..com

SourcesEarth: independent.co.uk

WHAT IS GOING ON ON VENUS?

NANONEWS I

On September 14, an international research group of astronomers published their findings of phosphine gas in the atmosphere of Venus. This is quite a big deal, since phosphine on Earth can only be synthesised by anaerobic microorganisms or by some industrial processes. These findings sparked up a new debate about possible life on the rocky planet Venus.

The research team wanted to confirm previous findings of traces of phosphine gas (PH_3) in the cloud tops of Venus with a JCMT telescope. They did this by using a more sensitive telescope, ALMA, and then performing spectral wave analysis. The observed quantity of phosphine was about twenty molecules per billion.

While this may seem like an infinitesimal amount, it is actually quite significant. Phosphine is a very energetically demanding gas to synthesise and the conditions on Venus are not extreme enough to facilitate this. On top of this, Venus' atmosphere is extremely acidic, so the molecule should not have been able to accumulate to the observed amount before being annihilated by the acidity. The observed quantity is also too big to be explained by inorganic events like volcanic activity, meteor impacts or lightning. This means that either some yet to be explained chemical process is going on, or some sort of life might be active in the atmosphere of Venus.

There is still a lot of discussion among scientists if the findings of phosphine gas on Venus are reliable. ALMA telescopes are not really made for observing small quantities, especially not in bright objects like Venus. This made data processing a very difficult and long-lasting process. John Carpenter, an ALMA observatory scientist, is questioning if the data were affected by this extensive processing. He proposes that there is a possibility the processing returned an artificial signal at the same wavelength as phosphine. Another issue Carpenter mentioned is that the team has not yet performed correct molecular identification, which requires the detection of multiple fingerprints of the phosphine molecule at different wavelengths on the electromagnetic spectrum.

So while the observation of phosphine gas on Venus could be really groundbreaking, there still needs to be done a lot of follow-up research to confirm these findings and draw conclusions from it. The next step would be to make observations closer to Venus, with more specialised spectrometers.

J. S. Greaves, A. M. S. Richards , W. Bains, P. Rimmer, H. Sagawa, D. L. Clements, S. Seager, J. J. Petkowski, C. Sousa-Silva, S. Ranjan, E. Drabek-Maunder, H. J. Fraser, A. Cartwright, I. Mueller-Wodarg, Z. Zhan, P. F. Coulson, E. Lee, J. Hog (2020), *Phosphine Gas in the Cloud Decks of Venus*, Nature Astronomy,<https://www.eso.org/public/archives/releases/sciencepapers/eso2015/eso2015a.pdf>

N. Drake 2020, *Possible sign of life on Venus stirs up heated debate*, National Geographic, <https://www.nationalgeographic.com/science/2020/09/possible-sign-of-life-found-on-venus-phosphine-gas/> [Accessed October 25 2020].

Source: wallup.net
Source Venus: dreamicus.com

CAMPUS ZOMBIE SURVIVAL GUIDE

APOCALYPSE

The zombie apocalypse has been played out in a lot of different locations like a mall, a prison, a farm, a city or a village but I have never seen one play out on a college campus. Everyone has probably imagined what they would do in a zombie apocalypse at least once, right? But what if it happened during a lecture? Well, in the Erasmus MC you probably would not survive long as it is a hospital in the middle of one of the most densely populated cities of the country and all, but at the TU Delft?

Base locations

TNW-south

TNW-south is ideally located as it is far from all other buildings with people, including zombies in them. It is also close to AE whose dreams of going to Mars might finally be of some actual help to the people here on Earth. If that however, does not seem to be an option, TNW-south still has the advantage of only containing two exits/entrances with two sliding doors each. This makes it easy to defend against incoming hordes. Once inside, the large central and mostly open hall is ideal as it is easy to keep the high ground. This is all assuming of course that in our search to build life from scratch we did not end up creating the zombies here ourselves...

Source: iamap.tudelft.nl

Source: iamap.tudelft.nl

The Green Village

Surrounded by a trench filled with water and only accessible using a bridge, the Green Village seems nicely isolated from the rest of the campus. A few extra high fences would not hurt though. The Green Village being a test ground for sustaining innovation, living here might be relatively comfortable once all infrastructure breaks down. Especially in the future when new projects have been built here.

The Aula

The Aula is one of the buildings closest to the rest of the city and the concentration of zombies is therefore probably higher than on the more southern side of the campus. The Aula is however probably one of the best defendable buildings with its upper balcony and large open entrance hall. A fully equipped kitchen and amount of space will allow for a lot of people to stay here as well.

Source: iamap.tudelft.nl

EWI and CE are both mazes and I would rather not be in one filled with zombies so let's not, and has anyone ever been in 3me or Architecture? Well I have not, so base building there is at your own risk.

Tactical locations

Food

The first few days food is going to be the most important resource to collect and sadly Alev is going to be too far away. The Aula is by far the best located when it comes to food collection. It is close to both a Dönner Company and Spar and, if surviving on the most student-like dinner is not quite your style, has its own cafeteria filled with food that for once becomes affordable. Our own faculty at TNW-south has a small amount of food to start off with in the small cafeteria on the first floor, but nothing else in the immediate vicinity. The Green Village does not have anything to start off with but does allow for the creation of a farm.

Weapons and defence

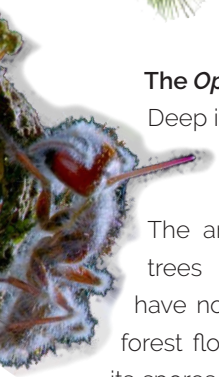
For weapons the best place to look is probably ID as they have tools to, like, make things? I am not sure what it is they do exactly. The library has shelves, tables and books that can be used for walls. Any other study books around campus can also be used of course, it is not like you are going to finally read them now anyway.

A zombie apocalypse on campus leaves many options and potential scenarios. Now that we don't have to worry about upcoming exams we might finally be able to relax a little bit, if you ignore the zombies for a moment at least. I mean, if you manage to go to a Tuesday drinks while being behind three chapters on signals and systems you will be fine ignoring the living dead in front of your window for a moment.

Source :www.vectorshop.com

NIGHT OF THE LIVING ANT APOCALYPSE

Perhaps the most famous type of apocalypse is the one caused by the living dead. Through its many iterations perhaps one of the most unique ones is presented in the game "The last of us" in which a parasitic fungus turns people into aggressive monsters. This zombie spreading fungus, a strain of *Cordyceps*, however actually exists.



The *Ophiocordyceps*

Deep in tropical forests the *Ophiocordyceps unilateralis* is a genus of fungi that infects Camponotus leonardi ants. The ants who prefer to stay high in the trees to avoid this parasite sometimes have no other choice but to cross over the forest floors. Here the O. *unilateralis* spreads its spores. Once one of these spores lands on an ant, it attaches itself to the exoskeleton and breaks through with a mix of enzymes and force. The ant has no clue that it is infected yet and will return to the nest. Once inside the ant, the fungus spreads through its body until it reaches the nervous system.

Zombiefication

At this point the behaviour of the ant changes. The exact mechanisms by which that is done are unknown, but there are several hypotheses. One of these proposes that the fungus does not infiltrate the brain directly, but rather releases proteins and metabolites that act as neuromodulators. No conclusive evidence has been found..

Source: flickr.com

Now that the fungus has taken control, the ant starts convulsing until it drops down back again to the forest floor. Here it starts searching for a plant close to the ground. It climbs up and stops on the underside of the plant at a height with an ideal humidity. Using its strong mandibles, the ant attaches itself there. The ant dies while the fungus grows out of its body into a stalk with a fruiting body releasing new spores to infect its next victim.

Preventing the infection

If you find these fungi as terrifying as I do you might be relieved to hear they are insect specific and are thus unable to infect anything else (so far). The *O. unilateralis* has possibly existed for millions of years and is known to be able to wipe out entire colonies. Ants do try to defend themselves by for example cleaning each other's exoskeleton to avoid infection. However, if an ant does get infected the colony, like any group in a zombie apocalypse movie, gets rid of the infected ant by carrying them as far away as possible.

Source Heidi: www.123rf.com

Source left ant: nationalgeographic.com

INTERVIEW WITH JOHN VAN DER OOST

INTERVIEW

Professor John van der Oost is a Dutch microbiologist who works at Wageningen University. Van der Oost has delivered a major contribution to developing the field of CRISPR/Cas9. This is a revolutionising technique in gene editing, which is much like copy and pasting DNA.

Via Zoom, we talked about the technique, its future applications and Van der Oost's role in the discovery of the system.

What does your work look like given the current situation?

"Well I'm at home in a small room overlooking the garden, he chuckles. However, since March he has not been in the lab frequently. Given the small number of people that are allowed to be in the lab simultaneously, there currently is hardly any room for Bachelor or Master students to work at his laboratory."

What was your part in CRISPR/Cas9-research?

"When I heard about CRISPR, I got very excited. Together with a postdoc who now has his own research group in Delft, Stan Brouns, we decided to go for it. This was around 2005. A PhD student was recruited and together they isolated the system from E. coli. We were the first to reveal part of the molecular mechanism of the CRISPR-system", he says excitedly. Although E. coli was a model system to reveal some important mechanistic insights, some bad luck was involved. The CRISPR/Cas system that occurs in this organism is a type-I system, which involves a so-called Cascade complex and a separate Cas3 nuclease; compared to the single-protein Cas9 nuclease (type-II). it appeared to be much more difficult to use the Cascade/Cas3 system for genome editing applications.

"We decided to go for it"

When did you know the full potential of what you had discovered?

"We were discovering new biochemistry, and important basic principles of the E. coli system. It took a couple of years to realise that this could be huge. Not long after that, the Cas9 system was studied by other groups which turned out to be the easiest one to turn out to applications. When these groups, led by Charpentier and Doudna, caught up with what we were doing, it was the summer of 2012. A couple of weeks ago these two women won the Nobel Prize in Chemistry."

Can you say something more about the different systems?

First, he explained some things about the most famous system; CRISPR/Cas9, which is part of type-I. *"If you look here at the orange part, you see the guideRNA"*, he says while showing a big 3D-model of a protein-structure in front of the camera of his PC. The blue part is where the scissor is located to cut the DNA. The beauty of Cas9 is that it is an-all-in-one complex. People compare it to a Swiss-army knife.

Rolling his chair to the back of his room to get yet another protein structure, he says: *"at the time this was made, we did not have that much money."* After which he shows a structure of an enzyme-complex which is part of type-II in front of the camera which is ten times as small as the previous one. In real life this one is three times bigger than the first complex. It consists of a lot of different subunits. But for cleaving DNA it needs to bind yet another molecule, Cas3. This all is great for its biological function; to destroy a virus, but it's not good for editing. If you want to use CRISPR/Cas for gene-editing, it is much easier to do that with Cas9.

"It was the best thing that ever happened to me"

Even though working with the system that he discovered was much more difficult, Van der Oost expresses his gratitude towards the opportunity. *"I never regret that we started working on it. It was the best thing that ever happened to me."*

Where do you see CRISPR in ten years?

"We should not create too many expectations. For sure CRISPR is not going to cure every genetic disease, but in ten years I expect that we will have several examples of diseases that can be cured this way.

Recently I heard an example of a patient being cured from sickle cell disease. This is a point mutation in the gene coding for haemoglobin. This single point mutation really screws up the functionality of the protein. This way, the body will not get enough oxygen from the blood. Blood stem cells were taken from the patient, which were treated with CRISPR. Afterwards these modified cells were tested, cultivated and put back in the bone marrow of the patient. The other day I heard that at least three patients are now cured from the disease!"

Van der Oost elaborated that this was a relatively easy one to solve using CRISPR because it can be done ex vivo. When one needs to use CRISPR inside the body on a specific tissue, it will be much harder. However, scientists are working hard on this and are making substantial progress.

Regulations concerning CRISPR are very different in other parts of the world than in Europe. Are you afraid that this will limit the clinical applications of this technique?

"When it comes to the editing of humans, I do not know. I know that clinical trials with CRISPR are going on in both the USA and in Europe.

Especially when it comes to editing of plants, there are major differences. At the moment the regulation of CRISPR-editing in Europe is not very easy. Two years ago the European Court of Justice decided that CRISPR-editing would be considered GMO.

This in itself is a little weird, because in contrast to conventional GMOs (in which genes from very different organisms are exchanged, e.g. from

bacterium to plant), CRISPR can also be used to introduce changes that can not be distinguished from what happens in nature. So, it should be judged from case to case, major CRISPR edits (introducing genes from other species) should indeed be considered GMO, but not the minor changes.

"I find it ridiculous that all CRISPR editing is subjected to these regulations if you know that in classical mutagenesis, through the use of radiation and chemicals, a high rate of mutations is introduced. This is not considered GMO, because it has a so-called 'long history of safe use'. This method has led to all fruits and vegetables you now buy in the store, and that is OK because it appeared to be safe. However, now CRISPR offers us a way to make genetic edits very precisely, and just because it is a new method (without a long history) it is considered potentially dangerous. That is stupid, we should not judge the process but rather the end product. And that, in cases of minor changes that also occur in nature, is perfectly safe ! I think it's very good to have broad discussions, and on the basis of solid scientific facts come up with general rules, both for editing of plants and for human gene therapy. We have to do that soon because the technology is moving very fast."

"You learn a lot from complementary interactions and it is a lot of fun to collaborate!"

You have been working on CRISPR for a while. What are you working on nowadays?

Besides still working on CRISPR, Van der Oost is working on building a synthetic cell. it is a big national project. We want to build its components, mix them and build a cell. It's very exciting. We're collaborating with many people, also with a lab in Delft; Cees Dekker's lab. Delft is very important, he says with a smile. That's the fun part of research, to work on exciting projects together with other colleagues, and every now and then make unexpected discoveries.

Who would you say is your role-model in Science?

Charles Darwin. He is my big hero. I think what this guy accomplished is really amazing. Also in his own work, Darwin's discoveries on the principles of evolution play an important role. This whole evolution theme is great. If we want to connect it to CRISPR, we now know of 6 different types, which has everything to do with the ongoing war between viruses and their hosts. It's an arms race, a competition in which they try to outsmart each other. A group in Canada found viruses that produce small proteins that could bind strongly to these CRISPR-associated nucleases in order to inactivate them. Then we said "there must be anti-anti-CRISPRs" and indeed, they have recently been found.

The bachelor in Nanobiology teaches us to describe fundamental biological processes with mathematics and physics. Do you think students with such a background would fit into your research?

For sure, although that is not really what we do ourselves, we certainly collaborate with colleagues with such expertise. Van der Oost thinks it is necessary to work with people from different fields to obtain a deeper understanding. You learn a lot from such complementary interactions, and as said before, it is a lot of fun to collaborate !

Listen to the full uncut interview now on the mRNAudio podcast!

WHICH PLANT ARE YOU?

APOCALYPSE

Ever wondered which zombie-fighting plant is most like you? Do this test to find out!

What is the best part of a plant cell?

a. The mitochondrion, because it is the powerhouse of the cell.
b. The chlorophyll, because MAKING ENERGY.
c. The cell wall, because it makes the cell strong.
d. Granules, because you need to store your goodies.

Corona is over and you are planning a holiday! Where are you going?

a. Somewhere I can be active all day and night.
b. Doesn't matter, as long as it is sunny.
c. Somewhere I can do a lot of chilling.
d. Oh jeez, I need some more time to think about this.

The zombies arrived at TNW-south during a lecture! What do you do first?

a. I find something to fight them off.
b. I help those who want to fight them by providing them with the things they need.
c. I lock all the doors and put stuff in front of them to keep the zombies out.
d. I run to one of the labs to make an explosive.

One of your friends, X, insults another of your friends, Y, and you can tell Y is hurt! What do you do?

a. I give X exactly every reason why they should not have done this, until they yield.
b. I don't say anything, but I talk to both of my friends later on to show them how I feel.
c. I defend Y. Gotta protect the weaker.
d. I become really, really angry with X, but later regret how I responded.

If you got mostly a: you are a pea shooter! You are assertive, not afraid to give your opinion, and you like to be in the center of attention.

If you got mostly b: you are a sunflower! You love helping others, cheering people up, and giving energy.

If you got mostly c: you are a wall-nut! You are strong, defend what you stand for, and have a lot of willpower.

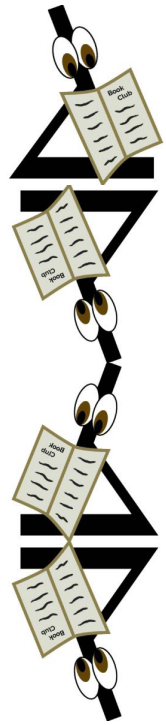
If you got mostly d: you are a potato mine! You take your time, but you can be very explosive, even if that damages yourself.

Source: *Plants vs Zombies* by PopCap Games

BOOKE CLUB RECOMMENDATION

ANNEMIEKE MATHISSEN

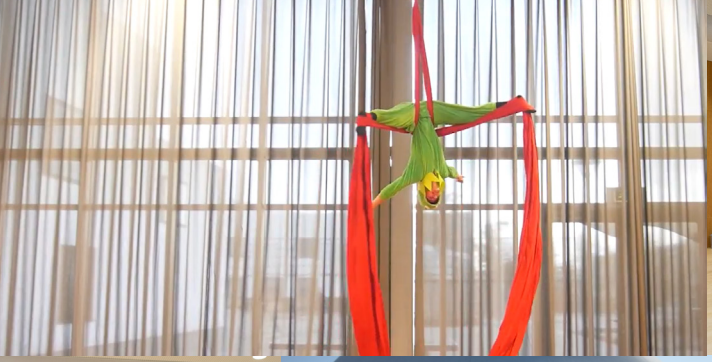
These days, we all struggle a bit with isolation. In the Hooke Booke club, sometimes we read about it. This time around, the Booke Club read *Silas Marner* - a forlorn tale from 1861 that brings the reader on a path from loss to rediscovery.



Silas Marner is a man separated from society. Fleeing from a past of false accusation and spurn, he settles in a remote town named Raveloe, where his withdrawn demeanour and skills as a weaver dub him an eccentric recluse. His trades soon earn him a wealth of gold, which he prefers over human company. But when this gold is stolen and he finds himself with a golden-haired baby instead, his care for the child draws him out of his shell, and leads him from unhealthy obsession to content parenthood and acceptance into the community.

Although companionship is a key theme in this story, *Silas Marner* also speaks to the importance of the past, the consequences of secrecy, and the ease of redemption. It is a wonderful short and sweet story about all our interconnection. This is a great book to read and discuss with a group, or just a brief read on your own. Hats off to Mary Ann Evans, the writer behind the pen name!

Source: crisismagazine.com



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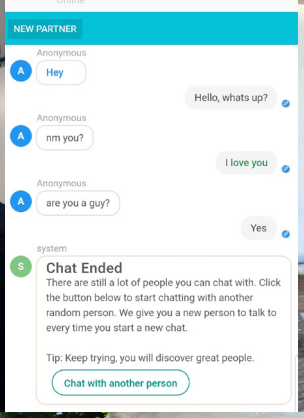
NEW PARTNER
Anonymous
Hey
Hello, whats up?
Anonymous
nm you?
I love you
Anonymous
are you a guy?
Yes
system
Chat Ended
There are still a lot of people you can chat with. Click the button below to start chatting with another random person. We give you a new person to talk to every time you start a new chat.
Tip: Keep trying, you will discover great people.
Chat with another person


Studievereniging Nanobiologie Leiden


Changing of the boards


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THE MYSTERY OF MARINE BIOLOGY
APOCALYPSE

The oceans have always been rather mysterious. Only six centuries ago, Europeans set out to discover the world beyond our very own continent. Before that, no one had a clue what would happen once you crossed the horizon. Luckily, the first ships to do so did not fall off the Earth. After mapping the seas, the mystery of the oceans still remained. Even now, according to the National Ocean Service, we have only charted 5% of the ocean floors! Besides, we have not found Atlantis, the Kraken nor Aquaman yet. Let us show you a little bit of the sea's mysterious lifeforms.

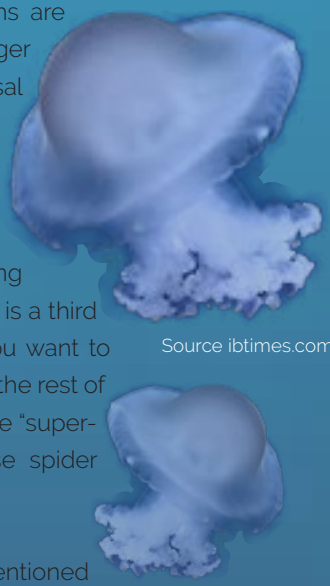
Big nightmares?

In 2003, a great white shark in Australia was tagged to be followed for research on changing animal behaviour due to climate change. Only a few months later, its tag was found on the shore. After analysing its data, scientists found that at an instant, the body temperature of the shark rose from eight to twenty-six degrees Celsius, which suggests an attack. Although cannibalism is common between sharks, the jury is still out on what could have devoured such a three-metre-long and dangerous animal.

The oceans are incredibly deep, which results in extreme changes in pressure. Certain species can only survive in certain areas of the seas. Once we dive deeper than three kilometres, organisms become incredibly weird. Above the zone of utter darkness, around six kilometer deep, where only a few organisms can survive, there is the abyssal zone.

Source: nasa.gov.org,

Here, animals tend to grow much bigger than we are used to. The largest "regular" squid is estimated to grow up to four meters long. Nevertheless, these depths are inhabited,by a much larger species of squid; the colossal squid. As far as we know, this animal can grow up to fourteen meters. However, it has been suggested that they can grow to a striking length of 27 metres, which is a third of the height of EWI! If you want to be afraid of the oceans for the rest of your life, you should google "super-giant isopod" or "Japanese spider crab". Seriously, I dare you.



Source ibtimes.com

The phenomenon mentioned above is referred to as deep-sea gigantism, or abyssal-gigantism. Why animals at these depths grow so immensely large is not known just yet. The "how", however, is simply because the buoyancy force is so large for these animals, that they do not have to "fight" gravity.

It is thought that these insanely huge animals have an evolutionary advantage, because of the volume-to-surface ratio. As Fokko has taught us, volume grows faster with an increasing radius than area does. One consequence of having a large volume compared to surface area is that the heat loss is very limited. The temperature of water at these depths is two to three degrees Celsius, therefore loss of energy is a very serious threat.

Who needs oxygen?

Hydrothermal vents, also known as black smokers, form on the ocean floors where Earth's plates are moving apart. Here, hot material from beneath the Earth's crust heats up the water and as a result, hot fluids, rich in tons of elements, spurt out of the ocean floor. In contrast to many areas this deep under water, these vents are the basis for complete ecosystems.

The absence of light and oxygen make this one of the Earth's most extreme habitats. But how does life thrive here, you may ask. Well, there are no cyanobacteria here to practise photosynthesis. Instead, microbes in this environment do chemosynthesis, of which hydrogen-sulphide (H_2S) and carbon-dioxide form the basis. The chemical reaction looks like this:

$$6CO_2 + 6H_2O + 3H_2S \rightarrow C_6H_{12}O_6 + 3H_2SO_4$$

In 1890 Sergei Winogradsky hypothesised that there were organisms that survived by doing an alternative process to photosynthesis; chemosynthesis. Nevertheless, the discovery of ecosystems that are fully reliable on this process was a major one. This proved that as long as there is water available, organisms and even ecosystems can survive! This of course had its implications on theories of astrobiology; extraterrestrial life.

Deepest part of the ocean

When we dive even deeper we enter the Hadal zone. The Mariana Trench is the deepest part of the ocean in the world, at roughly 11000 metres below sea-level. The organisms that live here are extremophiles, as the environment is not amongst the easiest ones to survive in. This is mostly due to the incredible pressure at this depth, equal to about 1100 times the atmospheric pressure. Humans would be crushed here. Yet, the amount of life at these depths is much bigger than expected.

Source: oceania.org

When samples of the mud at the bottom of the trench were tested, over 200 different microorganisms were identified. However, since only three people have ever made it all the way down, a lot is still unknown. Think about it, 241 people have gone to stay at the International Space Station, yet only three people have ever made it to a place on our actual planet!

Source: wikipedia.org

WHAT IFS

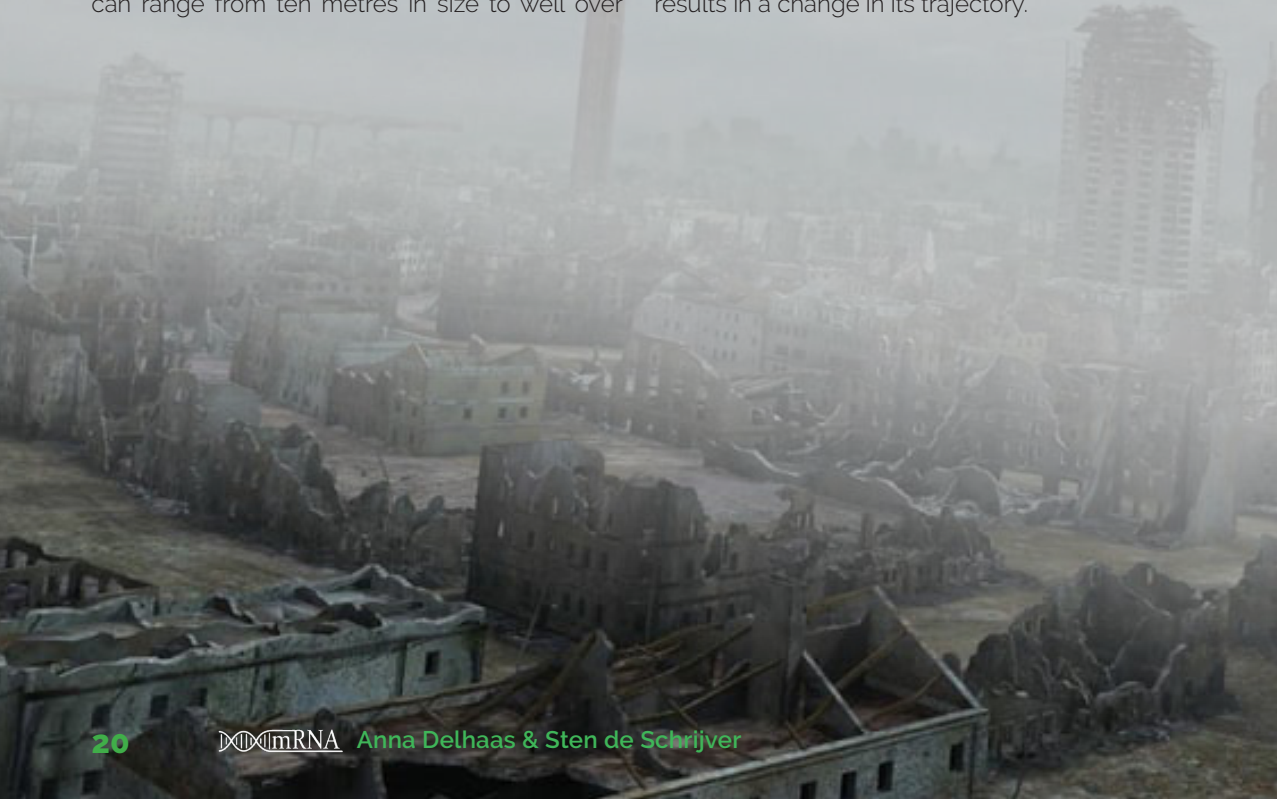
APOCALYPSE

When hearing the word "apocalypse" you might think of movies such as *2012*, *Armageddon* or series like *The 100*. Possibilities of how the human race or maybe even the world will end have inspired humans for centuries. An event that has people scared for 60 years now for example, is a nuclear war. But there are many more possibilities. We would like to go over these doomsday-scenarios with you, and give you some insight into them.

Armageddon 2.0

One of the most well-known apocalyptic scenarios out there is the collision of a huge asteroid with earth which, needless to say, has occurred in the past. NASA takes this threat very seriously, by monitoring all Potentially Hazardous Asteroids, which are asteroids that have a specific probability of colliding with our planet. They can range from ten metres in size to well over 500 kilometres, and their speed is on average eightteen kilometres per second. If an asteroid that is 800 metres in diameter impacts earth at a velocity of thirteen kilometres per second, its energy is 10 000 000 times the energy of the Hiroshima bomb. Besides destroying anything in proximity, such an impact will cause a lot of debris and dust to fill up our atmosphere, which will block sunlight and therefore cause a massive extinction.

So how do you fight this recurring event? Well, there are a couple of ways. Obviously we could nuke the astroid, however this might have an unpredictable effect on the asteroid's trajectory. Another interesting method would be to wrap the object in mirrors or reflective foil, such that the insane amount of photons from the radiation emitted by the sun, would cause a significant change in the asteroid's momentum, which results in a change in its trajectory.



Biological attacks

Bio warfare is defined as the deliberate use of pathogenic microorganisms to kill or harm living creatures on a large scale. Biological weapons are relatively easy to produce compared to nuclear and chemical weapons.

After 9/11, several journalists and officials in the US received anonymous letters which were infected with anthrax powder. Twenty-two victims were infected, five of them died.

The bacterium that causes anthrax is an example of a bioweapon. It causes skin lesions and it can affect the lungs and the gastrointestinal system. Symptoms depend on which biological agent is used and the dose. Severe cases can result in death if untreated.

Another biological threat is the outbreak of an unknown version of a contagious disease, whether or not on purpose. An example of such a highly contagious disease is smallpox. Smallpox can only be prevented by vaccination, since it has no cure. Before the vaccination program succeeded, three out of ten patients died from this disease. Survivors of the disease are sometimes left with permanent scars or blindness.

The prevention program that is targeted at these biological threats contains several measures, like close surveillance of outbreaks of diseases, vaccination programs, organised communication between relevant sectors and informing the public. Nevertheless, bio attacks are planned in secret and are generally very unpredictable, which makes it hard to act fast. This is what makes humans vulnerable.

Nuclear holocaust

A scene that has scared modern civilisation since the end of World War II is a nuclear war. Besides "just" the unimaginably big explosions these bombs cause, using the technology this way has other devastating effects, such as insane amounts of radiation. It is known for sure that Russia, the United States of America, the United Kingdom, China, France, India, Pakistan, North Korea and Israel have nuclear weapons.

During the Trump administration, the Paris agreement on climate change was not the only treaty that the US left. Additionally, the superpower retreated from nuclear arms treaties with Russia. Needless to say, the fact that the two countries with by far the most nuclear weapons do not have a solid peace treaty on this is concerning.

The president of the USA does not need anyone's permission to push the scary red button on his desk as he would be the commander-in-chief in such a scenario. This means that there is no real stopping him if he decides to start a war. Luckily, the "No First Use" policy is being treated in Congress, which would solely enable the president to launch nuclear weapons after being attacked by such weapons first. It also seems highly unlikely that the United States will start a nuclear war out of nowhere.

A more likely threat is nuclear terrorism. In 2014, after the fall of Mosul, ISIS got their hands on nuclear material from the university. Yet, many nuclear experts told the UN that given the amount of nuclear material found here, there was no immediate threat. Still, many organisations have warned the world that both ISIS and Al-Qaeda are very interested in nuclear weapons.

CHEMISTRY NOBEL PRIZE & SPINOZA PRIZE

NANONEWS II

The Nobel prize of Chemistry

The Nobel prize of Chemistry was won by Jennifer Doudna and Emmanuelle Charpentier for their findings of the CRISPR/Cas9 genetic scissors in 2012.

source: nobelprize.org

The gene editing technique is revolutionary and permits researchers to change the DNA of animals, plants and other organisms. It could lead to new cancer treatment by gene therapy and it could cure a number of inherited diseases. Since Doudna's and Charpentier's discovery in 2012, the use of genetic scissors has grown exponentially.

Their collaboration began in 2011 in Puerto Rico, where they met at a conference and started a conversation about bacteria's defences against infection. The organisms defends itself by chopping the DNA of the attacking virus.

After the conference, they agreed on the transatlantic collaboration. This eventually led to the new gene editing technique.

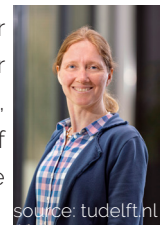
Although they received a number of prizes for their discovery, a real war for the CRISPR/Cas9 patent took place between UC Berkeley and the Board Institute of MIT and Harvard. The two female scientists eventually won the patent battle.

The scientific community sensed as early as 2015 that Doudna's and Charpentier's discovery would get them a lot of attention and prizes, some even thought they would receive the Nobel Prize as soon as 2015.

But the Royal Swedish Academy of Science officially announced their win on October 7 2020, and their prize ceremony has taken place on the 10th of December.

The Spinoza prize

Nynke Dekker receives the Spinoza prize, one of the most prestigious awards in Dutch science.



source: tudelft.nl

The biological physics professor received the prize on September 30 for research, design, developement and use of instruments that can probe at the nanoscale.

Her lab combines the use of physics, chemistry and biology and focuses on individual DNA and RNA molecules and their interactions with protein in bacteria, viruses and eukaryotes.

Her successful research includes real-time studies of polymerases on both DNA and RNA, probing the mechanisms behind DNA-binding proteins in DNA compaction and the termination of replication.

Nynke Dekker and her research group are in the unique position of being able to quantitatively compare individual biological molecules in vitro and in vivo.

Recently, she concentrated her efforts in the study of the dynamics of the complete eukaryotic fork at the single-molecule level, as she is known for her studies of molecules at that level. Her research on the topic could be a key to comprehend the development of genetic disorders, cancer and other genetically linked illnesses.

ELECTIVES

FUTURE PROSPECTS

The second semester is getting closer and that means that it is time for some of us to do electives! To give you some ideas on your options, we talked to Valery Schoenmakers about the electives she followed last year.

Valery started with Quantum Mechanics for Nanobiology 1 in octal 5. She had prepared for the course to be hard and a lot of work, which was indeed the case. However, it turned out to be much more interesting than she had anticipated. *"Quantum was such a vague idea in my head, but during Quantum 1 I really learned the fundaentals of physics."*

She decided to also do Quantum 2. This has the extra advantage of only having to make one combined exam for both quantum courses together. If one decides to only take Quantum 1, the final exam will be simultaneous with Quantum 2 - five weeks after the last lecture. Quantum 2 continued on the basis of 1 and also provided some examples of biological applications of quantum.

So what did this homework entail? Mathematical, quantitative exercises on the physical, chemical and mechanical properties of biological nanoscale machines, Valery summarises. She compares the course to Biophysics, and explains *"I found it a typical nanocourse: applying physics to biology."*

Finally, Valery took Neural Networks in octal 7. This course has been changed to Computational Neuroscience this year, in which there will be more emphasis on the simulations of biological neural networks. The teacher and method of assessment remain the same.
Although Valery liked the elective, she found the others more interesting. The teacher was very enthusiastic and he gave them code to experiment with.

'Quantum was such a vague idea in my head, but during Quantum 1 I learned from the basis why things work as they do.'

During octal 6, Valery did not only follow Quantum 2, but also Molecular Motors. Before starting this course, she had heard stories from others about how difficult it was going to be. However, the course turned out to be interesting and the exercises challenging, but in a good way. She notes that some students did not like it as much, because they were really struggling with the homework.

"It was learning by trying out, reasoning why inputting this results in that output'"
The course was also quite different from other courses because the final grade was determined by a project rather than an exam. The students got a lot of freedom in this final project.

CHERNOBYL REVISITED

APOCALYPSE

On April 26 1986 Chernobyl Nuclear Power Plant Reactor Number four burned down. The fire lasted for ten days and the emitted radiation was 400 times the intensity released by the atomic bomb dropped on Hiroshima in 1945. Over 300.000 people were evacuated from their homes and everything within a 30 kilometre radius of the power plant was and still is locked down. Thus, if there is one place on Earth that has a post-apocalyptic ambiance, it is the exclusion zone of Chernobyl. In this article I will tell you how nature and humans were affected by the explosion of the power plant and what the situation is now. Let's explore and get a taste of life in Chernobyl.

Flora and fauna

Near the power plant there is a pine forest located. The massive radioactive fallout, consisting of cesium-137, strontium-90, and plutonium-238, -239, and -240, caused the trees to turn red and die instantly. This forest is now called the Red Forest. Animal populations in the area were also extremely negatively affected by the initial blow of radiation, causing only few to survive. After the disaster, most of the forest was bulldozed down and the trees were put in a trench covered in sand. New trees were planted so the sand would stay in place. It was thought that the forest would not be able to recover from the radiation damage and that this area would remain a lifeless desert.

Now, 34 years after the accident, nature is thriving again and the area has even experienced an increase in biodiversity. It turned out that the effects of radiation were not big enough to destabilise the ecosystem permanently. Plants in the exclusion zone of Chernobyl have also developed resistance against the radiation. A study of the American Society of Plant Biologists in 2004 said the following: "*We analysed the possible molecular mechanisms of their resistance to mutagens and found a more than ten-fold lower frequency of extrachromosomal homologous recombination, significant differences in the expression of radical scavenging (CAT1 and FSD3) and DNA-repair (RAD1 and RAD51-like) genes upon exposure to mutagens (Rose Bengal and x-rays), and a higher level of global genome methylation.* " (Plant Physiology, 2004 May, 135(1): 357–363).

Animals have also found their way back into the area. There has even been an increase in wild boar, red deer, roe deer, elk and wolf population. However, the effect of radiation depends on the type of animal. Smaller animals were more affected than big animals. For example it was found that insects in the area have a shorter lifespan because of the radiation. Also, birds in the zone have smaller brains and the amphibians in the exclusion zone have been found to be darker coloured than those outside the zone, as an adaptive response to the radiation. Another interesting point to mention is that some animals lost their competition or predators because of the incident, which gave them the room to fully develop. This is why remarkably large catfish can be found in the cooling ponds of Chernobyl, that can grow up to 3,6 metres. The absence of

Source: researchgate.net

human beings and the stress they put on nature is considered to be the most important reason that nature was able to recover from the incident. Could it be that humans have a worse impact on nature than a nuclear incident could have?

There still lurks danger in the forest. The radioactivity (about 0.1-10 mSv/hour) is mostly concentrated in the soil nowadays. Radioactive contaminants could get into groundwater and contaminate the Pripyat river. The Red Forest has also been dealing with a lot of forest fires lately, which may cause an even greater release of radiation.

HUMANS

After the power plant exploded in 1986, more than 350,000 people had to be evacuated from the vicinity. It is known that 31 people died as a direct result of the explosion. Two workers died from the blow itself and an additional 29 firemen died from excessive radiation exposure. The total number of deaths as a consequence of the disaster is not known, but the estimation is around 4000. A lot of people who lived near the power plant suffered from radiation poisoning, which causes nausea, hair loss, infections and anaemia. The long term effects of acute radiation depend on the level of exposure. The most common illnesses from radiation are gastrointestinal syndrome, (thyroid) cancer and bone marrow syndrome. The accident also had a serious impact on the mental health of the survivors. The trauma of experiencing such a disaster, having to leave their homes behind and undergoing severe stress resulted in anxiety disorders and depression for many people.

This might come as a surprise, but there are still people living in the exclusion zone of Chernobyl. About a 100 people, mostly women, decided to sneak their way back into the zone about a year after the accident. A documentary has been made about these women named '*the Babushkas of Chernobyl*'. The exposure to low levels of radiation for a long time period seems to be less harmful than originally thought. There has even been a claim that people who returned to the Chernobyl zone have a longer lifespan than those who never returned, since they did not have to suffer the trauma of losing their home, but there has not been enough research done on this topic to claim that this is indeed true.

Source: I.Kovalchuk, V.Abramov, I.Pogribny, O.Kovalchuk (2004), *Molecular Aspects of Plant Adaptation to Life in the Chernobyl Zone*, Plant Physiology: American Society of Plant Biologists, 135(1): p. 357–363. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC429389/#fn1>

Source: viajar.elperiodico.com,

AN ALTERNATIVE TO EARTH

APOCALYPSE

Imagine this: Earth has been ravaged by planetary-scale disaster. All sorts of terrible events could happen, the Sun could die out, an asteroid like the one that wiped out the T-Rex might show up to get us next, the zombie apocalypse could start or we might have nuked the world to a crisp. It would be a tragedy if the story of human existence ends then and there. What if we could leave to another world and keep it going? Where would we go?

How about we travel to our nearest neighbour, the Moon? We even need not bring water. This October, a team of scientists revealed evidence of water on parts of the Moon where the sun shines. They had made observations using SOFIA, an infrared telescope bolted onto the side of a 747 jumbo jet to discover that water might be distributed across the entire lunar surface, instead of being exclusively found in the cold, shadowed places near the lunar poles. Paul O Hayne, a professor of astrophysical and planetary sciences at the University of Colorado called the discovery a "real game changer".

The Moon will, however, not do if we want to live somewhere for an extended amount of time. For one, we do not yet know whether humans can stay healthy for extended periods of time when subjected to a mere 1/6th of Earth's gravity. We can however use the Moon as an interplanetary motel on our way to our destination. So where do we go next? If we look at nearby options, there is Venus. During a presentation at the 67th International Astronautical Congress, Elon Musk describes the planet as a "high-pressure—super-high-pressure—hot acid bath". That does not sound very appealing.

How about Mars? Mars is the most accessible planet in the solar system. It is a rocky planet and has an atmosphere, just like Earth. The diameter of Mars is about half that of Earth, but its surface area is nearly the same as Earth's dry land. Mars is only 50% further away from the sun. Martian days last 24.6 hours and are called "sols", which does not differ much from a day on Earth (23.9 hours). A year on Mars is equivalent to 687 Earth days and the planet has seasons too! Interestingly these seasons vary in length because Mars' orbit traces an ellipse around the sun. The red planet is also a lot richer in resources than the Moon. Take water: Mars seems to have had a very watery past. The planet has geology that can only be explained by the presence of water. Currently, water on Mars is found in the form of ice under the surface in polar regions. All this means that Mars would be the far better option to call home.

Source: wallup.net

It might be the case that our entire solar system becomes uninhabitable, forcing us to look further afield for a planet B. The study of planets outside of our solar system is relatively new: it was only in 1995 that the discovery of a planet orbiting the star 51 Pegasi marked the start of a revolution in astronomy. A "scientific gold rush" ensued, in the words of Frans Snik, astronomer at the University of Leiden. We learnt that given better equipment and enough patience, we could find at least one world circling every star. Astronomers found systems where up to seven rocky planets orbit a star. The most famous of these being the TRAPPIST-1 system, which is named after the Belgian beers. We also found planets that circle binary star systems just like Tatooine in Star Wars, defying our expectations for planetary stability around these stars. Even the closest neighbouring star, Proxima Centauri, has a rocky planet to keep it company. Finding "Earth 2" outside the comfort of our solar system does not seem as crazy of an idea anymore. The catch? For the time being we will have to be satisfied with merely observing these bodies, as a trip to Proxima Centauri would take thousands of years even in our fastest rocket!

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MENTAL HEALTH

TIPS AND TRICKS

I will survive!

The pandemic really took a toll on all of us with lockdowns, online courses, social distance, and so much more. There's probably more to come, but here are some resources and tips to get through it all.

First of all, remember, it may seem like an endless situation but it is not. Try to stay positive. Connect with friends by having virtual drinks, games or even just texting and video call.

Another very important point for remote studying, create a study space that works for you. Try to have your working area somewhere you're comfortable, relatively distraction-free, and with your essentials to study: internet, headphones and electricity plugs nearby. The best is to have your desk near a window so you have natural light.

Then onto the work itself: make a plan for the week or day and try to stick to it. Note your course's schedule and try to set your daily goals, it could be anything from doing a chore to working out. Just break them into little chunks (30 minutes tasks for example).

Maybe try the Pomodoro technique. It is a time management technique. You use a timer to break down your work into some designated time (usually 25 minutes) and then have a short break (usually 5 minutes). After the fourthth time, take a longer break (from 15 to 20 minutes) then repeat until your original task is done.

If you need help, ask for it. If you get stuck on an exercise, ask the lecturer or your classmates. If you are having technological difficulties, send an email to the Student IT desk. If you are having any kind of questions about the program and possibilities, you can make an appointment with our program's counselor Tanja.

Also try not to postpone the learning tasks. Try to follow the online lecture and be actively learning. Take notes, pause the video if possible, and check your understanding of the material.

Don't forget to take breaks and exercise! Otherwise your concentration decreases and can lead to a burnout.

You can also increase your concentration by cutting out distractions like notifications from your phone and your laptop. Try having distraction free background music like a YouTube focus track or a movie soundtrack.

A lot of other tips on living better are provided in the TUDelft student portal in the category Well-being & Study. It is a great resource as well as the e-Health tool that can be found on the same webpage.

source: TU Delft Student Portal Well-Being & Study, *Remove Studying -how to make it work?*, TU Delft, <https://www.tudelft.nl/en/student/well-being-and-study/ > [Accessed November 9 2020].

source:backround:all-free-download.com

RANDI

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Do you remember a year ago when the main problem was to wake up in the morning and get to your lecture in time, when you would meet family and friends and get that genuine warm hug, when you could be in the most crowded places without the fear of something that soon would have changed people's lives around the world.

Then 2020 started!

Yes, this year will be remembered. It has already been ten months, but the notorious coronavirus is still up for messing up any kind of plan you had.

Back in January, when we would hear of this Covid-19, it felt like one more disease that would make the news for a while, and nothing more. People started to get concerned when Italy announced a national lockdown. Speculation on what was the best way of the virus containment led to two general solutions: immediate lockdown and herd immunity.

At this point Prime minister Rutte felt like he wanted to do something, certainly proportional to the gravity of the situation, he banned handshakes. I am not criticizing, but in my eyes many countries did not want a full lockdown only for the safeguard of the country's economy, regardless of the threat on people's health.

Soon after many countries followed in Italy's footsteps and went into lockdown. The "new normal" phase was a fact.

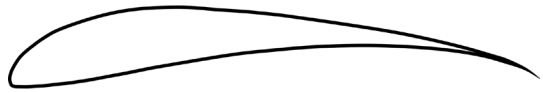
On one hand smart working, sanitizing obsessions and social distance became a daily routine, toilet paper was worth more than gold and coughing in public was the most terrifying thing ever.

On the other hand most of us had the chance to invest time in ourselves. Some would just love the pyjama day (or week), some would work on the, long time delayed, fitness, some had the chance to spend time with their loved ones, and so much more. Honestly not that bad. With the right amount of awareness on the real problem, we could go through this - I thought.

Sadly, the apparent decrease in new cases together with the growing lockdown-sickness, made summer the perfect moment for a corona "pool party". The weather, the holidays, the will of not giving up normal life for one summer brought what we are now experiencing as the second wave. More smart working, more social distancing, new lockdown rules, is now driving our mind crazy.

We are not children anymore, our actions have consequences. Be responsible, make the effort not for your safety only, but for everybody that surrounds you.

Wear a mask when possible, wash your hands, stay at home, or isolate yourself when you have corona symptoms. Keep up for a bit longer and soon normal life will be back.



"What is the air-speed velocity of an unladen swallow?" - Ignacio

Well, that depends on whether it is a European swallow or an African swallow!

Let us not forget the fact that the African swallow is non-migratory, so we will consider the European variant. We know that the average adult European swallow (*H. r. rustica*) has a wing length of 12.2 cm and a body mass of 20.3 grams. Now let us play a game called *A Nanobiologist pretends to be an Aerospace Engineer (suf) and makes an incredibly rough estimation as a response to a Monty Python joke.*

Using image analysis, we find that the European swallow has a total wing area of 80 cm^2. Now: how do their wings perform? We can get this information from the following graph made by analysing 3D scans of bird wings:

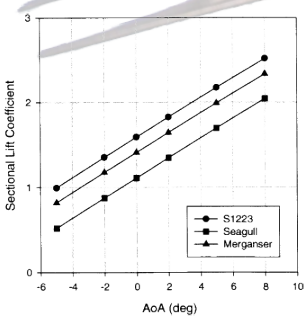


Figure 2. The sectional lift coefficient as a function of the angles of attack. Source: ntrs.nasa.gov

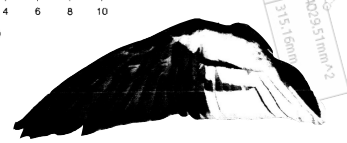


Figure 3. The Merganser wing. Source: ntrs.nasa.gov

The profile of the Merganser wing is most similar to that of the European swallow. The paper also shows that the Merganser wing is similar to the high-lift, low Reynolds number aerofoil S1223.

Figure 4. (Above) The S1223 aerofoil. Source: aerofoiltools.com

Let us assume that the swallow is cruising at an angle of attack of 0 degrees. The Reynolds number for birds is on the order of 10^5. Data on the S1223 aerofoil shows that it has a *section lift coefficient* of approximately 1.037.

Finally, we dust off our slides for the course AE1101: Introduction to Aerospace Engineering so we can look up the following equation for air-speed velocity:

$$V = \sqrt{2 \cdot \frac{W}{S \cdot \rho \cdot C_L}}$$

$$= \sqrt{2 \cdot \frac{20.3 \times 10^{-3}\ kg \cdot 9.81\ m\,s^{-2}}{0.008\ m^2 \cdot 1.225\ kg\ m^{-3} \cdot 1.0370}}$$

$$= 6.2602 \approx 6\ m\,s^{-1}$$

We find an air-speed velocity of approximately six metres per second. Note that we calculated the velocity at a reasonable, however arbitrary, angle of attack. We also did not consider drag nor thrust. Considering this, we find this analysis wanting. It does, however, place us near the actual airspeeds of European swallows flying in wind tunnels: eight to eleven meters per second!

Now I am going to take off my *Aerospace Engineer hat* and vow to never put it on again. This has been enough looking up vague coefficients in tables for the next decade or so.

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Figure 1. (Background) Calculating the wing area of the European swallow, Source: birdsofthebay.com

UPCOMING ACTIVITIES

HOOKE AGENDA

VSParticle lunch lecture	15 December
Board information drinks	16 December
Committee night	17 December
Christmas Holiday	21 December - 1 January
Young Medical Delta	5 January
OGD lunch lecture	14 January
Wnt & Diffucie	30 January

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