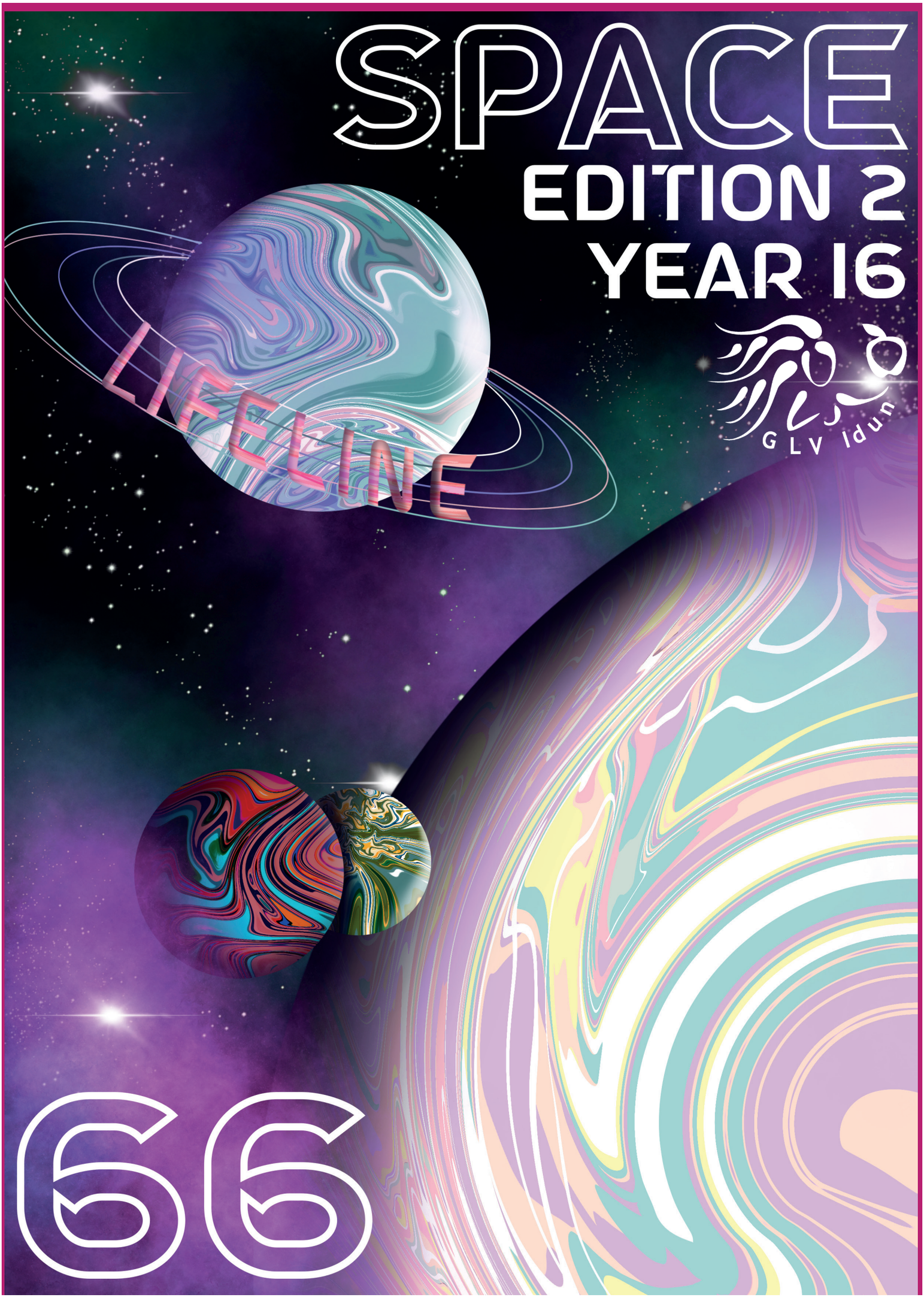


CONTENTS

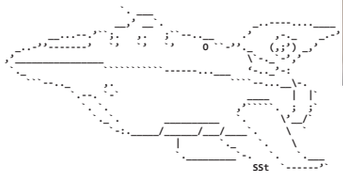
PREFACE

Greetings dear Idunnaren,

In these dark winter times, don't forget to seek a little bit of light too. As the Lifeline, we think it's our duty to provide a helping hand with this. Therefore, our latest Lifeline has the theme 'Space', which covers, but is certainly not limited to, the big great empty our earth is floating in. The theories and paradoxes behind space are interesting, but might cause a slight existential crisis, so we created some down to earth pages as well to ground you back on your feet. It is okay to take some space from life sometimes and get your rest. I believe there is almost no better way to do that than with this Lifeline. Our writers and lay-outers worked their hardest on this edition, so I hope you will enjoy it :)

Kind regards,

Dear readers,



This time, we will focus on space. For example, the fast cold space you can get lost in when you look up towards the beautiful night sky. This all-encompassing nothingness with its numerous shining constellations can raise many questions in the minds of the scientists wandering the earth. Such as: Is there life in space, is there still an undiscovered planet within our solar system and why did Elon Musk shoot his tesla into space? One can only ponder what the answers to these difficult questions could be... Will there be life which can survive in the ice cold lakes of the moon Europe... Will planet X be discovered during the upcoming years... and will there be a tradition where Elon Musk will go out of his way to deliver an ice cold package with SpaceX. Amongst all these uncertainties, there are at least a few givens. The earth turns around the sun, ice melts and there will be another Lifeline.

To infinity and beyond,

Thomas Westerhuis
Chairman of GLV Idun 2021-2022

Pun intended by lay-outers of having much "space" hihi

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Editor in chief:	Marit Bonne
Editors:	Marit Bonne • Nadia van Eekelen • Juultje Eenink • Koen Freerks • Anette Hallik • Lauren Hansen-Manguikian • Jelle de Jong • Meiske Pieters • Renate Kloostra • Roos Slijfer
Lay-out:	Marit van Kampen • Lisanne Leenheer • Meiske Pieters • Jente Zeubring
Final editing:	Marit Bonne • Juultje Eenink • Koen Freerks • Lauren Hansen-Manguikian • Renate Kloostra • Lisanne Leenheer
	This edition features contributions by Bas van Boekholt and Siebren Wobben

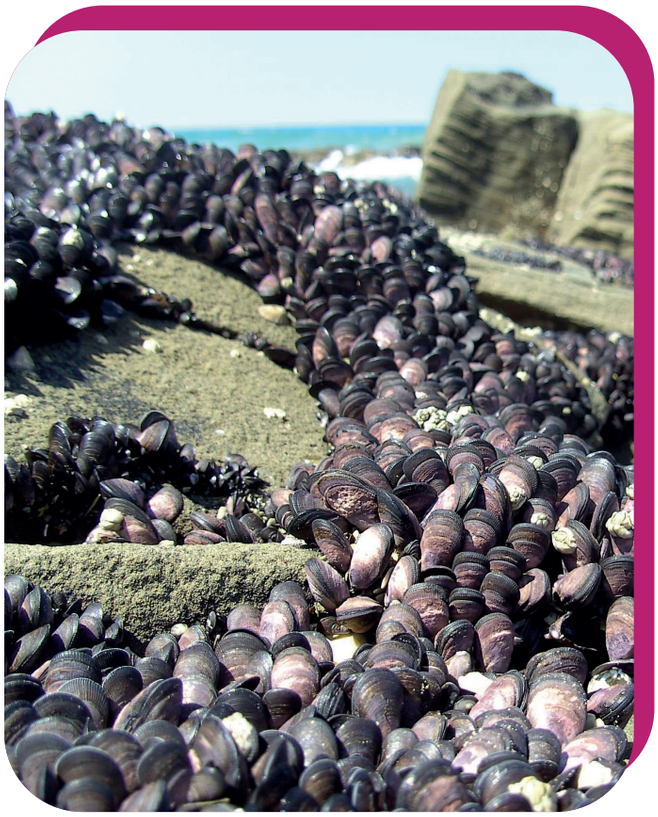
SCIENTIFIC NEWS

By Jelle de Jong

Biomimicry

Mussel Foot and Spider Silk

Nature has had billions of years to evolve all sorts of fantastic materials. It came up with the fibers to construct trees like the giant sequoia. It invented amazingly strong spider silk, which can theoretically catch a cargo plane mid-flight. When you know where to look, you can find all sorts of state-of-the-art materials in nature. These often come in the form of proteins, like the mussel foot protein. Mussels can produce a special protein to super-glue themselves to flat surfaces like the hull of a boat. Each of these natural materials already has great properties, like biodegradability. When combined, these properties can be added together to create all sorts of exotic materials. Researchers at Washington University (St. Louis, Missouri) have combined the properties of spider silk and mussel adhesive in a new material. By combining spider silk protein and mussel foot protein they created a water-resistant biodegradable adhesive, stronger than steel and tougher than Kevlar. The material can be used for underwater repairs and because of its biodegradability even has possible medical applications.



Antarctic ankylosaur: Stegouros

While most dino fanatics are familiar with the tail club of an ankylosaur and the thagomizer (spiked tail) of a stegosaur, a newly discovered dinosaur has an entirely different type of tail weapon. It has been dubbed Stegouros, which means roofed tail. The closest thing it can be related to is the macuahuitl, an ancient close combat weapon used by the mesoamericans. The macuahuitl looks like a cricket bat embedded with sharp blades around the edge. Who knows, maybe the weapon design was inspired by this fossil. It is no surprise that of all places this strange dinosaur was found in the southernmost part of South America (In Chile). This part of the world is geologically very interesting because it once was connected to Antarctica. Not much is known about the fossil record of Antarctica due to the current harsh climate. However, when dinosaurs roamed Antarctica it was much warmer and more hospitable. It is thought to have been the home to many (yet to be discovered) dinosaur species.

The glass shard desert

A relic of the past

One of the most mysterious looking landscapes on earth is located in the Atacama desert in Chile; part of the desert is covered in strange glass shards. For over a decade the mystery of the origin of these shards has puzzled geologists. Now, finally, there seems to be a logical answer; A giant meteorite exploded around 12000 years ago, increasing temperatures to such extremes that part of the sand melted into glass. The evidence is preserved by the uniquely slow rate of erosion. What makes the event even more interesting, is that it might have contributed to the extinction of local megafauna and could have been witnessed by the first humans in South America. To compare this event to a well documented similar event; when in 1908 the Tunguska meteor exploded above Siberia, pines snapped like toothpicks. A lonely reindeer herder, 30 km from the epicenter, ended up twelve meters high up in a tree. When looking at the impact site today, it might be hard to believe that a destructive event even happened. We wouldn't even know of the event if not for the few humans present there. Relate this to the glass shards of the Atacama desert; If not for the barren climate the evidence of the meteorite would almost certainly have been lost to time.

Marble Berries

All that glitters is not gold

While plants mainly use cellulose as a building material for their cell walls, *Pollia condensata* was found to apply cellulose in a stunningly unique way. While other plants produce pigments to make their fruits appear more striking, this plant uses a trickier way which involves cellulose nanostructures. The cellulose in marble berries (the fruit of *Pollia condensata*) is arranged in unique spiral shaped formations, which mess with light in such a way that the berries appear incredibly glittery and blue. The advantage of using cellulose instead of pigments is that while pigments in fruit degrade when the fruit goes bad, cellulose is very hard to degrade. Subsequently the marble berries still look very appealing even if spoiled. A chemist from the University of Cambridge got inspired by the marble berry and investigated how the spiral arrangement of cellulose could be recreated. He succeeded at recreating the conformation and aims to use it to replace glitter. Glitter is currently made from toxic, pollutive and non-degradable substances like microplastic or metal. With time, the new cellulose-based glitter has huge potential to make these harmful substances obsolete.

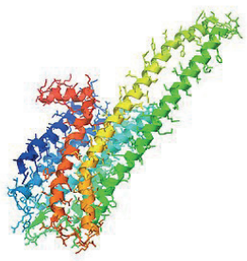
OH, TO BE ON A FLYING CARPET FLOATING THROUGH SPACE

By Parit

Wouldn't you like to go to space? To float between stars, galaxies, and black holes? You could see creatures that are not from this world, smile at them, and be wondered by them. No NASA, no Elon Musk for that matter, only you; wandering through space.

Turns out, you can take such 'wonder pills' to escape from reality. More specifically, you could become totally detached from the world as we know it. The world of hallucinogens might make you see all things extraterrestrial, but let's see what happens when we look from a more down to earth perspective.

First things first, the spacy hallucinogens are not the only flavor of the drug. The classic hallucinogens make reality feel unreal: emotions will swing and perception of time, motion, sounds, and oneself are distorted. The dissociative kind (the floaty, spacy ones), however, cause a detachment from your body and thus reality, combined with hallucinations that can be visual, auditory, or sensory. You might already know that researchers do not know the exact brain mechanisms responsible for these hallucinogenic effects and the difference in association, but fortunately they can make an educated guess. All classic hallucinogens (so the associative kind) are known to stimulate the serotonin 2A receptor. An antagonist of this receptor abolishes the hallucinations and the affinity of the hallucinogen for this receptor correlates with their strength. Dissociative hallucinogens are different in their effect, and, therefore, also different in their mechanism. These types of drugs are thought to disrupt the actions of glutamate, the most prominent excitatory neurotransmitter in your brain, via the NMDA receptor. This receptor and neurotransmitter play a role in cognition, emotion, and pain perception.



We all know that drugs aren't the greatest for your health. That being said, most people consider hallucinogens a good option, as this drug category is non-addictive, entertaining and sometimes a beautiful experience (who doesn't want to go to space?). However, it is good to be aware of the risks that hallucinogens bring with them. Some kinds could be addictive (PCP, for example, as it acts on the dopamine system too) and with frequent use you can still build up some tolerance for the substances. It doesn't fortunately cause drug-seeking behavior in humans. Next to this, dissociative hallucinogens can cause some serious damage when taken frequently in high dosages, such as seizures, psychotic symptoms with PCP; immobility, amnesia, or experiencing an almost complete sensory detachment (near-death experience), called a K-hole. It is also important to note that overdose is more likely with dissociative drugs, than with associative ones.

However, it is not fair to downgrade the reputation of hallucinogens. Currently, the potential of some hallucinogens in the treatment of mental disorders are investigated. Ketamine is now used as a treatment for patients with severe depression that do not respond to traditional treatments. It is offered in a medical office as a nasal spray, where it can pass the blood-brain-barrier and enter the cerebrospinal fluid. The most recent results are positive and since ketamine acts on glutamate, rather than dopamine or serotonin, it could offer new insight into mental disorders like depression.

All things considered, when safely used, hallucinogens could be a fun experience, but keep in mind that these drugs can be unpredictable in their effects. When in doubt, I would advise you to go for a safe, tested dosage of associative, or classic, hallucinogens, as the chance of overdosing is less. It is cool to float through space without Elon Musk, but don't forget that without him, there is no one to catch you if you fall either.

AFRAID OF OUTER SPACE

By Juultje Eenink

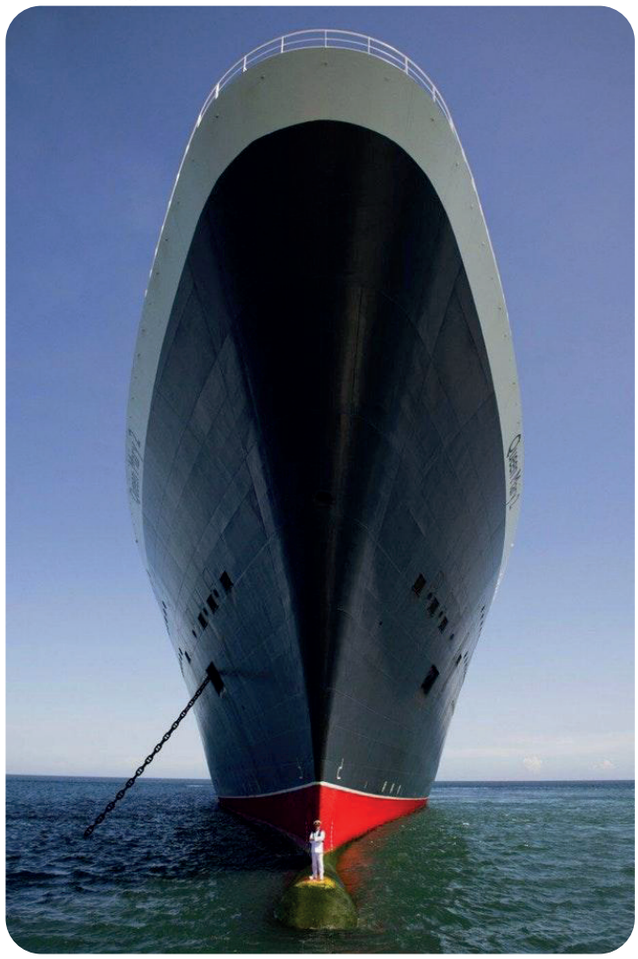
Space: some think it is fascinating, some think it is beautiful, and some... think it is terrifying. This may sound weird. The fear itself is often irrational indeed, but also very real. Different types of phobias exist that are somehow connected to outer space. These phobias are often quite impactful as space is not something you can escape or avoid – you are always in space.

A case study in the 1960's gives us insight into the lives of people that live with a phobia of outer space. One patient (male, 33) said to feel unsafe "because the earth is a ball spinning round and I am on it." This made the man feel unstable, particularly because he was afraid of falling off the earth, disappearing into the vastness of space. The other cases also reported the fear of falling into space, even though they all knew gravity was keeping them down. As is often the case with phobias, rationalisation does not do much to lessen the fear and often turns into ruminating instead, worsening the disorder.

Factors that affect the patients were open spaces (because of a lack of protection from outer space), high buildings and chimneys (because they emphasized height) and hills (because you could slide of the earth). The instability of the earth was also a major concern for the patients, with earthquakes raising the fear of the earth crumbling. Human-caused imbalance of planet earth was also mentioned - with chimneys, coal mining and oil drilling as causing factors. A specific trigger that was seen in all four patients was the sun. The sight of the setting sun touching the horizon exacerbated the phobia in them – and yes, they were aware that this sight was caused by the sun and earth meeting in just their visual field. It worked mostly as a trigger, making them think about space and "because [the sun] accentuates heights" and "it is like a ball of fire", said one patient.

Astrophobia pops up first when researching phobias of space. Although very real, it does not seem to match with the cases of fear of outer space as described in 1960. Astrophobia entails the fear of space and stars and is often connected to a fear of aliens. Often, people suffering from this condition are interested in conspiracy theories about UFOs and government cover-ups of alien sightings and life.

Thinking about it, a fear that matches the overall feel of the ones described in 1960 is megalophobia: a fear of large objects. I first learned about this fear on TikTok, and it caught my attention immediately. "Large objects" do not sound particularly scary, so I was expecting some sort of joke if I am honest. It is TikTok after all, not some serious science magazine. But the images that followed took my breath away for some reason. One of the pictures of this TikTok is shown on this page, but for the full dramatic effect put on "hoist the colours" from Pirates of the Caribbean while looking at it – that's how it was shown in the video.



But space is not an object. If anything it is the opposite of an object. That excess of space is captured nicely in thalassophobia. Thalassophobia is the fear for large bodies of water, such as the sea and the ocean. The fear does not stem from the fear of water, but rather the vast emptiness of the body of water beneath and around you. A striking similarity to the phobia of space. In fact, one of the patients (male, 40) interviewed in 1960 described feelings that would match today's description of thalassophobia quite good. Putting him on a raft on the ocean, would be their biggest nightmare: "because of the space above, below, and round you", he explained. And that describes precisely why the fear of space is so impactful. Because space is all around you. All the time.

Mastering student cooking with Koen

These dark winter months could use some warmth. The following recipe will surely do the trick! Pumpkins are versatile vegetables that can be used in a lot of dishes. However, for this edition, I will show you how to make a cheap and healthy pumpkin soup. Good luck!

Vegan pumpkin soup

Who doesn't love pumpkins? Also known as the Halloween vegetable. In October this veggie is found on many porches as decoration. Of course, you can also eat them! I know that a lot of people have some trouble cutting the pumpkin. However, if you choose the Hokkaido pumpkin (those little orange organic pumpkins), you don't even have to peel it. This makes making pumpkin soup a lot easier. You can also find pumpkin cubes in the fridge and freezer of many supermarkets. This soup is very nice served with garlic bread, which I insist you try. This recipe is for a total of 8 bowls, so u can share it with your friends or consume it throughout the week.

INGREDIENTS (FOR 8 PORTIONS):

- 1 onion, in rings
- 1 clove of garlic, finely chopped
- 1 winter carrot, in pieces
- organic pumpkin of +/- 1 kilo, diced with skin (one Hokkaido will do)
- 250 ml coconut milk
- 1 liter vegetable broth
- fresh parsley to taste
- pepper to taste
- coconut oil
- spring onion and pumpkin seeds for garnish

HOW TO MAKE:

1. First of all, cut the pumpkin into cubes. Do this by first cutting the pumpkin into discs and removing the seeds and threads with a spoon. After this, you can cut it into cubes. The skin can stay on.
2. Put a large soup pan on the fire. Melt a tablespoon of coconut oil and fry the onion and garlic. Add the cubes of pumpkin and pieces of carrot. Fry briefly.
3. Add the broth. Bring the broth to a boil and let it simmer for about 30 mi nutes. The pumpkin should be nice and soft.
4. Turn off the heat and puree the soup with the hand blender until smooth. Now stir in the coconut milk. Do you think the soup is too thick? Add some extra water. Season to taste with pepper and fresh parsley.
5. Garnish with pumpkin seeds and finely chopped spring onion. Now it's ready to serve!

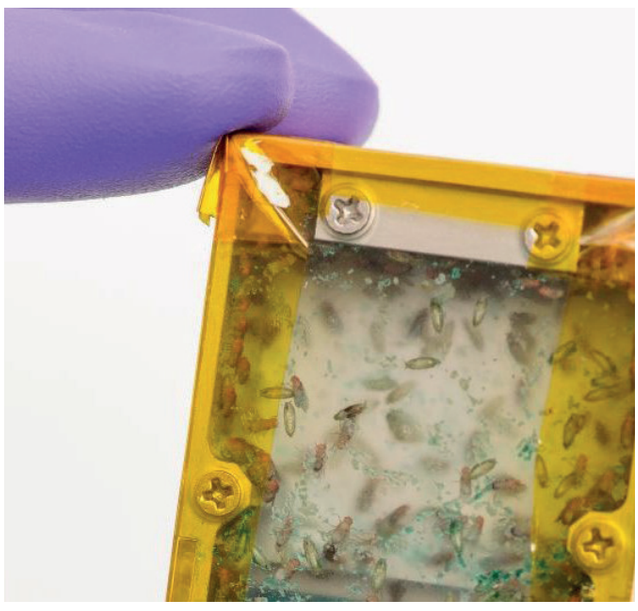
SPACE FLIES

SENDING DROSOPHILA TO THE ISS

By Nadia van Eekelen

While Elon Musk is busy designing his spaceship to carry 100 people to Mars, scientists are still investigating the effects of space missions on astronauts' bodies. Since the 1940s, all types of animals have been sent into space to test the impact of space flight on living beings. These animals included insects, mice, rabbits, cats, dogs, monkeys, fish, and tortoises. In all these experiments, things were happening that were not expected. DNA was damaged, the immune system was altered, eyes were swollen up causing blindness... and these are just a few of the effects.

Before we can start our journey to the distant Mars, we have to know how microgravity affects the different organs in our bodies. Microgravity is the condition in which gravity is almost zero and people or objects appear to be weightless. To study its effects, scientists have been using fruit flies – the very well-known and famous (at least to us) *Drosophila melanogaster*. *Drosophila* work well for this type of research for a number of reasons: their systems and genetic makeup closely resemble ours, their entire genome has been sequenced, their genes are easy to manipulate, and they reproduce quickly (unlike mammals) so it is possible to study many generations in a short amount of time.



A few years ago, 1.800 *Drosophila* travelled to the International Space Station (ISS) and stayed there for a month. Both eggs and parents were sent, so there were flies born in a microgravity environment. When the flies came back to Earth, they were immediately researched. Their ability to fly was measured, videos of their beating hearts were captured, and gene expression changes were mapped. This revealed that the *Drosophila* had smaller hearts that could not pump blood very well anymore.

The scientific team explains: "In the normal fly heart, the muscle fibers work like your fingers when they squeeze a tube of toothpaste. In the space flies, the contraction was like trying to get toothpaste out by pressing down instead of squeezing. For humans, this could become a big problem."

To the scientists' surprise, the extracellular matrix (ECM) that surrounds the heart of the flies was severely reduced. The same thing happens to human patients that are confined to bed and/or sit in a wheelchair. Changes in the ECM, either reduction or overproduction, interfere with heart function. Since most cardiovascular diseases involve the ECM, most heart researchers investigate the interplay between the heart and the ECM. Now, in the space flies, the scientists have found several ECM-interacting proteins that were dysregulated. These specific proteins were never of interest to heart researchers before, but now that they are, the development of therapies to improve heart function can be sped up. So, even though the health of astronauts was the primary goal of the space fly research, people on Earth also benefit greatly from this work.

All in all, microgravity has dramatic effects on the heart. So for long-duration space travel, it is likely that medical interventions are needed to keep astronauts' hearts healthy and strong. To put things into perspective: the Apollo astronauts could fly to the Moon in just a few days, but travelling to Mars would take anywhere between 6 to 9 months. If we want to make Elon Musk's dream come true to build cities on Mars and become a multi-planet species, we have to send a lot more *Drosophila* to space and do a lot more research on how microgravity affects our organs.

DEATH OF THE UNIVERSE

By Roos Slijfer

A cool fact about the universe is that the same patterns repeat themselves over and over. This would mean the universe is a fractal, a geometric pattern that repeats again and again at a different scale. You can think about the branching of a tree for example, that can also be seen in the human bronchus, fungi, or coral. This is also known as the law of correspondence.

This law states that patterns repeat throughout the universe, and on a personal level, our reality is a mirror of what's happening inside us at that moment. Think "As above, so below. As within, so without." As you can see, it might be that things are connected. For the people watching 'the big bang theory', you know that the universe has a beginning, about 13.8 billion years ago, and is expanding ever since. So we know how it started (sort of) but how the universe will end, however, is not clear yet. There are a few theories though.

The first one is called 'The big rip', where it is hypothesized that the ultimate fate of the universe, from stars and galaxies to atoms and subatomic particles, and even spacetime itself, is progressively torn apart by the expansion of the universe at a certain time in the future until distances between particles will become infinite. According to the standard model of cosmology, the scale factor of the universe is accelerating and, in the future era of cosmological constant dominance, will increase exponentially.

The second one is called 'The big freeze'. Most observations suggest that the expansion of the universe will continue forever. If so, then a popular theory is that the universe will cool as it expands, eventually becoming too cold to sustain life.

The third one is called 'The big crunch', which is a hypothetical scenario for the ultimate fate of the universe, in which the expansion of the universe eventually reverses and the universe collapses, ultimately causing the cosmic scale factor to reach zero, an event potentially followed by a reformation of the universe starting with another Big Bang.

As you can see there are some theories about how the universe will end. But no matter what the universe will do, the earth will die in approximately 5 billion years when the sun engulfs it. So that is maybe a nice constant in our lives.

LIFE FROM SPACE

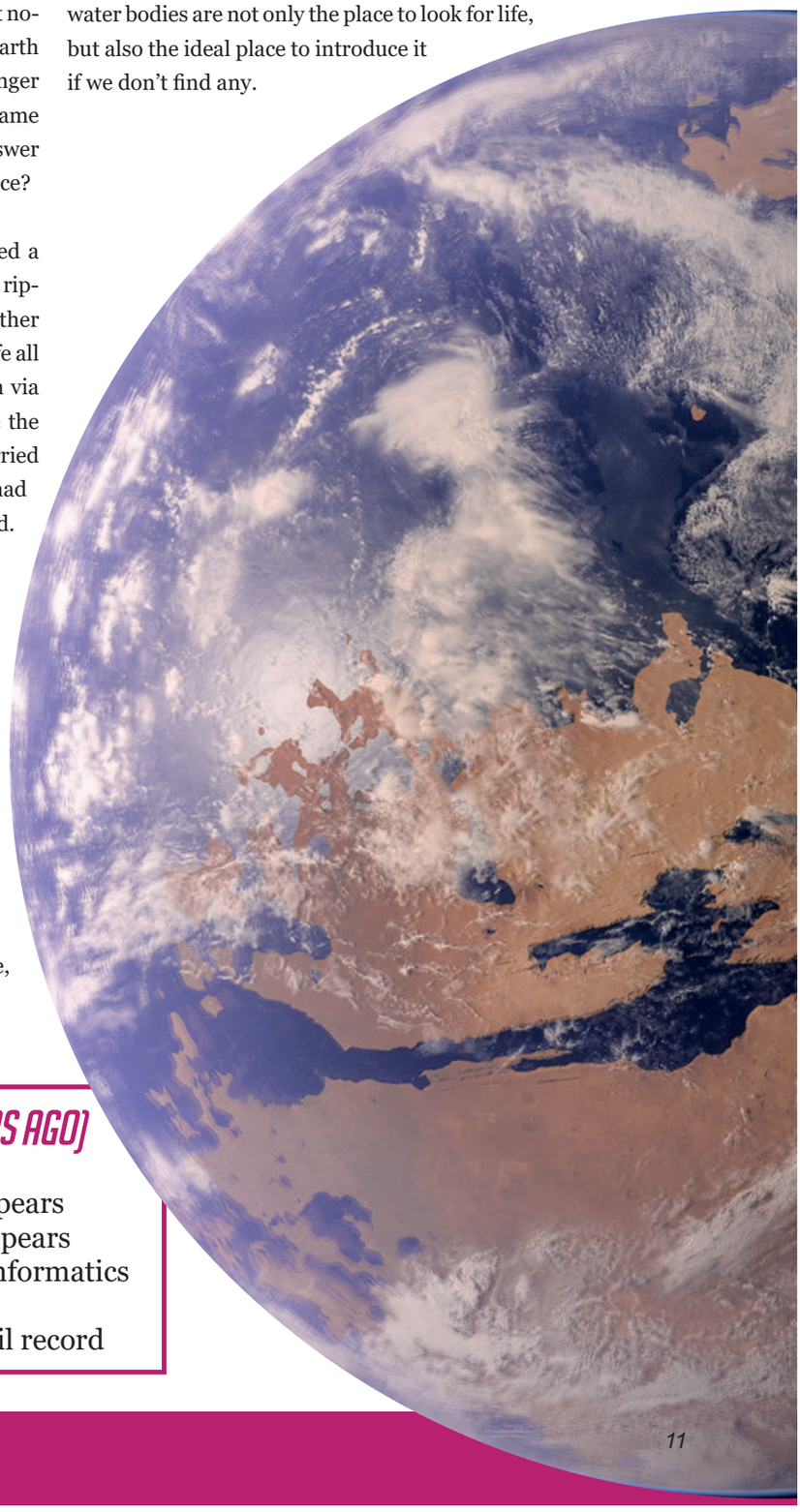
By Jelle de Jong

Most people probably have thought about the origin of life. What do we know at this point? With the relatively recent bioinformatic tools and sequenced genomes, all life on Earth can be traced back to a single ancestor. This ancestor seems quite complex and not much is known about its origin. It could be that all other lifeforms living alongside the ancestor of all current life just didn't make it and thus we can't obtain their genomes anymore, making it impossible to obtain information about the earliest nodes in the evolutionary tree of life. The first signs of life on Earth are dated to be 'only' a couple hundred million years younger than the earliest oceans. While it could be possible that life came to exist that quick, there's another option. What if the answer to the origin of life does not come from Earth, but from space?

Rocky planets, especially in the past, have exchanged a lot of material; mountain sized chunks of rock were ripped off one planet and violently crashed into another one. Events like these could have carried early life all around our solar system. If life came to Earth via space, out of all the planets, Mars would be the most likely donor. For life to have been carried from Mars to Earth, both planets must have had liquid water at the same time. Spoiler; they did.

While currently Mars looks like a barren, rusted rock, billions of years ago water rained from the Martian clouds, feeding its rivers and seas. Like Earth now, ancient Mars had an atmosphere capable of blocking harmful UV radiation and a magnetic field to protect the surface from solar wind. Mars had many of the life-friendly properties that Earth is known for today. It's not that far-fetched to think that Mars could have produced the organism that all life on Earth evolved from. Mars could provide valuable clues on the origin of life in our solar system. While digging for fossils and analyzing rocks is useful to find out if there was life, where do we look for the possible remaining life?

If there was life on Mars and if it's still around, it will almost certainly be trapped underground. Due to Mars losing its atmosphere it is extremely unlikely for life to be on the surface. The copious UV radiation cuts and alters bio molecules like DNA. Additionally, the lack of atmosphere causes all water on Mars' surface to quickly evaporate unless frozen. The only water that remains is trapped underground or frozen. These subterranean water bodies are not only the place to look for life, but also the ideal place to introduce it if we don't find any.



APPROXIMATE TIMELINE IN BYA (BILLION YEARS AGO)

4.60 bya	Mars forms and liquid water appears
4.54 bya	Earth forms and liquid water appears
4.41 bya	First life on Earth based on bioinformatics
3.70 bya	Mars' liquid water disappears
3.50 bya	First life on Earth based on fossil record





BELTRUM











Lifeline

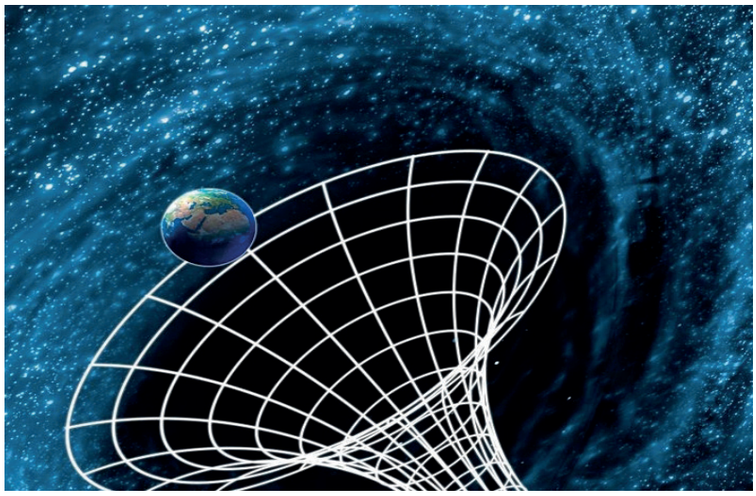
THE GREAT FILTER

WHY WE HAVEN'T MET ANY ALIENS (YET?)

By Lauren Hansen-Manguikian

We're all super excited to find life on Mars. There are so many possibilities to study life and even for the origin of our own life, as Jelle wrote about on page 11. But finding life on Mars may not be all fun discoveries. It could mean that our species is doomed: never to leave our tiny rock and colonize space. In this article, I will explain why.

Most people have heard of the Fermi Paradox. The Fermi observation is that we have seen no signs of extraterrestrial life. The paradox is that we know there are plenty of planets out there that look like they should be habitable. So if there are so many



planets out there like Earth that have been habitable for way longer than our planet... why hasn't anyone come knocking? Is there something... stopping them?

The Great Filter, named by Robin Hanson, is the idea that there is some step in between having a habitable planet and having life on that planet explore space that is extremely difficult to achieve. There are two possibilities: This great improbability lies behind us, or it lies in our future. If it lies behind us, it could be the germination of life itself, or the step from prokaryotic to eukaryotic life (which took 1.5 billion years).

If we discovered life on Mars, and we found that life there had evolved independently, this would essentially eliminate the possibility that the germination of life is the Great Filter, and make it much more likely that the Great Filter is in our future, not our past.

So what could be a Great Filter that we must still get through? This is where I will get into my own wild theorizing.

The 'present bias' is our tendency to give a higher weight to sooner things rather than later things. For example, we tend to choose a smaller reward if we get it sooner, rather than a larger reward later. This tendency may have evolved in an environment where the threats are NOW: a food-scarce, predator-rich environment where you could die at any moment. This is evidenced by the fact that the more comfortable and safe the environment is, the more future planning (such as waiting for a greater reward, or saving for the future) occurs. We see this difference across species and humans in different environments.

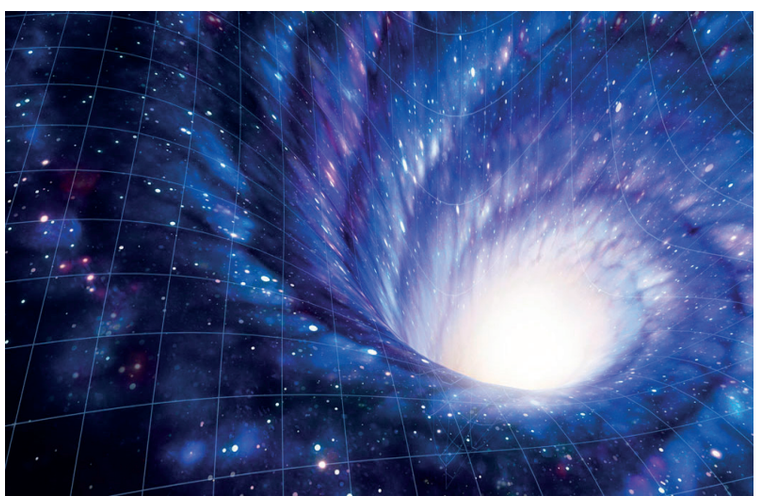
This bias that we have inherited may be our downfall. There are so many long-term existential risks in our future, but we currently have no incentive to protect against them. Corona is a perfect example. If we had been prepared for a pandemic and taken action, this would have been over years ago. But no one had an incentive to prepare for that risk. Neither the voters nor the politicians were thinking about it. Because we want things now, we don't want to save money to put in place a system to prevent possible pandemics, even though they have the possibility to end civilization as we know it. It's not in our nature.

My theory is that there will never be sufficient incentive to protect from long-term existential risk, thus all intelligent societies will fall to long-term destructive threats.

I think the only way a civilization could arise that would prepare for existential risk is if the organism evolved in an environment that was changing so slowly that most risk would be future-risk in general. If they also gained the ability to reason and use language, they would be able to respond appropriately to the risks. Basically, not procrastinating.

However, language itself was created in a niche of immediacy. It is about the complicated communication of ideas in the present moment. We can talk about the future or the past, but we talk about it right now, because the need is right now. If a species faced long-term threats instead of short-term threats, they might never need to develop language and thus never be able to build technology and civilization in the first place.

So what do you think? Will it be your research that helps us get through the Great Filter to colonize space? Can we overcome our inherent biases to save our species? Or do you believe we are already past the Great Filter, and it's smooth sailing from here? If so, are you so sure that you'd bet our future on it?



BRAIN STORAGE

HOW MUCH SPACE IS IN OUR BRAINS?

By Anette Hallik

As a student, it very often feels like our brain has reached maximum capacity. Like there is no way that any more chemistry formulas or names of bacteria can fit on our hard drive. But then again, how many song lyrics do you remember from the 2010-s? All of them!

So how much space does our brain actually have?

Short answer: a lot! Much more than you would ever need.

As you probably know, these days smartphones have storage capacity roughly from 64 to 256 gigabytes which seems a lot, as our whole life fits in our pocket. Well, human brain space is measured in petabytes. This means a million gigabytes, and the human brain has not just one but 2,5 of them. That is roughly 3 million hours of TV shows which translates to 300 years of non-stop television in the background. Needless to say, none of us can actually acquire that much information in our mere century of existence, so it's pretty obvious that no person has reached the maximum capacity limit of their brains.

However, measuring the actual usage of human brain space is less straightforward, as we learn new things and acquire new memories every day but at the same time forget names, numbers, formulas et cetera. Therefore, we can assume that our brain has approximately 2,5 petabytes of storage space, but as we constantly make room by forgetting the definitive space in our brain is not known.

But how does all this information fit in our heads? Teamwork makes the dream work.

If every neuron in our brain could only save one memory, we would have as much brain space as an IPod or a USB stick. To have more capacity, all neurons cooperate and contribute to many different memories, resulting in millions of more gigabytes of space for all those Britney Spears lyrics that you sang as a teenager. Therefore, we cannot for sure say how many memories one can fit in their head, as sometimes different neurons and their connections are used to remember things that we have seemingly forgotten.

Which leads us to our next mystery - how much of our brain do we actually use? The most common myth is that humans use around only 10% of their brain actively. This myth has been all over the news and websites, nevertheless it is not at all true. Doctors and scientists have been investigating this matter to either prove or disprove that claim. With the use of MRI (aka magnetic resonance imaging) it has been shown that in fact we use almost 100% of our brain throughout an average day. The brain still is the most energy-needing part of the human body and is responsible for many bodily functions we need to survive, therefore it only makes sense that most of that resource should be used daily. Thus, although we often struggle remembering things, this is not about the lack of brain usage nor the lack of brain capacity, this is barely human nature and the fact that we don't need all of that information to survive. So do not worry, you did not spend all your brain space on random song lyrics, there is still quite some space left for you to memorize even more!

A CHAT WITH...
Dr. Ir. Marjon de Vos

We as students are aware that an academic world exists on campus, but we rarely know the faces behind them. To give an impression of what research(ers) are present in our beautiful Groningen, we had a chat with Dr. Ir. Marjon de Vos, assistant professor in Ecology, Evolutionary Biology, and Microbiology. She is intrigued by extraordinary tiny forms of life, strongly believes the 'weird' behavior of Enterococcus could be explained, and got hooked onto microbiology because of hyperthermophiles near volcanic vents.

WHEN DID YOU REALIZE YOU WANTED TO BECOME A SCIENTIST? HOW DID YOU KNOW ACADEMIA WAS FOR YOU?

For a long time I didn't even realize I could become a scientist. Just when I was thinking about quitting Biology, I took microbiology lectures by Gosse Schraa. In those lectures he told us about hyperthermophilic archaea that live near deep sea volcanic vents, and I was just blown away, and microbiology-hooked.

Where my biology friends were happy to go on a field trip and catch insects and plants (I considered them 'true' biologists - and was not sure what that made me), I was happy that my biology specialization did not require field work. On top of that, a scientist in my head was a white man with a beard, such men that are often depicted at the introduction of a particular biological subject (one reason that I try not to use too many of such images in my lectures now).

Later, I went on an internship during my MSc. There I studied the carbon-cycle of a hyperthermophilic archaeon by assessing protein expression levels under different carbon environments. One evening I sat down in my dark room, staring at the differential protein expression data, and drawing metabolic cycles. At that moment I realized that there might be a previously unobserved shunt from one carbon cycle to another. That was such an epiphany, such an eureka moment, that I realized that I - a first generation university student - was also able to find previously unexplored knowledge in nature. I realized that I wanted to understand more about nature, and particularly that I wanted to understand the processes driving the emergence of the building blocks of life.

At that moment I was honestly (still) rather oblivious about the workings of academia.

WHAT ABOUT YOUR FIELD INTERESTS YOU THE MOST?

The benefit of studying microbes is that they have a very short generation times. You can literally see evolution occurring while you are performing your experiments, and that is just a-ma-zing. On top of that microbes respond to other microbes in their microbe-ecosystem - you can therefore investigate how the evolution of one microbial population affects the evolution of another. I'm for instance obsessed with the idea to steer evolution by particular ecological interactions with other microbes.

ARE THERE PARTICULAR SCIENTISTS, WHETHER YOU KNOW THEM PERSONALLY OR NOT, WHOM YOU FIND INSPIRING?

I met Ada Yonath after she gave an invited lecture. She told us about her background and the hardships she endured during her scientific career. That she did not give up, despite all those hardships - and really kept pushing (and became such an excellent scientist - yet still very kind and attentive).... Pfew, I find that extremely inspiring.

WHAT DO YOU THINK IS THE BIGGEST MISCONCEPTION ABOUT YOUR PROFESSION?

That microbial ecology and evolution might be boring?

HOW DOES/DID THE ACADEMIC HIERARCHY AFFECT YOUR LIFE NOW AND IN THE PAST? YOUR FREEDOM TO DIRECT YOUR OWN RESEARCH?

During my first postdoc I had the luck that my PI wanted to move into a new direction - I was therefore relatively free to set-up a research line. He allowed me to take that project with me when I left, and received a fellowship to continue similar work elsewhere. And currently, GELIFES is a flat organization. This means that there are no chair-groups (headed by a 'big' prof), but that each research group (like mine) is loosely organized in a larger structure (expertise clusters), which then fall under the board. This means that I have quite some freedom to steer my own microbial research in the direction where I was hired (Microbial Evolutionary Medicine). Funding streams are at the moment more limiting that freedom.

HOW DOES ACADEMIA IN THE NETHERLANDS COMPARE TO ACADEMIA ELSEWHERE IN EUROPE?

The past years the government has had the idea that research should be more, and more applied. This means that there is less budget available for fundamental research, which is a big shame. Because when fundamental knowledge dries up, our innovative motor also cannot run.

In general, in the Netherlands there are not as many funding opportunities (especially for fundamental science). In other countries, e.g. Germany and Denmark, the government spends a higher % of gross national product on science, ánd they have

By Marit Bonne

By Anette Hallik

more foundations that sponsor science.

This also means that the scientists in the Netherlands are forced to think smaller - while I think that for the true innovations and leaps in sciences one should think big.

WHERE DO YOU SPEND MOST OF YOUR WORKDAY? WHO ARE THE PEOPLE YOU WORK WITH?

Unfortunately, I often spend my days at home these corona days. I go into the office about 1 or 2 days a week (also since I find myself a potential corona hazard to others, with three kids in three schools). When I go in I meet with the technician, the secretary, PhD/ MSc/ BSc students in the lab - on those days we discuss the research projects in the lab. And that is just so wonderful and energizing that I sometimes forget to eat.

Sitting at home on the other hand can be rather boring. I often meet collaborators/ students/ other staff online - and while it is nice to be able to meet online on these days - it's much more energy draining than meeting in person.

WHAT IS YOUR FAVORITE THING TO DO WHEN YOU'RE NOT WORKING?

The corona situation has unfortunately rather drained my life. Lockdowns were hard without daycare for the little one, and homeschooling for the others, and when there is no lockdown the kids are more at home due to (other) colds. This means that in the recent past, I have mostly worked or taken care of kid(s), and my social life diminished. I however look forward to taking up running and drumming again (I suck at the latter, but I really enjoy it), and meeting and eating and drinking with friends.

And, I love watching dark detectives (this is something one can do from the couch, anytime).

WHAT IS YOUR FAVORITE PART OF YOUR JOB? WHAT DO YOU LIKE THE LEAST ABOUT YOUR JOB?

I love:

- Performing and discussing science with the (PhD) students in the lab, and collaborators.
- Bringing research (ideas/ vision) further, by connecting the science to its societal implications (e.g. in relevant committees).
- When students get their own 'epiphany' during a course. I really think more people should know about Microbial Evolutionary Medicine :).

I dislike:

- Filling in forms,
- When politics in science is actually about narrow-minded big egos
- Running after people when they don't take responsibility

WHAT HAS BEEN THE MOST EXCITING DEVELOPMENT IN YOUR FIELD IN THE LAST 10 YEARS? WHAT DO YOU THINK WILL BE THE MOST EXCITING DEVELOPMENT IN YOUR FIELD IN THE NEXT 30 YEARS?

Oof.. Well, I think that the sequencing revolution has helped us understand better what traits are under selection. We can now see what genes are mutated in our eco-evolutionary experiments - and that is just so cool and insightful, and... very difficult to imagine that that was not possible (at such a scale) some years ago.

Hmmm, next 30 years?

Technology-wise: Plug and play microbes (gene editing is already much faster now than when I did my PhD - but with speed up we can also scale up, and our genotypic probe-space can get huge), immediate sequencing results.

Societal wise: antibiotic resistance is going to be a maaassive problem since we will have more and more difficulties treating infections - we therefore need other solutions for treating infections or prophylaxis.

Fundamental science wise: I am pretty sure we will not be able to solve the mapping from genotype to phenotype to fitness of organisms - thus predicting the full functionality of an organism by genotyping only. Therefore, I think people will still be investigating this in the coming ehm... 100 years ;).

DO YOU HAVE A FAVORITE ANIMAL? A FAVORITE PLANT? WHY?

I hope you don't mind me choosing a microbe.. (see question 1). Enterococcus. It's a genus that's often found in urinary tract infections (and in probiotics!) and people often say it has no function in the urinary ecosystem - it has 'weird' behavior when cultured together with other urinary microbes, which tells me it's not found in the urinary niche 'by accident', but I haven't figured it out yet.

FOR PEOPLE LIKE ME, UNDERGRADUATES INTERESTED IN PURSUING A CAREER IN ACADEMIA, WHAT WOULD YOU TELL THEM NOW?

Follow your heart, soul and passion. Find your own niche.

Don't pursue a career in science because you want to stay in science - pursue a career in science if you very badly want to study a particular topic (obviously, that particular topic can change over the years...).

NASA TWIN STUDY

THE EFFECTS OF A YEAR IN SPACE

By Meiske Pieters

In 2015 NASA conducted an unprecedented study: they send an astronaut named Scott Kelly to the International Space Station (ISS) while his identical twin Mark remained on Earth. What followed was a 340-day biomedical study of their health. NASA was particularly interested in understanding the long-term spaceflight effects on the human body and published their results in Science in 2019. Very convenient, especially now that public and private organizations are planning long-duration missions to Mars to take humans there.

What if we seriously need to evacuate everyone to another planet because we destroyed Earth? We would need to know the effects on health. So, different research groups looked at gene expression, cognition, telomeres, proteomics, microbiome, metabolomics, biochemical, immunome, epigenomics and integrative omics. They collected data of both men, preflight, inflight and postflight, by taking stool, urine, blood, and plasma samples. The subjects also participated in physiological and cognitive tests.

A lot of the biological functions, like the immune response to a flu vaccine, weren't significantly different afterwards. However, there was an interesting effect on the telomeres. These ends of DNA strands, that protect our chromosomes, were elongated in Scott, though they immediately shortened within hours after landing. The mechanism behind telomere lengthening is still unclear but it is associated with healthy lifestyle factors, such as nutrition, physical activity, and weight loss. This correlates with Scott's reduced body weight during his flight.

A common issue that astronauts can have in space is Space-Associated Neuro-ocular Syndrome (SANS). Some of the symptoms are swelling of the optic disc (where the optic nerve enters the retina), flattening of the eye shape and cotton-wool spots. It happens because of prolonged exposure to microgravity, like on long-duration spaceflights. Scott showed symptoms that were consistent with SANS, which likely happens because of the cephalad fluid shift caused by spaceflight. Researchers found that Scott had vascular engorgement of his internal jugular vein, which might contribute to congestion of the blood vessels supplying blood to the retina. Even though Mark went on four short-duration space shuttle missions before, he didn't show signs of SANS.

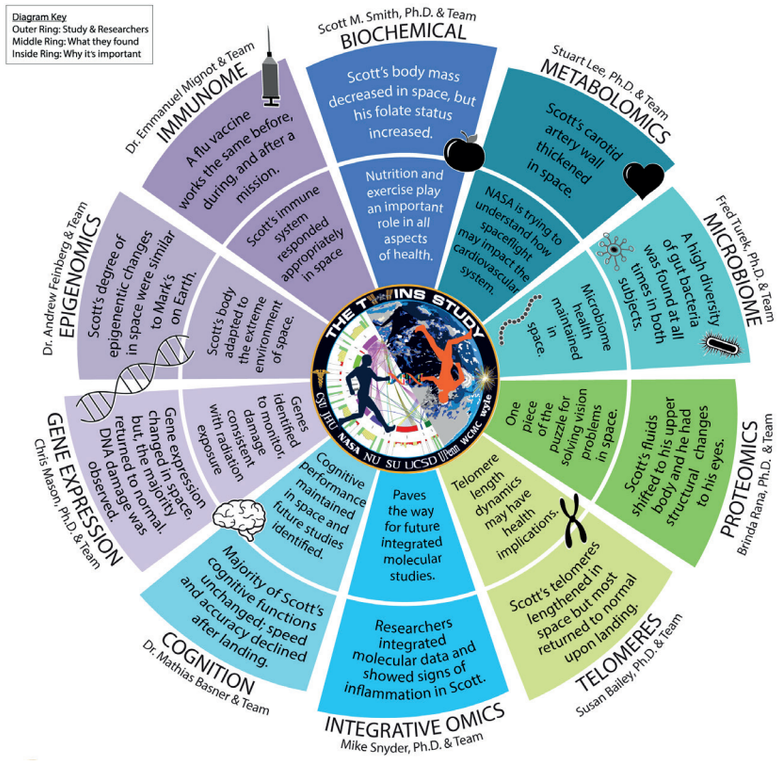
There were many more discoveries as you can see in the infographics. The Twins Study showed the resilience and robustness of adaptation of the human body in space and can guide later biomedical research in space. A promising future for our travels to Mars.

TWINS STUDY BY THE NUMBERS:

- **10** RESEARCH TEAMS
- **1** SET OF TWINS
- **8** STATES
- **10** INVESTIGATIONS: Biochemical, Microbiome, Proteomics, Telomeres, Immunome, Cognition, Gene Expression, Epigenomics, Metabolomics, Integrative Omics
- DAYS IN SPACE **340**
- SPACE WALKS **3**
- **5,440** REVOLUTIONS AROUND EARTH
- **36** COGNITION TESTS
- **-80°C** TEMPERATURE OF BIOLOGICAL SAMPLES DURING TRANSPORT
- **12** HUMANS SCOTT SAW IN ONE YEAR
- **183** COMBINED BLOOD SAMPLES FROM TWINS
- TOTAL BIOLOGICAL SAMPLES **285**
- **7%** REDUCTION IN SCOTT'S BODY MASS
- **10 Billion** MILES OF DNA IN SCOTT KELLY
- **13,690** CUBIC FEET OF LIVING SPACE ON ISS
- **84** RESEARCHERS

TWINS STUDY RESULTS AT A GLANCE:

What They Found and Why it's Important



SHOULD YOU CLEAN UP YOUR ROOM?

By Sibren Wobben

This article is a crossover between the LifeLine and the Francken Vrij from T.F.V. 'Professor Francken', of which one of the editors wrote this piece on the emptiness of atoms.

Most people have probably once been told (or felt) that they need to clean up their room. Presum- ably, your room was full or there was no space to walk. However, today we'll be trying to proof that your room is actually almost empty and that you'll always have lots of space to left.

To tackle this problem we'll have to make some assumptions. Rutherford's model of the atom describes that all particles consist of a nucleus at the center of the atom, with electrons orbiting around it (comparable to planets orbiting the sun). If we assume that atoms only touch each other and have an average radius 'r', what would be the densest way of stacking these 'balls'?

In the centuries following the discovery of the canon, people started to wonder what would be the most efficient way of stacking their canon balls, perhaps to transport as many as possible. It didn't take long to figure out that there exist multiple close-packing structures, one of which is called face-centered cubic ("FCC"). Figure 1 shows the way this structures is made. In 1831 (350 years after the invention of the classical canon) Carl Friedrich Gauss finally proved that these are the densest ways of packing spheres.

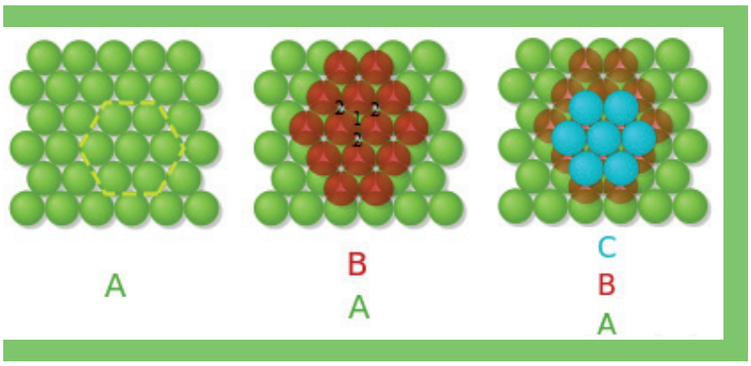


Figure 1: The construction of an FCC structure. Each layer/plane could exists out of hexagonal patterns. The FCC is stacked in an ABCABC arrangement: The second layer (B) is stacked such that they fill some of the gaps in the first layer (A). This pattern could be repeated in an ABAB arrangement if the next atom were to be placed at point 1 (which is also a close-packed structure called HCP). Instead layer C is stacked on top of B such that it is not the same as A.

Every Applied Physics student in Groningen must be able to dream the calculations of the atomic packing factor (the fraction of the volume that is occupied by the atoms) of FCC, using the forumula:

$$APF = \frac{N_{atoms} V_{atom}}{V_{unitcell}}$$

Where N_{atoms} is an amount of atoms, V_{atom} the volume of a single atom ($\frac{4}{3}\pi r^3$), and $V_{unitcell}$ is the volume of a unit cell. Each layer in 1 can theoretically be infinitely big, and there could also be an infinite amount of layers. If repeated, a unit cell is just the smallest group of atoms that can be used to build the entire structure. For an FCC structure the unit cell looks something like this:

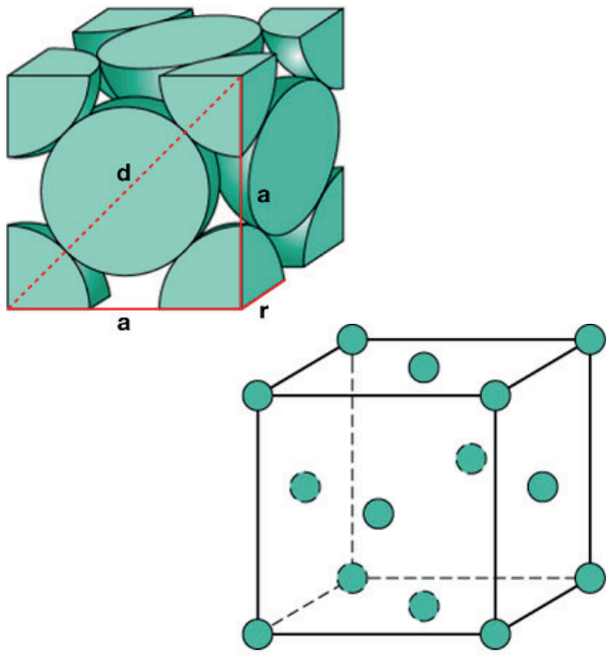


Figure 2: The unit cell of an FCC structure. On the left the atoms as spheres, and on the right a schematic view.

If we look at figure 2 we see that one unit cell contains $8 * \frac{1}{8} + 6 * \frac{1}{2} = 4$ atoms (each corner is one eighth and there is half an atom in the middle of each surface). If we draw a diagonal line (d) through any surface, we can see that d is exactly 4 radii long. Using Pythagoras' theorem it can be calculated that the length of one sides (a) is $2r\sqrt{2}$. Consequently, $V_{unitcell} = (2r\sqrt{2})3$. Then, using everything we've learned so far, we can calculate the packing factor to be:

$$APF = \frac{8 * (\frac{4}{3}\pi r^3)}{(2r\sqrt{2})^3} = \frac{\frac{32}{3}\pi r^3}{16\sqrt{2} * r^3} = \frac{\pi\sqrt{2}}{6} \approx 0,74$$

Thus equal sized balls can only fill 74% of space, making that by definition 26% of your room is empty space. However, atoms aren't spherically filled balls in space; atoms are tiny nuclei surrounded by electrons. If we'd blow an atom up to the size of a football stadium, the nucleus is about the size of a marble, making the atom approximately 100% empty space.

So, if you ever feel like your room is an absolute mess, just remember that (*using some rough assumptions) 26% of your room is empty space by definition, and the other 74% is practically empty.

TIPS TO SURVIVE IN A SMALL SPACE

Dear readers,

Usually we selflessly give our free time and energy trying things so you don't have to. We tried origami shapes, dark chocolate, and apple pies in the last year. We even tried the weirdest de-stress tips we could find on the internet. All so you can optimize your choices next time you want to make origami, de-stress, and buy dark chocolate or apple pie. Such sacrifices we make!

But unfortunately the coronavirus strikes again, muddles our plans, and keeps us inside. Thus, for this edition, we are not reviewing anything, but giving you our tiptop lifeline-approved tips and tops for surviving another lockdown in our student spaces!

with love,

the Lifeline

DRESS YO ASS UP

Even if it's just an online meeting, dress up as if it's a physical one. Then, instead of going to bed after the meeting, you can't waste that good work outfit! You will be more likely to stay productive after the meeting and keep up that momentum. It's all about momentum!

MOVE YO ASS

It can be hard to get out the door, but a simple walk can do wonders for your mental health and productivity. It may seem like you don't have time, but even 10 minutes will give your brain a much needed boost after sitting all day. If you start your day off with this, it can be a trigger for blood flow and muscle activity, just what you need to get engaged in what you need to do.

You can also meet a friend for a walk outside and have some corona-proof socializing time.

MAKE YO BED

Many of us, without external forces dragging us out of our room to class or the gym, will lose our daily routines and rituals that keep our rooms and minds from becoming total chaos. Simple, small ritualistic acts can keep us from devolving into Netflix zombies or sleeping all day.

Making your bed in the morning is one such act. If you perform this small step when you get out of bed in the morning, it can help you stay out of it. By seeing a made bed it can be a simple signal that you're not going to get back into it. It will stay nice for the day until bed-time!

DESIGNATE YO SPACE

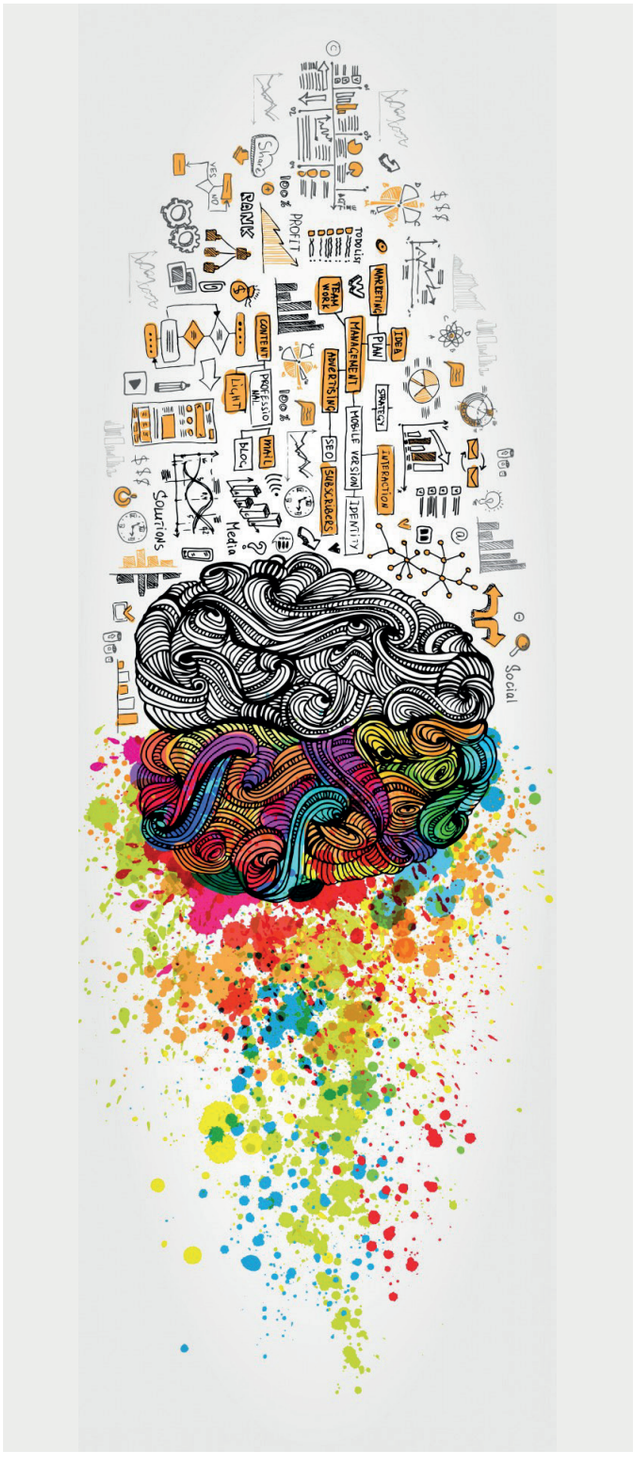
Make separate spaces for different activities. Don't do work in your bed; keep that for sleeping. Make your desk only for working. Make your couch the Netflix zone. We are more likely to do the activity if we are in a space that is associated with that activity. So if you usually do work in your bed, you will be less likely to get to sleep. If you usually watch Netflix at your desk, you will naturally gravitate to that instead of working. Usually we naturally do this by going to the library or office to work, but since that's not possible, we have to work with what we have!

~~REVIEW~~ TIPS

By Lauren Hansen-Manguikian

DO YO MAKEUP

Nothing says boss-ass bitch that gets things done like a snatched face. It makes you feel like you are ready for the day, even if that day you literally won't see anyone. It's all about tricking your mind into thinking 'this will be a productive day!'



GET YO CREATIVITY ON

Art is an underrated activity. It give you something to do with your hands, it engages your mind, it's relaxing and stimulating at the same time, and in the end (usually) you have something to show for it. Something you made. If you're feeling super down, watching shows probably won't help, but art will. Draw, color, sew, fold origami, or even just doodle on your notepad. My personal creative recommendation? Follow along to a Bob Ross painting video! Sing! Dance! Blast your music and jump around like a fool. If you pass by the Van Brakelplein pond on your walk you may be able to see me doing this through my window.

BAS EN Z'N BEESTJES

Beasts by Bas

By Bas van Boekholt

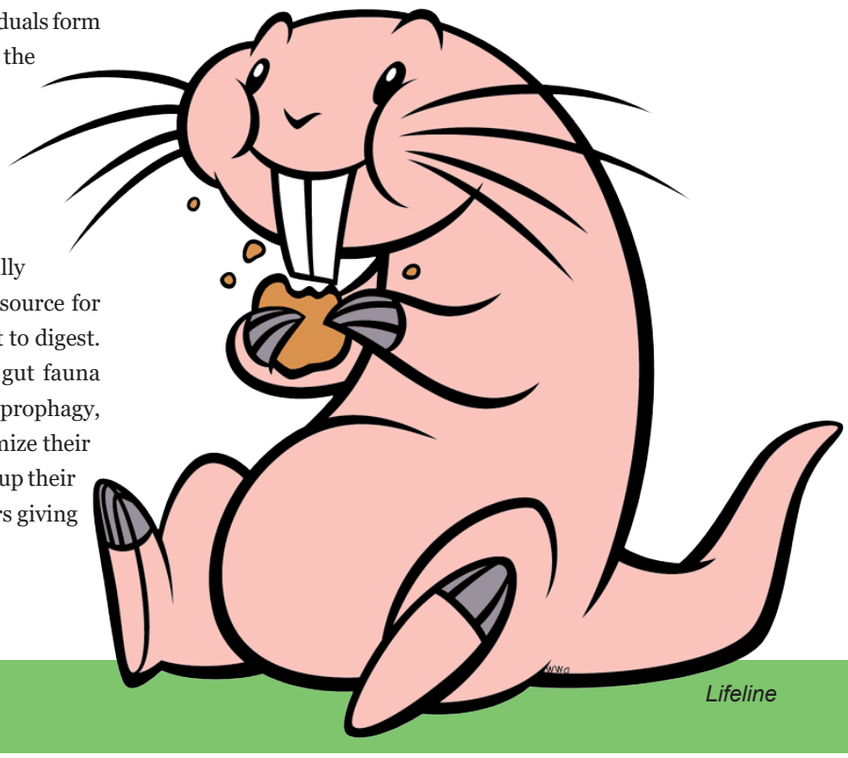
In the very first Bas en zijn Beestjes I wrote about the tardigrade. An amazing animal that can best be described as looking like a crumpled leg warmer. 7,5 years and 29 animals later I somehow ended up at another slightly bigger crumpled leg warmer. The Latin name of this animal literally translates as the smooth one with the weird head. But just like the tardigrade, what this animal lacks in looks it more than makes up for all its other fascinating features. This anniversary edition Bas en zijn Beestje turns back to roots and introduces you to the naked molerat!

First of all, naked molerat (Hetercephalus glaber) is a giant misnomer as this rodent is neither naked nor a mole nor a rat! Naked molerats are closer related to guinea pigs and porcupines and live under the tropical forests of East Africa. Naked molerats are one of only two eusocial mammal species which means that just like wasps and bees they live in colonies where only one queen and a harem of males reproduce and all the other work for them. These colonies can consist of over 300 "workers" and "soldiers" and together they live in one giant branching network of tunnels that are kilometers long. While the workers are physically able to reproduce a pheromone released by the queen inhibits them. If a female is put out of the colony she becomes sexually active within a week. If after 25 to 30 years, the queen dies the strongest females fight each other hunger games-style until only one stands who then becomes the new queen.

For workers, their main job is getting food and digging more tunnels in which they both are very successful. With almost a quarter of their muscles in their jaws, one worker digs about a kilometer per month. This is comparable with a human digging for half a marathon! During the digging process, individuals form a real assembly line: the front animals breaks through the dirt while a string of workers sweeps the soil through the tunnel system to an opening at the surface, where another worker kicks the dirt up onto the ground above its head, forming a molehill. For food, naked mole rats are dependent on roots and tubers. If they encounter a big tuber they will carefully pierce and keep it growing so it can serve as a food source for years. Their diet is high in cellulose, which is difficult to digest. Therefore, naked mole rats have high densities of gut fauna that aid in digestion. They also regularly practice coprophagy, the re-ingestion of feces, which allows them to maximize their uptake of nutrients from their food. For pups to build up their gut fauna they receive feces on demand by the workers giving them nutrition in the process.

By living their whole lives under the ground, the naked molerat underwent some peculiar changes. First, they are not blind but have very small eyes they barely use. Second, they are adapted to living in extreme oxygen arm environments. Because of this adaption, they lack the neurotransmitter for 'substance P' which actually makes them unable to feel pain. Third, they are the only coldblooded mammals, and all huddle and sleep together during the cold long nights. However, one of their coolest features is the fact that they seem resistant to cancer! No wild naked molerat has ever been found with cancer. While first it was thought that there was some intrinsic feature that made their cells immune a recent study showed that it is more likely due to the micro-environment directly around the cells. However, the riddle of their cancer-free life has not been uncovered yet.

I know can become philosophical about how looks don't say shit about what is on the inside or that you are stronger in numbers. But let's take another route this time. Naked molerats are a perfect example of why after 7,5 years I am still writing this blog. If even a, and excuse my language, "penis with long teeth" living their whole lives under the ground can show so many fascinating things; can I then ever truly say that my hall of fame is full? In this wicked world, something extraordinary can be found under any rock. And the further and deeper you go the weirder and interesting they get. I am sure that nature can show me more than enough beestjes for another 7,5 years. So, I'll see you in July 2029 where maybe I find another crumpled leg warmer to enlighten you about. Until it is so far, don't stamp too loud when you are in East Africa. There might be a whole colony of naked molerats digging and living their lives right under your feet.



TINY BOIS

A TINY STORY

By Renate Kloostra

Where I usually talk about big ass animals, aka dinosaurs, one of my most favourite animals is actually tiny as hekk. It is the tardigrade, or the beerdiertje in dutch.

But why do I love these animals so much? And what exactly are they?

Tardigrades are microorganisms that resemble bears. This is why they are also often called water bears. Tardigrades have 8 legs and can be found all over our lovely planet. They have a maximum length of 1000 micrometers, which means they are indeed, very tiny. There are about 1300 species of tardigrades. The name tardigrade means slow walker, and I have no idea why they gave them this name, to be honest.

But why do I love them so much? Basically, tardigrades are the most badass creatures ever. They are not extremophiles but they can endure all kinds of amazingly extreme conditions. To live, they require a thin layer of water around them to thrive. This thin layer basically makes them indestructible. They can live in vacuum, under high pressures and they can survive without food for 30 years. This means they can live in space. And they're the only organisms known to do so. They're basically the best thing ever.

But how do they do this?

They basically do this by changing their metabolic life state. It can enter a certain cryptobiotic state. This is a state in which they almost stop their metabolic processes. They will suspend their metabolic processes to 0.01 percent or less. This means that they reach a state similar to death.

IDUZZLE...

By Juultje

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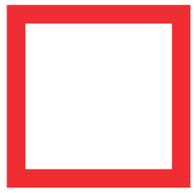

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The previous Iduzzle was won by **Karin Weel** Congratulations! They have won a marvelous prize, which they are very happy with! Would you like to be mentioned here in the next Lifeline? Please submit your answer to the Iduzzle to redactie@idun.nl before March 20th.

Answer to iduzzle 65: The time to relax is when you don't have time for it.