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BIO SCOPE

IN THE FUTURE

ENGLISH EDITION

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Universiteit Utrecht

EDITORIAL



Dear reader,

I often find myself wondering what the future will bring. Because biology is such a broad field, the career possibilities seem endless. But with endless possibilities, the choices of which way to go and which way not to go sometimes also seem endless. Choosing means cutting opportunities out, and that feels scary sometimes.

On the other hand am I curious of where me and my friends will end up. After the first year, we all chose different courses. Some took courses in plants, others in ecology or evolution, and others in cell biology and biotechnology. I think it is fun that everyone will end up in very different places with the same bachelor's degree and the same courses we started with. That's what makes the bachelor special!

Our authors also took a trip into the future. They will answer questions: 'Will we get our vegetables from vertical farming? What do bats have to do with our future? And how will humans look like in the future?' We will take you with us in the time machine in this edition of the Bioscope!

Have fun reading and we would love to hear what you think of this English edition!

Best,
Floor







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YOU'RE FUTURE BENEATH THE GROUND



Stella Belzer- 2nd year biologist

When we talk about the future, we usually think of the world our grandchildren will live in, how nature will reshape itself, or the economy in which humanity will then exist. But there is also a future that unfolds not above ground, but rather beneath it. A future that lies ahead for every organism, large and small. The future of your body, that remains behind.

"I want to look at what happens when you are no longer there, but your body still is"

Although I am talking about death and decay, this essay is not destined to become dark or morbid. I actually want to look at it with a curious eye, with the same curiosity with which you, as a biologist, might gaze at an anthill. With that curiosity, I want to look at what happens when you are no longer there, but your body still is. And especially those, who will be with you at that final moment? Consider it as a celebration of death in this season of Halloween.

When you lie underground, a process of rotting begins, and although the word "rotting" often carries unpleasant associations, it is actually a beautiful collaboration. A decomposing corpse is the cornerstone of a vast and complex ecosystem. It is the very last interaction you will have with the countless organisms you have carried with you all this time as a microbiome. Forensic investigators have divided this process of rotting into five distinct stages, which we will examine step by step. (This field of study is known as forensic taphonomy.)

During the initial period (between 0 and 3 days) that you lie underground, there may be little visible change. However, insects will seize the very first opportunity to lay as many eggs as possible inside of you. In addition, your cells decide that they, too, have had enough and disintegrate through autolysis (autolysis means self-destruction at the cellular level).

A few days (between 2 and 10 days) after you are buried, anaerobic microorganisms also get to work. They have been living in your gut all this time, helping you with digestion. But now that your immune system is no longer standing guard and nutrients are no longer available, they begin breaking through the intestinal wall. Suddenly, they have access to loads of proteins and amino acids. Intriguingly, this feast leads to gas formation including hydrogen sulfide (H2S). This H_2S reacts with hemoglobin in the blood, forming greenish pigments that contribute to the characteristic discoloration of a decomposing body. In addition to your abdomen, the gases fill your blood vessels, causing them to expand. A marbled pattern becomes visible across your entire skin.

Between 5 and 25 days, your body enters a stage that forensic investigators call "active decomposition." At this point, your body is overcome by a strong smell of cadaver. That's hardly surprising, given that the increased gas pressure has torn your skin open. All your fluid tissue begins to escape, and that does not go unnoticed. Maggots swarm towards you to nibble on that soft tissue.

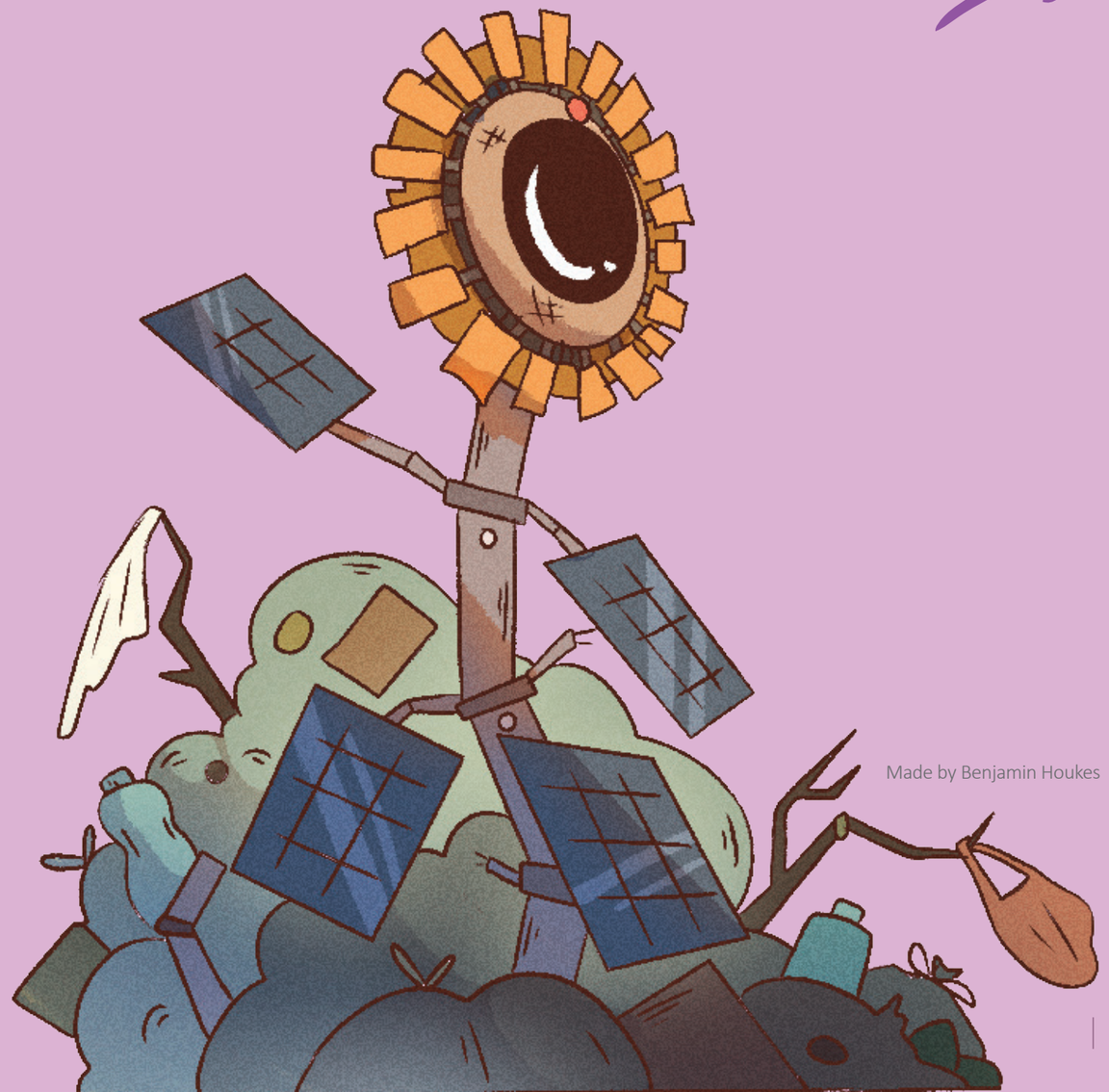
"A decomposing corpse is the cornerstone of a vast and complex ecosystem"

After about 14 to 50 days, your body is in the so-called stage of "advanced decomposition." The soft tissue has completely disappeared. What remains is dried out and has a leathery texture. That is when the beetles are increasingly taking over your body. Trained and well equipped to feed on the tougher, coriaceous material.

And then, after months or even years depending on the soil you are put in, you are finally dry and skeletonized. Only your bones and gristle are still intact, and that will remain the case for a long time to come. Your nails, hair, tendons, and joint tissue will also last for a while, but eventually they, too, will disappear.

Thus ends the life in which you were able to benefit from countless organisms. From gut and soil bacteria to fungi, insects, and even mammals. In the end, they benefited from you one last time.

But before it comes to that, we are still living here above ground. Luckily, we still have plenty of time to gaze at an anthill and enjoy the world. The same world you eventually will hand back.



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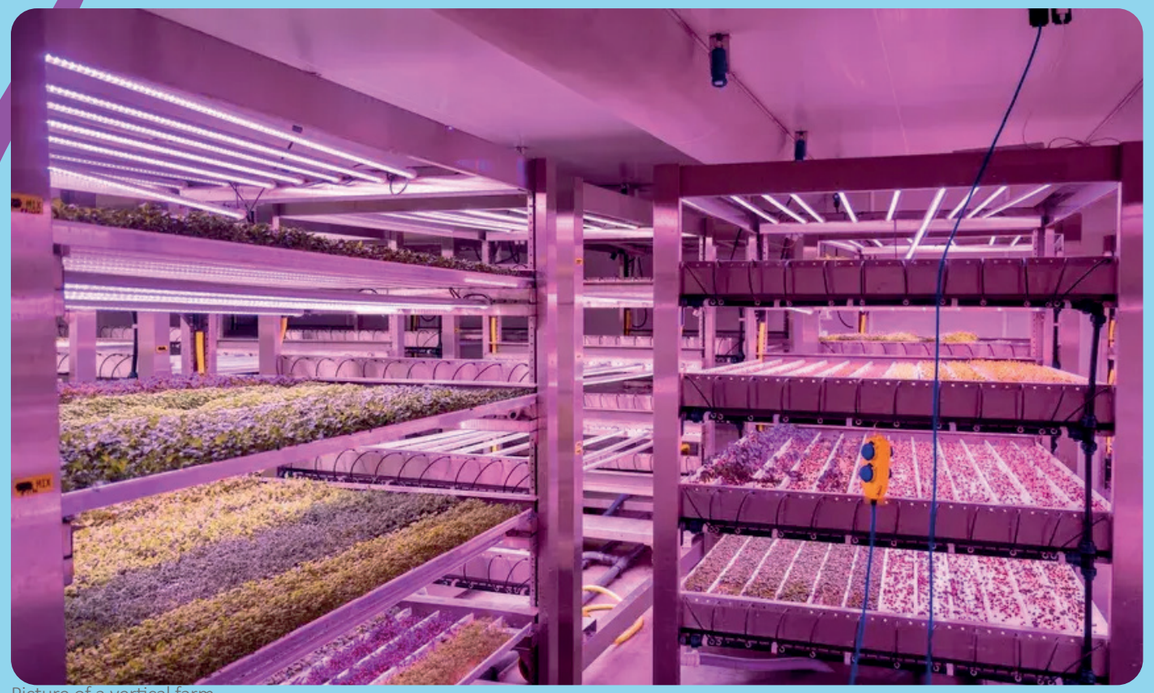


Picture of a vertical farm

VERTICAL FARMING: A REVOLUTION OR RUINATION OF FARMING?



Kimberley Uittenbogaard - 5th year biologist

Think about your favourite vegetable and about where it came from and what the landscape looked like where it was grown. You might be imagining a sunny farm, a rustic barn or endless green fields. But what if the most delicious vegetables weren't grown under the open sky at all, but inside a concrete building?What if they were even healthier, completely untouched by pesticides, offering a consistent harvest? This nontraditional farming system is vertical farming!

Vertical farming could take on a more prominent role in the future, as it comes with a wide range of advantages. For instance, the climate can be precisely controlled to create ideal conditions for the plants, resulting in a consistent harvest in the entire year. Furthermore, we won't need to import as many crops from abroad, because we can adjust the indoor weather to suit almost any plant at any time. Moreover, with the same amount of land, we could get 10 to 20 times as much yield, because floors of vegetables are stacked inside a building. Also, the loss is reduced because pests, diseases and weather-related damage will also become a thing of the past, since the crops grow safely indoors, away from external threats.

"Vertical farming could take on a more prominent role in the future"

Because the climate is controlled, it's possible to gain the best possible consistent yield. To further control the yield, the plants in the building don't even grow on soil. Vertical farms use advanced growing media or hydroponic systems, where roots hang directly in nutrient rich water. This brings a major advantage: plants absorb water and nutrients far more efficiently, accelerating their growth. Also, the light is not regular light, but a precisely determined mix of colours that gives the best advantage to the plants. The colour can even be changed to get the desired effect. If they want the plant to be sturdier, they can turn on the blue light. Want it more stretched? Turn on the far red. And if you want more growth then they should turn on the red light. However, a downside is that managing this artificial condition requires precise technical expertise and monitoring; a single imbalance in the water can quickly affect an entire layer of crops. Luckily, a lot of research is being done to improve the conditions. And it shows! Because the first vertical farming products can already be found in the supermarkets. Therefore, these vertical farming systems sound like a dream scenario. However, as with all good things, it also has a downside. If you grow vegetables outside, the light is freely given by the sun. Unfortunately, inside a building, light must be produced using electricity. Not only do the lights take up a massive amount of energy, but heating, cooling and air ventilation also claim a large portion of the total energy bill. Luckily, it is possible to be more responsible with energy, meaning that the light intensity is adjusted for the size of the plants. When the plants are little, they will receive less light, because they need less light, thereby wasting less energy.

But there are more disadvantages to growing plants indoors, because while weeds and bugs have a hard time entering the building, some pathogens can still be a huge problem for the vertical farming system. And inside the vertical farm the nutrients are recirculating, making it easy for pathogens to spread. Pythium is an oomycete that causes root rot and damping off in the plants and can easily attack many plants due to this recirculating nutrient solution. Furthermore, it is not yet possible to grow all sorts of crops. Tomatoes, for instance, grow too high, making efficient stacking difficult, while root vegetables like carrots and potatoes grow underground, which causes serious technical difficulties for vertical setups.

Unfortunately, solving this issue can also have serious consequences on the geopolitical situation. Currently, we are importing and exporting many different crops that cannot be grown in our country or that other countries cannot grow. But, maybe in a far away future it is possible to grow everything in a vertical farm. Therefore, we would not need to import and maybe cannot export anymore. It has the advantage that we are less dependent on other countries, making all the countries more resistant to major global shocks that disrupt the food chain.

"vertical farming may not solve every agricultural challenge overnight: it will take many years of research and investments to overcome biological, energy and geopolitical issues"

However, this also has a serious downside. Countries that depend on agriculture, because a specific crop grows well in their country, can lose their primary source of income. Meanwhile, another country with massive energy resources or plenty of money to buy them can grow that same crop as well, and perhaps even better. This could be a problem for instance for Asian countries that grow rice but cannot afford a vertical farm or gather enough energy to maintain one. So, vertical farming could potentially increase the inequity between countries. Therefore, vertical farming may not solve every agricultural challenge overnight: it will take many years of research and investments to overcome biological, energy and geopolitical issues. So, you should not be scared that the traditional farms will disappear. Yet, the concept is far more than a futuristic gimmick. It is a glimpse into a world where our food is grown closer to home, using less land and yielding far more than ever before. When handled in the right way, it could be a revolution for agriculture. However, when treated in the wrong way it could cause problems, like vulnerabilities in water balance and energy-intensive climate control, the rapid spread of pathogens through recirculating systems and rising geopolitical inequality that threatens agricultural nations.

Homo futuris

What will humans look like in the future?



Stijn Vinkenburg - 3rd year biologist

During one of the first tutorials in evolutionary biology, the first years get asked the question: "Do humans still evolve?" Obviously, the answer to this question is: Yes! Take a look at human height or our resistance to diseases. But this, of course, brings up the question of what future humans will look like. Does evolution keep playing a big role in our existence, or will we eventually overrule evolution and be completely independent of it? In this article, I will write about three different future perspectives for humanity. It is all highly speculative, so I will gladly hear whether you agree or think it's all crap!

Linear evolution

In the case of linear evolution, we will keep evolving the way we are currently doing. Therefore, people will keep getting taller until, at a certain height, we will have too much weight on our bones and too many cells to potentially turn into cancer cells. At this point, our height will probably stabilize. Dutch people are already close to the maximum human height. The average human will probably not grow a lot taller than 185 cm. Another acquired trait people will evolve into is darker skin. This is because climate change will expose us to more UV radiation, which gives having darker skin a selective advantage.
Because of the high amount of gene-flow, caused by our growing globalization, our society will become more homogenous. We will keep on looking more and more like one another. Our selection pressures will come mostly from cultural aspects, like trends or social pressures instead of dangers for our survival.

Biotechnology

Another pathway for the future of our species is the possibility of technology being incorporated into our bodies. We can already see this happening in prosthetics. Our legs and arms can be replaced with metal limbs, but the future might also provide us with mechanical organs! We are already using pacemakers for our most vital organ, so why stop there?

If we take it a step further, we might be able to eventually replace parts of our brains with tech or even upload our brains to a computer. In this case, we will have ruled our evolution, and the only way of us evolving is by artificial evolution.

Genetic manipulation

The final vision of the future I want to speculate about is the use of genetic manipulation. In this case, we will also be putting evolution to a halt because we can modify our bodies any way we want. This, of course, brings along its own complications, like a gap between people who are and are not wealthy enough to do body modifications, or the loss of genetic diversity, which will be fatal if new diseases would come up. People are already using plastic surgery to make themselves look different from their coded genes, but this might go way further into technology becoming so advanced that we can change our looks in every possible way.

In conclusion, humans are still evolving, but there is a big possibility this won't be the case for long. Technological innovations, like robotic organs or gene editing, might put an end to our evolution and bring us into a new era of human civilization. We just need to ask ourselves what we want our future to look like and how we will fit in there ourselves.



Why Evolution Keeps Inventing Crabs: And What That Might Mean for the Future

Charles Zheng- 4th year biologist

Look closely at the evolutionary history of crustaceans, and you will notice a strange pattern. Creatures that once stretched out like elongated shrimp gradually become shorter and rounder. Their tails fold underneath their bodies, and their shells widen and harden. Before long, they start to look undoubtedly like crabs. This recurring change has a name of its own: carcinization. This carcinization is a clear example of convergent evolution. Different species end up with the same body build because they face similar conditions and challenges.

Carcinization in particular is fascinating because it often happens within one group. For example, true crabs, porcelain crabs and king crabs are not close relatives at all. Yet, they have all grown into a similar body shape. This suggests that the decapod body plan is unusually adaptable. Small genetic changes can reorganize the whole animal: altering limb positions, shrinking the abdomen and reshaping the shell. In other words, evolution seems to find the crab form as a solution quite easily.

The crab body form has some powerful benefits. For example, the soft parts of the body are protected by the sturdy shell. In addition, a compact body helps the animal to turn quickly. These characteristics aid the crab's survival in deep sea slopes, rocky shores and coral rubble. They can hide from predators, move across rough terrain and squeeze into cracks without much trouble.

Carcinization also raises questions about the future. If similar conditions continue, will more crustaceans turn into crab-like animals? And could other animals follow the same path? Many environmental conditions are changing rapidly: oceans are warming up, their natural habitats are breaking apart, and food sources are becoming more unpredictable. In these perturbed conditions, strong and adaptable body plans might be advantageous. The crab shape might be one of those plans: it is sturdy, compact, and works in many locations. Evolution has already chosen it several times, and it might choose it again in the future.

Carcinization is not just a strange pattern from the past. It shows how evolution often returns to body plans that work well. And when we think about life in the future, the crab body plan is a reminder that nature can keep replicating specific builds. Not because it is simple, but because it is efficient. In a world that is constantly changing, that might be more important than ever.

Youtube Thumbnail of Noisestorm- Crab Rave (Official Music Video)



SPECIES SPOTLIGHT: COMEBACK CUTIES



Guus Hageman - 4th year biologist

Predicting the future of species can be a tricky thing. Many biologists concern themselves with the fate of life on earth. Whether that be in the shape of creating models that anticipate the habitat change of a species, carrying out supporting genetic research or by actual hands-on conservation efforts. Unfortunately we don't have a crystal ball that tells us exactly how the future is going to play out, but with all our efforts combined, we have a pretty good shot at conserving and protecting nature. In this Species Spotlight, I will shine a light on three species of birds that have been through hard times, but are now making a hopeful comeback.

Azores bullfinch - *Pyrrhula murina*

As the name implies, the Azores bullfinch is native the Azores islands in the Atlantic Ocean. Since the species split from the Eurasian bullfinch in 1993, this name might not be fully in line with the history of this bird and hopefully neither with the future. It is speculated that the original range of the Azores bullfinch stretched over the entirety of Macaronesia. This species breeds in a habitat that can exclusively be found on these island groups in the Atlantic: laurisilva. Laurisilva, or laurel forests, are an archaic type of subtropical forest, comprised of strong evergreen species that have survived multiple glacial periods and therefore are remnants of families that have gone extinct in mainland Europe. Being tied to such a specific habitat, the Azores bullfinch is quite sensitive to habitat loss and external threats. Historically, the bird was often recorded as a pest, terrorizing fruit orchards in great numbers. However, at the end of the 19th century, numbers began to decline. After the bird was thought to have gone extinct in 1932, it was rediscovered in the 70s, albeit in the form of merely 30-40 breeding pairs. Still, it is the most endangered Passerine in all of Europe. Thankfully, the entire habitat of the species is protected as a Special Preservation Area, and it appears that rebuilding and conserving the ancient laurisilva forests offers the Azores bullfinch the chance to regrow its population size. Luckily this species is now estimated at a total of 500-1700 individuals and it has stepped up to the status of Vulnerable in the IUCN Red List. The stable population occupies about 83 km2 at the moment, on only one island of the Azores, but the numbers are still slowly increasing and it might make its way over to one of the other Macaronesian Islands sometime soon.



Via www.iucnredlist.org

Pink Pigeon - *Nesoenas mayeri*

The pink pigeon is a species of pigeon endemic to Mauritius, the same island the dodo once used to roam. The pink pigeon's exact placement in the tree of life is a topic of discussion at the moment, but it likely stems from an old and distant lineage of pigeon species that can't be placed under any of the existing pigeon genera. Funnily enough, this lineage is relatively closely related to the dodo itself. Surviving on Mauritius as a species is not easy; only 2% of the original forest cover still exists on the island, and on top of that the endemic species are faced with many introduced problems, like predators, competition of invasive species, diseases etc. This impacted the pink pigeon so heavily, that in the 90s, only 10 individuals survived in the wild. Thanks to intense conservation efforts, mostly led by the Durrell Wildlife Conservation Trust, the species has slowly made an incline in numbers. In just 30 years time, the population has grown from 10 birds to about 365 mature individuals. This hopeful development has even led to the species being raised from Critically Endangered to Vulnerable in the IUCN Red List. The pink pigeon has regained habitable territory and is slowly stabilizing in six subpopulations around the island.



observation.org

White-tailed eagle - *Haliaeetus albicilla*

On a more local scale, the white-tailed eagle has made a huge comeback in Western Europe. Historically, this species used to breed all over the European continent, including the British Isles, and as far southwards as Egypt and other parts of North-Africa. However, starting in the 19th century, this top predator was widely extirpated from its natural habitat. Being a large and territorial raptor, these birds hunt for food over large areas of wetlands, feeding on all kinds of wetland prey. As agriculture became systemically more prominent in Europe, it soon became clear that white-tailed eagles were direct competitors to commercial farming. On top of that, the transformation from wetlands to dry agricultural fields strongly threatened the birds livelihood. Habitat loss and hunting caused the bird to go extinct in all of Europe by the 1900s, with only a couple breeding pairs remaining in Northern Fennoscandia. Thankfully, this species is now legally protected so it can no longer be shot. International conservation efforts are re-introducing this species in its original distribution area, and with the attention shifting from systemic agriculture to more environmentally friendly farming, the white-tailed eagle is slowly re-establishing itself all over Western Europe. In the Netherlands, this "flying door" has been stably breeding since 2006, for the first time in over a century and since its comeback, it looks like it's here to stay!



Via www.biesbosch.nu

Batting on a better tomorrow

Antonius Scherf - 4th year biologist

What the Norns are weaving for us, I do not know. We do not know. Whether this unknowing is due to our lack of knowledge or the computational irreducibility of existence, I do not know either. Being clueless for us is often somewhat irritating and with the plethora of uncertainties arising every day, this lack of clarity with regard to the future can feel like a vast, yet narrow, misty, and murky backwoods with tall trees and little oversight. In this foggy forest, where ignorance is torture, we deploy all our trickery and sacrifice to get some answers, some enlightenment — some foothold on which we may stand tall for what is to come. Deep within these woods, on its knolly and mossy forest floor, you see a lass behind her desk wrangling and beating data. A bit farther, you see a lad betting all he has on the newest fad. Walking through the mist even farther you find someone using mystical rituals for a glimpse into the future. All part of a mental carousel of asking for what will happen next and rarely getting an answer that is truly satisfactory. In that same forest stood a man who needed answers and, moreover, needed change. His name is Merlin Tuttle, Merlin the bat conservationist.

"he made a career switch: from bat scientist to bat conservationist"

Mr. Merlin worked for years as a bat scientist, studying and trying to understand bats from all over the world. For Dr. Tuttle it must have been a weary and perhaps more eerie time when there was a schism between the animosity people feel towards bats — and hence mass-killing them — and his wonderful and insightful experience with these bats. Why the disdain was rather clear: scary films, virus-scares, being nocturnal flyers, you name it. He wanted to save bats from unnecessary bad press and cruelty. Hence, he made a career switch: from bat scientist to bat conservationist. His method for conservation is, in its essence, rather simple. Often he won these battles fair and square, weirdly enough by not fighting at all. He tells of stories in America, parts of Africa and American Samoa, and each time the same method is applied.

In Arizona, he would meet people who proudly told him about mass-killing bats in the area by setting their caves on fire. Personally, I would have the urge to give this guy a taste of his own medicine. Yet, Tuttle's approach is vastly different: he listened and asked questions that arose naturally. In this case, the man in question was a farmer who needed to use pesticides extensively and for far from trivial costs. He told this farmer that he could actually save this money by keeping these bats close to him. They hunt and eat so many insects that they outweigh the cost of additional pesticides. All this in a non-lecturing tone, since to Merlin it is always a conversation between two people, after all.

In parts of North-Africa, he brings to the attention that a lot of bat species are active seed dispersers. These places are susceptible to desertification due to mismanagement, but these bats help them out somewhat by spreading new plant life into deserted land areas. Telling and showing what services bats provide for free, as well as dismantling the idea that bats cause ebola, again helps people see that these furry flyers are far from the bad guys.

In American Samoa, he was called upon to protect a bat species that was being hunted into extinction. He had gathered a team and set out to save some bats: on the first day, when the rest are still in bed, he meets up with a few of the hunters and again does not talk down to them, but talks with them. He goes out 'hunting' with them (he refrains from the activity himself), and they manage to catch just a few bats. The hunters tell him of times when they would catch about a hundred of these bats in the same timespan. Dr. Tuttle asks the magical question — again, without vain — "What do you think caused this decline?" They knew it themselves, that they were, and still are, the cause. Merlin continued the conversation, but also asked questions pertaining to their future outlook: "What if there are no more bats for their children to eat?" and questions alike. Although his teammates were far from amused by him going out with the "enemy", the outcome was more positive than they had hoped for. The hunters took it upon themselves to protect and preserve this species. They demanded stringent rules and laws surrounding bat hunting. And more than 25 years later, the species has recovered in, what it seems, a very lasting way.

In all these, and more, cases Dr. Merlin Tuttle was able to conserve bat species and populations, not from a moral high-ground, but by sparking up a conversation, listening carefully, and seeking solutions that would both suit people and bats. Not only that: the people involved came to their own conclusions through the conversations, would support the forthcoming solutions wholly, and would sometimes set in motion legislation for bat protections and conservation laws themselves. In his words: "We should not be dwelling in the past. It is the future that counts. We have all made insane mistakes in the past, and we would not want to be hated for the rest of our lives for what we did wrong before we knew what was right."

So many more tales could be told and even more fascinating stories about bats abound when going through his works and interviews. He even remarked that bats eat plenty of mosquitoes, even species which carry the West-Nile virus. Perhaps we, too, should be more welcoming towards the bats in the Netherlands. Sadly, we see hatred towards bats here as well and population declines are noticeable, from serotines to long-eared bats.

"He has a nick for taking stunning photographs of bats and he had more stories to tell about the bat world"

If you want to learn more about Dr. Merlin Tuttle or bats, I would encourage you to take a look at his work. He has a nick for taking stunning photographs of bats and he had more stories to tell about the bat world. If you are an aspiring nature conservationist, I would also look more closely into his ways of working. Conservation through conversation seems to me to be a more fruitful and lasting way of saving species, since laws and nations fall, but love and hate can last for a thousand years.



Merlin Tuttle calling a hairy big-eared bat (Micronycteris hirsuta) to his hand for mealworms in Panama. Courtesy MerlinTuttle.org

Evolution-First Worldbuilding in Adrian Tchaikovsky's 'Children of Time'

Denna Broeks - 1st year biologist

Spoiler warning! This article contains spoilers about Children of Time, but not any of its sequels.

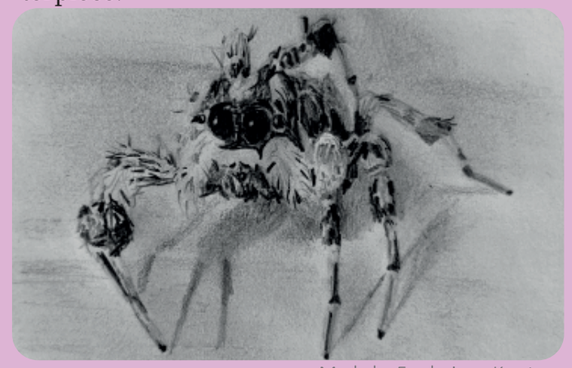
Worldbuilding. The joy of fantasy and science-fiction storytelling. There are many examples of great worldbuilding. Think Tolkien's Middle Earth, Ursula Le Guin's Earthsea or Brandon Sanderson's Roshar. All of these worlds are vast and interesting in their own ways. All of these writers approach their worldbuilding projects from different directions. Tolkien famously built his world around the constructed languages he'd made, and Sanderson built Roshar around a unique weather pattern. The thing that makes Children of Time so interesting is that the premise of the book stems from an evolutionary thought experiment: what if instead of humans, a species of spider evolved to be the dominant intelligent species on a planet? To make sure everyone is on the same page regarding our eight-legged friends, I will treat you to some context. The story of Children of Time takes place a couple thousand years after the fall of a galactic empire. The dregs of humanity are left with a ruined Earth, littered with the trash of a fallen civilization. As the Earth becomes less and less habitable, what's left of the human species leaves their home planet to search for a new home among the stars. The only hope they have, are the old star maps of the fallen empire that note some ancient terraforming projects that may or may not have succeeded.

One of these projects was run by one Doctor Avrana Kern. Her dream was to populate a new planet with a new species of intelligent primate. She planned to realize that dream by placing some amount of monkeys on her planet alongside a nano-virus that would accelerate their evolution towards human-like intelligence. Something, however, went wrong with her plan. Due to the untimely action of a terrorist group called Non Ultra Natura, the monkeys never arrived on the planet. When the virus did, and it couldn't find the monkeys it was designed to infect, it went looking for a different host. Eventually finding a species of jumping spider called *Portia labiata* to be best suited to receive its ministrations.

With the virus working to propel the spiders down the road of evolution as fast as possible, Portia is becoming smarter with every generation. Not only that, the virus is also introducing a concept that is historically foreign to the species: community. Portia is normally a solitary creature. One spider hunting alone. Hunting other spiders. Sometimes hunting others of the same species if the opportunity presents itself. With the virus helping however, Portia starts hunting in groups. Then forming small settlements. Then individual settlements are communicating. Slowly but surely, these isolationist spiders are forming a society.

Portia is thriving. She experiences setbacks, as all species must, but the general trend is positive. While there is war and plague, there is also science and culture. The spiders build cities out of silk. They domesticate ant colonies to function as biological computers. They uncover the virus within themselves and use it to modify their genetic code at will. They discover religion, and then meet their God.

The worldbuilding in Children of Time is beautiful and endlessly intriguing. Though maybe a tad horrifying if you're not a fan of spiders. It demonstrates a perfect balance of anthropomorphism. The spiders are human enough that we can relate to them, yet spider enough that they still feel alien. To anyone even remotely interested in speculative science fiction, I highly recommend picking up this book. It is a masterpiece.



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The Driehoek: A Sneak-Peek into the Future

Hannah Dijkstra - 3rd year biologist

It is the beginning of autumn in the year 2050, and you enter the *Driehoek* through the gate, over the charming wooden bridge that a few students made a few years back. The front field is filled with herbs native to the area. No nettles, no brambles, no reeds. The mowing of the field year after year shows its results. You remember the sweet smell of the flowering herbs in spring. You look to your left and right and see that the leaves of the familiar trees are starting to turn yellow. A few of the yellow leaves already litter the ground. The hedges made up of brambles and trees that frame the frond field shield the *Driehoek* from the noise of the area, but at the same time lets enough light in for the herbs in the field to flourish. To the right is the ash coppice bank ("*essenhakhoutwal*"), a historical feature of the *Driehoek*. Apparently ash coppice banks were of great importance to farmers back in the day, and they still are of great ecological importance. Utrecht is known for its ash coppice banks, and you are happy the *Driehoek* features such an important piece of nature. You walk on, through the bushes and towards the pond. You are greeted by the sound of birds, and you hear something slither away into the bushes. It was probably a salamander or grass snake enjoying the last warm sunshine of the year. The pond looks great. The water is clear, and you hear a frog croak. They will soon disappear in the mud. A kingfisher sits on the mostly rotten tree that fell more than twenty-five years ago. "For how many generations would kingfishers have been nesting here?" you wonder. You vaguely remember that the first time a kingfisher was spotted here was about twenty-five years ago. You sit down at the water's edge and enjoy the sunshine for a bit. You are early, and the others will be arriving a little later. You close your eyes and listen to all the sounds of nature around you. How lucky that such a nice spot of nature exists so close to the university.

You get up and follow the path towards the back field. The path is cleared of brambles, reeds and other plants; you did that last month with the help of your peers. You reach the bridge over the ditch. That, too, was renovated a few years back. The back field looks beautiful, although a lot still has to be done. You are excited for the work that has to be done and even more excited to see the results. Just as you decide to head back to the front field, you hear the others arrive, already making jokes and laughing. It is going to be a good day today...

I am Hannah, one of the new recruits of the *Driehoek* committee. I recently attended my first workday at the *Driehoek*. I helped clear some dredge out of the pond and spent the rest of the day fighting and pruning brambles. I really enjoyed the physical work; it is a very nice change from all the mind and desk work I have to do for my studies. I invite everyone who enjoys nature and isn't afraid to get their hands a little dirty (don't worry, there are gloves) to come to the next workday! I am really excited for my future at the *Driehoek*, and even though I only just started in the commission and I have only been present at one workday, I can see and imagine what the *Driehoek* is and can be in the future. The picture I sketched above is my hope for the Driehoek's future. I will not be a student anymore in 2050, but I hope that the future biology students at UU will be taking care of and enjoying the *Driehoek* for many years to come. And who knows, maybe I will pay the *Driehoek* a visit in the autumn of 2050 to see if I wrote a bunch of nonsense or not!

Driehoek
UBV

A NEW CROP

Koen Sekeris - 3rd year biologist



It was an unusual Wednesday. I had a lecture from an ecologist and was enjoying some coffee - so far, nothing out of the ordinary. However, the audience was composed of only one student: me. The rest consisted of farmers, researchers and journalists.

All of us were there out of interest in alternative farming methods. Maarten Schrama presented us one of the promising projects his team is carrying out at Polderlab: the cultivation of rice. Polderlab, located in Oud Ade, South Holland, explores new ways of agriculture, aiming to replace the less sustainable practices, like cattle husbandry, that are currently ubiquitous in the Dutch landscape. Ten minutes earlier, I was surrounded by meadows with beautiful grazing cows while biking through a morning fog that was lit up by the autumnal sun. Idyllic, but apparently problematic. Why is that? And how could rice offer a solution? Let's dive in.

"I was surrounded by meadows with beautiful grazing cows while biking through a morning fog that was lit up by the autumnal sun. Idyllic, but apparently problematic"

The Netherlands is, as the name implies, a low-lying country, with large parts sitting below sea level. Here, natural dunes, man-built dykes and historical 'poldering', which is the artificial removal of fresh water from landscapes, have kept many feet dry up until now. In fact, poldering serves our food production as well: lowering the groundwater level extends the season that cattle can graze and promotes root growth of grass and many crops. Perfect for optimizing agricultural land. This heavy environmental manipulation, however, must of course come at a cost. Not only does draining the land destroy native marsh ecosystems, along with the associated birds, but it also causes land subsidence and CO2-release. This happens because soil in the western parts of the Netherlands often consists of an accumulated peat layer topped with a nutrient-rich sealing layer. Whenever the groundwater level drops below this sealing layer, the peat starts to oxidize and decompose, causing the mentioned subsidence and emissions. This endangers the lives of many in the long-term: locally, as it reinforces the relative sea level rise near residential areas and weakens the foundation of buildings, and globally, as it stimulates climate change. These are important reasons why we should try to curtail the current form of intensified cattle raising and why we should invest in finding alternative land uses. Other reasons might include animal health and welfare and nitrogen deposition, but I don't have the time to go into that.

The question that arose here at Polderlab is whether rice could be part of these solutions, since the main advantage of rice is that it is not really affected by inundation like many other plants are, which could therefore be implemented to restore the state of the underlying peat. Inspired by Julian Helfenstein, who has done the same in Switzerland, they started experimenting with japonica rice, Oryza sativa subsp. japonica, planted in the trenches in between the pastures. This approach proved to be unscalable, so they switched to devoting full patches of land to rice production while experimenting with species of varying grain sizes. The germination and primary growth happens in greenhouses, as the climate does not allow for this outside. In May they plant, and in October is the harvest. This autumn, the first mechanical harvest happened, and the audience, including me, had the honor of watching along after the presentation. The machinery was apparently quite easy to acquire, as rice is the most consumed staple crop in the world. This might also be an obstacle: how to compete economically with established global rice production? Fortunately, it seems that this issue may be manageable, as already quite a few restaurants have expressed interest in their rice supply. The rice is locally sourced and, of course, has a nice story attached to it, but there could be a qualitative difference that attracts the chefs as well: rice can be polished, which makes it more durable, neutral tasting and easier to cook, at the expense of the nutritional value. Many cooks prefer the taste of brown rice, which is the unpolished version, but when imported from Asia, part of its flavor is lost. This would not be the case for Dutch rice. It is surely promising that after the harvest, even the researchers themselves were surprised by the rich flavor of the homegrown rice grains. Although this could actually be a gap in the market, the team at Polderlab remains cautious about calling this a crop of the future, as many aspects of upscaled production still need to be evaluated.

"Rice cultivation seemed to be correlated with decreased greenhouse gas emissions, implying reduced peat degradation"

Currently, the scientists are concentrating on discovering whether the rice plants in fact do help against land subsidence and how it affects greenhouse gas emissions and biodiversity. The results are not yet published, but he showed them to us nevertheless with that side note, so please interpret the following as mere speculation. Rice cultivation seemed to be correlated with decreased greenhouse gas emissions, implying reduced peat degradation. Even though methane production and release is a big problem for rice paddies in lower-latitude countries, this appears not to be the case in the Netherlands. Schrama suggested that this might be explained by our colder climate. As far as water life is concerned, only positive surprises have been found. Significantly different animal communities have been found in the rice fields in comparison with the surrounding ditches. For example, specific types of alderflies (*Sialidae*), and freshwater mussels (*Unionidae*) and predacious diving beetles (*Dytiscidae*) were present. Waterfowl like ducks and swans unfortunately need to be repelled with sound, since they are detrimental to plant growth. The biodiversity in the field, however, still attracts waders such as the oystercatcher and the godwit (in Dutch: grutto), a protected bird species in the Netherlands.

Although it seems to come totally out of the blue, the shift of rice production to northern countries follows a recent trend. Sadly, Mediterranean countries are experiencing more frequent droughts due to climate change. This constrains, much like with grapes, the yield of the rice crops on their lands. Perhaps the Netherlands, as the climate here seems to be getting more suitable, could replace a part of this lost production. It would also alleviate the pesticide pressure on our ecosystems, as inundation acts as a natural herbicide. To make these fields more profitable, they are even researching at Polderlab whether this type of agriculture could be blended with aquaculture by growing African catfish in the same waters.

It would be a dramatic transformation: replacing our cows with flooded paddies, unfamiliar harvesting machines, and unexpected wildlife. They seem like fun fantasies for now, but who knows, one might cycle through just that in the future.



A FUNGI FUTURE

Benjamin de Vries - 1st year biologist



Little twinkling stars, green in nature, seemed to dance around me as I walked through the rainforest. In theory, I knew they existed, but it's something else to experience for yourself. Somehow it was easier to believe they were alive because of their extraordinary light. Apparently it's a way to excrete excess oxygen, yet it's hard to believe it isn't some kind of magic. It feels like it anyway.

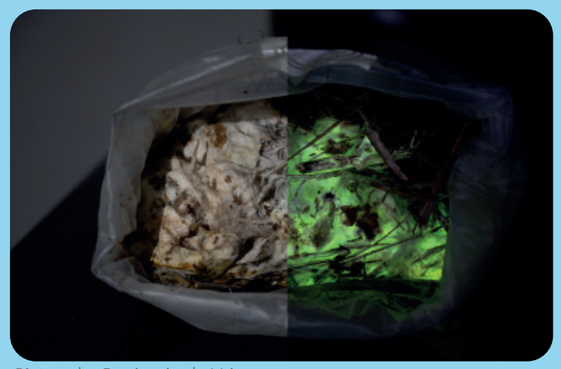


Picture by Benjamin de Vries

It was there, in the Atlantic rainforest of Brazil, in Sao Paulo state, that I came to truly appreciate the Fungi Kingdom. Not only are they some of the most important creatures in nearly every ecosystem across the planet, they also have some of the most extraordinary abilities you'll ever see in nature; bioluminescence for one.
I wasn't alone here in the rainforest. I was with Guilherme Aranha, or Spider as he's sometimes called (Aranha means Spider in Portuguese), a master student at the University of São Paulo specialising in fungi and their applications to society. He showed me around the lab where he does his research at the Betary reserve of IP-Bio, a Brazilian NGO. Stacks and stacks of sacks and blocks filled with mycelium covered palm leaves had taken over the room. Mycelium is the metabolising structure of fungi. Not only does it break down material, it's also very sticky. It holds the hard, ground-up palm leaves together into tight blocks, creating a sustainable building material. By adjusting the formula of fungi species and the palm-to-mycelium ratio, Spider can influence the material's properties and thus use them for many different applications. Some versions are very fire resistant, others are great at absorbing sound, and others still are great insulators.
In theory, you could build a fire-resistant, completely soundproofed and insulated, glow-in-the-dark house from just this material.

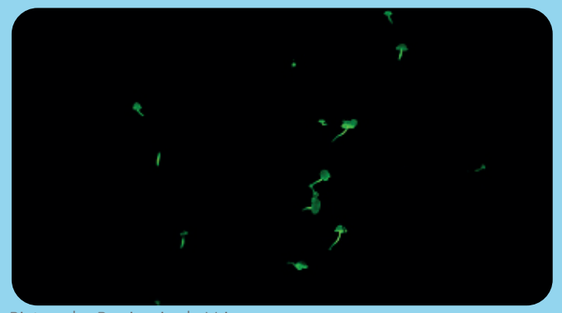
"Why only eat a handful if about 25 percent of all mushrooms are not only edible, but nutritional superfoods?"

I was sitting at a barbecue with a couple of people, including Guilherme himself. While most were throwing meat on the grill (or a palm endemic to the region), Spider was grilling his home-grown (or rather lab-grown) mushrooms. He was telling me about some other ways fungi can help us in the future. Only a handful of



Picture by Benjamin de Vries

mushrooms are eaten around the world, and nearly all of those species are from Europe. Not because we have the best mushrooms, but because those are the only ones we've ever tried to cultivate. Guilherme is cultivating mushrooms endemic to the Atlantic rainforest and trying to find many more edible species. Why only eat a handful if about 25 percent of all mushrooms



Picture by Benjamin de Vries

are not only edible, but nutritional superfoods? From what I've seen, I'm convinced the only way to truly make a sustainable society, both for humans and other species, is to invest in fungi. Learn more about them and find more ways to apply them. But (and this is a big 'but'!), none of this will matter, it won't have any impact, if we don't actually use it in our society. Many of these applications don't lie in the future. They aren't only theory. We can do these things for a while now; we just have to use them. We have to support companies that introduce these fungal innovations into society and everyday life, and convince the powerful companies of today to apply them as well.
The only truly sustainable future is a fungal one.

"The only truly sustainable future is a fungal one"

I often think back to those twinkling green stars, shining low from the ground or from the side of a tree. When I close my eyes, I can still see them. Little dots in a black abyss. At midnight in the rainforest, they served as lights to follow. Finding your way. Let them illuminate our way now too, to the future.



Made by Frederique Kerstens

Cancer stem cells may increase the risk of cancer development later in life



Lotte Diepstraten - 4th year biologist

Carcinogenesis is the process by which healthy cells turn into cancer cells. It is a multi-step process that involves genetic, epigenetic, and cellular changes in the cells. The first step of carcinogenesis is initiation, in which a carcinogen causes permanent DNA damage to a healthy cell. In turn, this initiated cell multiplies, a process also called clonal expansion. This clonal expansion is often driven by repeated exposure to promoters, like certain chemicals or chronic inflammation. The last step is progression, in which the accumulated genetic and epigenetic changes transform the growing cells into a tumor. When this tumor is malignant, it can invade nearby tissues, also known as metastasis.
Stem cells are unspecialized cells that can self-renew and differentiate into specialized cells, like blood, muscle, and brain cells. There are different types of stem cells, such as embryonic, adult, and induced pluripotent stem cells. Embryonic stem cells (ESCs) are found in early-stage embryos. They are pluripotent, which means that they can turn into almost any cell type in the body. The adult stem cells (ASCs) are found in some adult tissues like bone marrow and fat. Here, they repair specific tissues, like blood-forming cells in the bone marrow. Induced pluripotent stem cells (iPSCs) are lab-made stem cells that are created by genetically reprogramming adult cells, such as skin or blood cells, into embryonic stem cells.

Another type of stem cells are cancer stem cells (CSCs), which enhance the risk of developing cancer. One of the reasons why they contribute to cancer development is their ability to self-renew. CSCs can divide repeatedly while maintaining their stem-cell properties, allowing them to sustain tumor growth over time. In addition, CSCs can generate new cancer cells and may initiate tumor formation. Their self-renewal ability helps maintain the tumor cell population. They also activate mechanisms that help them survive conditions in which damaged cells are normally eliminated. In summary, CSCs can renew themselves, produce different types of cancer cells, and potentially establish new tumors in other parts of the body.

"Cancer stem cells can renew themselves, produce different types of cancer cells, and potentially establish new tumors in other parts of the body"

Cancer stem cells can arise from different cell types. For example, they can develop from mutated stem cells that lost their growth control and changed into tumor-initiating cells. But CSCs do not necessarily arise from other stem cells. Dedifferentiation of differentiated cells can also contribute to the development of CSCs. Furthermore, signals from surrounding cells, inflammation and changes in the tumor environment can stimulate the development of CSCs.

It is important to know that stem cells are essential in life, because they develop into different cell types that make up our body. In addition, they replace the cells of damaged tissues. Their self-renewal is strictly controlled, creating a balanced ratio of new stem cells and differentiation progenitor cells. However, in cancer stem cells, this regulatory control is inhibited, which allows the mutant cells to continuously expand, creating a population of tumor-initiating cells. Additionally, CSCs may carry mutations and epigenetic changes that promote survival, proliferation, and resistance to cell death. Some CSCs even have enhanced DNA repair and drug resistance. So, even though cancer stem cells exploit the same self-renewal and differentiation programs as normal stem cells, CSCs have characteristics that allow them to increase the risk of cancer later in life.

Student board member update



Cheyenne Ruska - 5th year biologist

Hi biologists,

We're already approaching the end of the first period of the academic year. Hopefully, you've enjoyed it just as much as I have! Depending on when this Bioscope reaches you, the student council meeting may be coming up, or it may have already taken place. Have you also started collecting the lovely stickers from the OAC-B members? You could even win a €50 gift voucher ;).

A student council meeting is the ultimate way to make your voice heard! I'd love to invite you to join us. I put a lot of effort into the poster last time, so if you weren't there, perhaps I can convince you to come next time with an even better poster?

The main topics of this student council meeting are the rest and space weeks and the new scheduling system starting next year. From next year onwards, Periods 1 through 3 will be changed to 9 weeks. Period 4 will remain 10 weeks because there are quite a few public holidays during this period. Some courses will also be moved to a different period next year. So, it's a good idea to take a look at your study planning in time and, if necessary, discuss it with your study advisor.

If you have any questions, feel free to approach me or send me an email at *studentenbestuur.bio@uu.nl*.
Have lots of fun starting your next period!

Best,
Cheyenne



Made by Tessa van der Leek



COLUMN OF THE BOARD

Dear reader from the future,

It might sound funny to think about, but to me, you are from the future! As I write this little piece for the wonderful BioScope, the weather outside is still sunny, the leaves on the trees are still green, and the sun doesn't set until 19:00. Funny how quickly things can change!
Now, imagine how much can change in a hundred years! The UBV has a rich 102-year history, during which many things have changed. When it was founded in 1924, the UBV consisted of only around 60 students. Today, we have more than 1,500 members! I wonder whether the UBV members back then could ever have imagined what our association would become: with multiple activities each week, many exotic animals living in our association room and over 30 active committees! I'm incredibly proud that I'm going to be part of this long history of the UBV, and that I get to share it with my amazing board! :) And while I don't think I'll be around to see it myself, I can't help but wonder what the UBV will look like another hundred years from now!

Kind regards from the past,
Judith Spierenburg
Penningmeester 2026-2027

Fun fact:
Judith used to have a really cute bearded dragon called Jackie!

AN OMNIBUS FULL... OF HUMAN RIGHTS WORRIES



Emiel Knoop - 3rd year biologist

Legislation is our past, our present, and our future. But it is also complex. The European Commission proposes to simplify existing legislation by presenting ten omnibus proposals, the last of which is the Food and Feed Safety Omnibus. This Omnibus also concerns pesticides. Since the matter is complex, I hope that you, reader, already have a background in the harmful nature of pesticides. As of this moment, pesticide producers need to demonstrate that their product harms neither human, animal, nor environment. Even when it reduces profit. This is a very important safety net for social and environmental health, held high by the EU for a long time. This new Omnibus is directed to bring forward cheap, fast, and competitive legislation. The latter since markets like those of the US and China are less tightly regulated, which may result in their advance in global market domination. As a precaution, the EU is apparently ready to undermine fundamental human rights of peasants.

Hence, several independent human rights experts were mandated by the United Nations Human Rights Council (sounds serious huh) to convey their concerns about the Omnibus in a letter. Allow me to summarise their main findings.
First of all, for most active substances in pesticides a periodic re-evaluation would be abolished. Thereby disregarding novel scientific evidence of previously unreported risks like neurotoxicity, carcinogenity, and ecological impacts. If the Omnibus is accepted, synthetic substances like glyphosate would enjoy an automatic unlimited approval.
Secondly, grace periods would be extended for the sale and use of pesticides. Currently, grace periods may not apply for pesticide products that are withdrawn in benefit of safety. The Omnibus would allow a grace period of three years, even for a proven hazardous product when there are no reasonable alternatives.
Thirdly, there are instances where short-lived exceptions may be made on existent laws, so-called "derogations". As of now, that's done when there's a serious threat to plant health. However, the Omnibus would add "plant production" as an argument. Which would mean that it'd become easier for harmful pesticides to stay on the market solely for farmland use, even when they do not meet safety standards.
Also, as an important sidenote, the Omnibus would not allow Member States to base decisions on recent scientific advances. They would have to base their decisions on the last EU-assessment. Then even if there is new evidence of health and environment risks, decisions may not be made based on that.

This weakening of the pesticide assessment process, and subsequently the process of acting upon that assessment, poses a big threat for human and environmental health. In the future, we might deal with more neurological, developmental, respiratory, heart, and/or cancer disease, next to polluted water sources, degraded ecosystems and agricultural land. This is not my ideal future. Retrogression of human rights is not something I'd have expected from the EU. Yet here we are. Sadly I do not have to offer any readily available means for you to act against this Omnibus. The one thing you can do is be aware of how important legislation and its changes can be. As I said: although legislation is complex, it is our future.

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Food review



Liv Lochtenberg - 3rd year biologist

Sending in a stool sample for personalized nutritional advice? That could very well be the future! No standard Schijf-van-Vijf guidelines for everyone or a general advice to eat more fibre, but a personalized menu tailored to your gut microbiome.

Your stool is full of bacteria. These bacteria play a crucial role in breaking down and transforming nutrients. In doing so, they can also produce substances such as short-chain fatty acids. These substances influence the gut lining and various processes in the body.

However, not everyone has the same gut microbiome. Research by Zeevi et al. (2015) showed that the participants, who were given the same meal, all had different blood glucose levels. Depending on which bacterial species are present in your gut, different substances are produced. As a result, the same diet can have different effects on different people. An analysis of which gut bacteria are present in your body could help with this. You could then receive recommendations suited for your own body.

It will probably be quite some time before this can actually be implemented, because there is still a lot we do not know. There are an enormous number of bacteria in the gut microbiome, and the effects of all the different species haven't been mapped out yet. It becomes even more difficult when you want to look at the effects of combinations of all these bacteria. In addition, the presence of a particular bacterium does not automatically mean that it leads to better health.

There are certainly still some challenges to overcome, but it may well be that, in the future, the post will increasingly consist of little bags containing stool samples.

Discovering bangers with Muziekcie

Sarniezz - Angine de Poitrine

Micha Müller

The track that immediately comes to mind when thinking about music in the future is Sarniezz by Angine de Poitrine. Earlier this year, the Canadian microtonal math-rock duo went viral for their performance of their VOL. I album at KEXP, with many people calling their microtonal sound a glimpse into what the future of music might hold. And their music is not the only thing unique about them. While on stage, the anonymous duo, going under the pseudonyms Klek and Khn de Poitrine, LARP as space-time travelling disciples of planet Earth's rock deities, complete with polka dot outfits and impressive head accessories.



Shortly after their KEXP performance, Angine de Poitrine released their VOL.II album, which Sarniezz is a part of. Sarniezz features a tempo and measure change, and the unique style that is a staple of the duo. While Klek is playing tight high-pace beats on his drums, Khn plays various melodies on his double-necked microtonal guitar+bass combo, which he then loops and mixes with his bare feet, using his toes to turn the knobs of his mixing apparatus.

To wrap it up, I highly recommend checking out Sarniezz, as well as Angine de Poitrine's other tracks from both their VOL. I and II album, since I find every single one to be an absolute banger!

Recipe of the month

Squash and sweet potato soup: perfect fall recipe

Ingredients:
1 butternut squash
1 medium sized sweet potato
3 tbsp olive oil
1 red onion
2 cloves of garlic
2 tsp smoked paprika
2 tsp curry powder
1 tsp cumin powder
Harissa (start with half a tablespoon; if you like it spicy, make it a generously full tablespoon)
850 ml vegetable stock (1,5 cubes)
250 ml coconut milk
Pumpkin seeds
Black pepper
Salt

Materials:
Hand blender
Sauce pan

Preheat the oven at 220 degrees Celsius. Peel the squash and remove the seeds before cutting it in little cubes. Peel and cut the sweet potato the same way you cut the squash. Put the squash and sweet potato on an oven tray and season with olive oil, salt and pepper. Cook these for about 20-25 minutes until soft and slightly caramelized.
After 20 minutes, put some olive oil in a sauce pan on medium heat and cook the onion and garlic. When the onion is soft, add the harissa along with the curry, paprika and cumin. If you like it spicy, feel free to add more harissa! Cook for a few minutes and then add in the sweet potato and squash. Add the water with the stock cubes, bring it to a boil and let it simmer for 10 minutes.
Remove the pan from the heat and blend the soup with a hand blender until smooth or until the soup has the desired smoothness. Add in the coconut milk and mixy mixy. Add salt and/or pepper to taste if needed. To finish off, add pumpkin seeds for a nice bite and beautiful garnish!

Creative with biology

Futuristic froggo

Stijn Vinkenburg - 3rd year biologist





Noa Snooij -
"This buzzard looked me straight in the eye when I was in Madagascar actively looking for bamboo lemurs. The buzzard's presence indicated that there were indeed lemurs nearby, which fled through the trees as quickly as possible to escape this bird of prey."

AGENDA NOVEMBER

Zo 8	Driehoek werkdag
Vr 13	Micropia
Wo 18	Mokken schilderen
	Studentenberaad
Do 19	Borrel
	UBV-feest
Zo 22	Driehoek werkdag
Vr 27	Ontwerp-je-eigen-vaandelactiviteit
Ma 23 - Vr 4 dec	UBV welzijnsweken