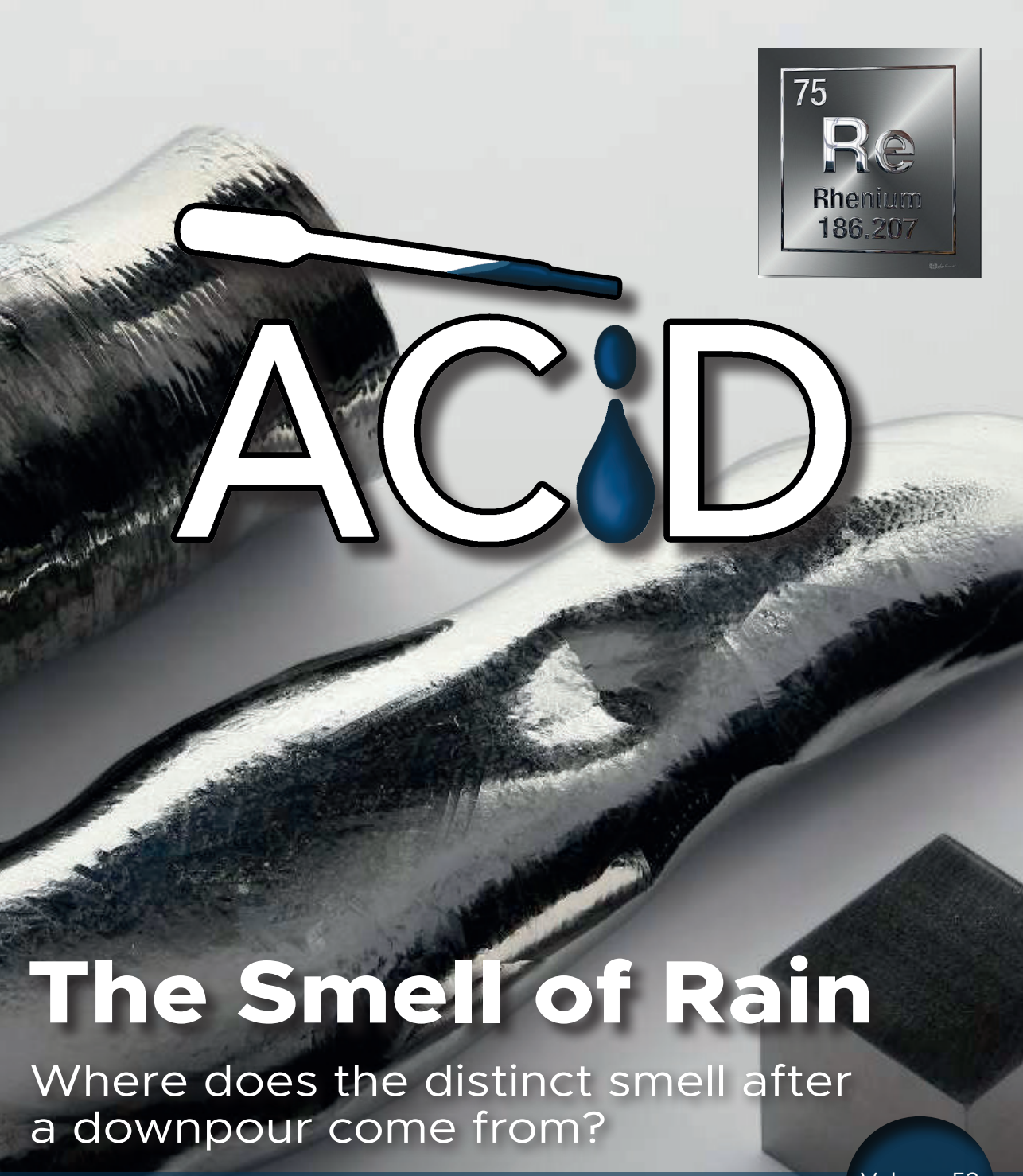

ACiD

The Smell of Rain

Where does the distinct smell after a downpour come from?

Volume 53
Edition 1

Amsterdams Chemisch Dispuut

Meet the Freshmen and Masters!

Working Mechanism of mRNA Vaccines

How exactly do you get immunity from your Jansen, Pfizer or Moderna shot?

Interview with an Environmental Advisor

Colophon

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From the Editor

Dear reader,

The new BLAD committee is very excited to present the first ACiD of the academic year! After studying at home for one and a half year it felt very good to see everyone on campus, and at all the activities of the ACD the last 3 months. In this edition of ACiD, the new board will introduce themselves and we will meet the freshmen, master students, and a PhD student from Birmingham. Furthermore, we will be diving into the chemistry in our own home, behind the mRNA vaccine and what the smell known as petrichor entails. As always the OC will show us what they have been up to, we have a new 'chemistry vs ...' and Tim will share one of his amazing recipes. You won't believe it, but you have even more to look forward to as the 2021 Nobel prize will be examined and Niels will be sharing his experiences of working as an environmental advisor. I hope you will be enjoying this edition just as much as we enjoyed making it for you!

On behalf of our entire editing team,
Stijn Engelaar

Content

The Old Chair Says Goodbye

Dear ACD'ers,

It is that time of the year once again; I am allowed to write some words to you and talk about the things we have done. This will be the last time I will be writing this piece and it has been both a pleasure and a pain to look back at the past two years as a board member.

The past year has been very tough on everyone, however, near the end of our 'reign' we saw that the weekly borrels could be hosted again, still at Eetcafé de Oerknal on Wednesdays at the time. I vividly remember that first borrel, because some mixed feelings got into my head. On the one hand it was amazing to see what wide range of people were actually attending that night, friends I've missed over the course of the pandemic, alumni that came back for that one last time to celebrate their graduation, but also first and second year bachelor- and masterstudents coming to their first borrel ever. On the other hand a strange water droplet crept up my tear duct and almost escaped my eye. I realized something I hadn't thought of in the past year: this borrel was going to be one of the final events that my board and I were going to host during our board years. Right at the moment that everything was starting to go 'back to normal' again, we were not able to organize any of the things we had in mind anymore. However, luckily, that feeling quickly turned around seeing the members of the now 76th board having the time of their lives and with that, enthusing the rest of the ACD'ers present. From now on I will be reading the words of my successor Martijn ten Brink with great pleasure. Hopefully he'll express himself here with the same kind of puns and wordplay that he uses oh so often in the vicinity of the ACD-room. Thanks to everyone reading this, it's been my pleasure! Best of luck to you all! Special thanks to Bart, Bente, Jari, Michelle, Nadav and Sam! We've done some amazing things.

All the best,
Your former chairman
Floris Blom

The New Chair Says Hello

Dear ACD'ers,

Here we are, a new study year and, as the new year is starting to unfold, more and more seems to be possible due to less strict covid regulations. I hope everyone is as excited as I am to be on campus again for studying, but also for social interactions with other students. With this new year, comes a new board as well, of which I am very happy to be the chairman. As a first thing, I want to thank our last board for their amazing work, even during the hard times of last year, organising (online) activities even when regulations barely allowed people to leave their house.

Maybe some of you have already seen me or the rest of the 76th board in our ACD room on the UvA or the VU, but if not, you are always welcome to walk in for a chat, a snack, or a drink. Besides our rooms, you can also find us at the fun activities, lectures, excursions and "Borrels" (all on site again) organised by the ACD. We have had a few amazing activities, both study related as more socially oriented in the last weeks, but there is a lot more to come.

For study related activities we have already had the Shell excursion and we will be having the enormous Lustrum symposium next week as I am writing this. But in the following months other excursions have been planned towards Hoyng, Baril and Tata steel, while there is also an orientation market planned where you can find out which types of chemical research are done at the UvA and the VU.

As for the more social activities, we have already had our borrels at Café the Oerknal on Wednesdays for the last weeks, but as I am writing this we are moving back to our favoured Fridays in the

Brainwave from 5pm til 10pm. Besides our borrels, there has ofcourse been the first years' weekend, where we got to meet the excited first year bachelor students. There has been a footbal tournament, we have had a reintroduction evening for the second-year bachelor students and we ofcourse had our constitution drinks in Amstelhaven. In the next weeks, more fun is about to happen with the end of our 15th lustrum party, our all-years weekend to Maastricht and a boardgame night, besides the usual Friday afternoon borrels.

While I am very happy to see everyone again, being on site again has its difficulties as well. I haven't written a physical exam in an exam hall in more than one and a half year, so as I am writing this, I'm kind of scared for the finals week that is about to come where I can't hide behind my laptop in my own room and answer all the questions without feeling observed by others every second. Well, maybe I am complaining again about nothing as I sometimes like to do. But I hope everyone gets through the final's week with a good feeling about the exams, so we can all relax and enjoy the upcoming parties, "borrels" and other activities.

Lots of kisses and hugs from your new chairman,
Martijn ten Brink

Het Wel en Wee van de OC Part 1

Sverre Overdijk

Dear reader,

Some of you might not know what the OC is, so I will start off with a brief introduction on the committee, its functions, and its members. Firstly, the abbreviation OC stands for program committee ('opleidingscommissie' in Dutch). The function of the committee is to make sure the quality of the education programme is up to par. We do this by providing the programme with solicited and unsolicited advice and by having a veto on the OER (Teaching and Examination Regulations or 'onderwijs en examenregeling'). We evaluate the OER by taking the information you provide us in course evaluations and evaluation panels. Furthermore, we have contact with the lecturers regarding this information continuously throughout the year. Therefore, it is important to us, but also to yourself and fellow students, that you fill in the course evaluations. In addition, the OC is a listening ear apart from the course evaluation, for all suggestions and more pressing matters. So, if any issues arise during your study, and you cannot resolve it with your lecturer, please contact us.

To make sure everyone has a say in these matters, the OC consists half of student members and half of lecturers. This year the student members are Casper van Eijden (vice chair) and me for the bachelor, and Anniek Verstegen and Annika Rinne for the masters. As for the teacher members they are Klaas Giesbertz, René Williams, Jocelyne Vreede (vice chair) and Tom Grossmann (chair). You can find the members of the committee on the dedicated DataNose page of the OC, which is also available via the UvA website. Also, if you want to share something in a less formal way, please feel free to approach any of the members in person.

So, after the introduction, what has the OC been up to as of late? Currently the first-year bachelor students are partaking in what is the first year of the new curriculum. We are currently taking up as much feedback on the affairs surrounding this new curriculum as possible, from the students, as well as from the lecturers. Furthermore, we are making sure that the coordinators of the previous edition of (similar) courses, are communicating thoroughly with the new coordinators.

Lastly ,the first-year students from both the masters and bachelor programs have seen at least one of the OC members during their Facultary Introduction and received a presentation about the OC and its functions. Concerning the other years, a member of the programme committee will give a short presentation during one of your lectures in the near future.

Next 'Wel en Wee' I will keep you updated on any developments surrounding these matters, as well as any other things that arise in the meantime.

OC mail: ocs-science@uva.nl
OC page: student.uva.nl/sck/content/az/opleidingscommissie/opleidingscommissie

Which Board Member Are You?

1. What is your favourite animal?
A) Chameleon
B) Cat
C) Platypus
D) Dog

2. Why did you decide to study chemistry?
A) Because I have no other choice
B) Chemistry is the best choice I've ever made
C) Chemistry is in my veins
D) It was my best subject in secondary school

3. How much alcohol do you drink per week?
A) 0 bottles
B) 1 to 3 bottles
C) More than I should be drinking
D) I am holding a bottle right now

4. What is your favourite research department in Chemistry?
A) Theoretical Chemistry
B) Organic Chemistry
C) Environmental Chemistry
D) Sustainability

5. How fast do you expect to complete your studies?
A) No clue, I'll take as much time as I need
B) As soon as possible with cum laude
C) I'm hoping for 6 years total
D) I want to complete all DLC's first

6. What is your favourite aspect of the Dutch language?
A) That it's not a world language
B) Using archaic Dutch words
C) I like to propose my own language
D) I like to pun-ish people on their grammar

7. What is your favourite ABC snack?
A) Kinder Bueno
B) Sugar waffles
C) Twix (the better half)
D) Brinkies

8. What is your secret talent?
A) I am a walking encyclopedia
B) I've read everything about history
C) I'm a trivia god
D) Able to function regardless of hangover

I have mostly:
A = Arthur, B = Ben, C = Perry, D = Martijn

In order from left to right in the picture:

You're **Martijn**, you have the talent of being able to say a lot of things without really knowing what you're talking about. At the same time, you're able to pull attention to yourself in any space and are able to switch between serious and goofy at a moments notice. Your favourite pastimes are drinking, being social, getting hangovers, drinking more and playing guitar.

You're **Arthur**, you come across as the prototypical 'crazy cat person' with about 12 cats and the same amount of facial hair. You don't care about others opinions on what you look like but expect them to like you for your personality and sense of humor instead. You roll through life enjoying every single day that's still to come.

You're **Perry**, you are known for being very social, enjoying a drink here and there whilst disappearing from time to time, which is why we have the catchphrase "where did Perry go?". As someone with an eye on internal affairs, you're an example of combining drinking with responsibility.

You're **Ben**, you always wear a dress shirt and fancy shoes. You're very hard working and are well-thought out with your responses. You have a great love for history; you should think about getting a goatee. You're meticulous and enjoy writing.

Spooktober - Pumpkin Fun

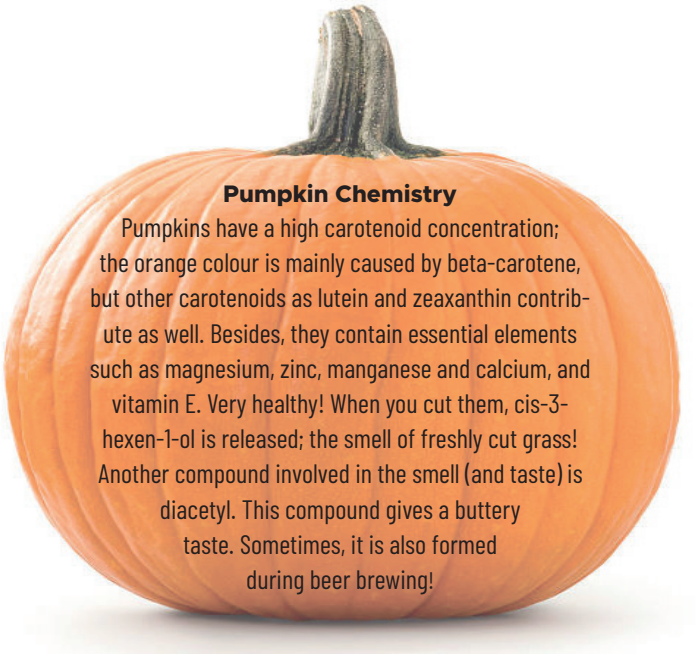
Rianne van Diest

When you think of October, you probably immediately think of … pumpkins! For the 31st of October, it has become a tradition to carve a pumpkin into a Jack O'Lantern. As the story goes, a drunkard known as Stingy Jack manipulated the devil in such a way that he could never let him go to hell. However, when he died, he was not accepted in heaven either, because of his lifestyle and poor choices. Therefore, he was doomed to roam, with only a hollow turnip with an ember in it to guide his way. This has later become the Jack O'Lantern. Spooky for sure!

But how to make your own Jack O'Lantern? First, take a large pumpkin and remove the cap. Cut a hole around the stark that is so big that you could reach with your hand inside the pumpkin. Then, remove the flesh and the seeds with a spoon or ice scoop. Don't throw the insides away! Now that you have a hollow pumpkin, decide what you want to make. You can make a traditional scary face, but you could also carve out your favourite molecule, or even the ACD sign! You can draw the carvings on the pumpkin first with chalk to avoid making mistakes. Then, carve out the desired shape with a paring knife (be careful not to cut yourself). Now, place a light (not a real fire!) in the pumpkin and light up your October!

What to do with the inside of the pumpkin? With the flesh, you can make a pumpkin pie! There are plenty of recipes on the internet and I tried one already 🙂. It will take some time but it is really worth it. The pumpkin seeds can be roasted with various spices – whatever you like! You can also roast them naturally and cover them later with caramel to make a nice snack. Bon Appetit!

Fun fact: the Centrum Wiskunde & Informatica (CWI) at Science Park has developed a tool named PumpKin (Pathway Reduction Method for Plasma Kinetic Models) to analyse complex plasma chemistry kinetics.



Nobel Prize in Chemistry 2021

Stijn Engelaar

The 2021 Nobel Prize in chemistry has been awarded to Benjamin List and David MacMillan for their work in the development of asymmetric organocatalysis. This is a form of catalysis that uses small organic molecules, specifically nonmetals.

Before 2000, several small organic molecules were known to have catalytic properties but were seen as unique examples and not as 'Part of development of a comprehensive methodology'.[1] In 2000, both List and MacMillan independently published papers on enamine catalysis and iminium ion catalysis, respectively. The publications show principles for inducing reactivity and controlling reaction pathways and have resulted in many different catalysts and applications in the following years. Organocatalysis is now known as one of the three pillars of catalysis, being complementary to transition metal catalysis and biocatalysis.

List and his coworkers' publication of enamine ion catalysis shows the catalytic properties of L-proline in an aldol reaction (Figure 1). The reactivity is enhanced because the enamine, being formed in the reaction, has a higher HOMO and nucleophilicity compared to the enol ether compound which is formed otherwise. The intermediate state in the compound is stabilized by the carboxylic acid through hydrogen bonding. List *et. al.* also suggested that L-proline might work as an enzyme mimic and that this proline-mediated enamine catalysis might have uses in other organic reactions.

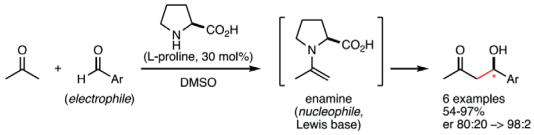


Figure 1. Catalysed aldol reaction by L-proline.[1]

Mac Millan *et. al.* showed that imidazolidinone can catalyse Diels-Alders reactions (Figure 2). The formation of the iminium ion with imidazolidinone lowers the LUMO compared to the aldehyde compound resulting in an increase of reactivity to diene. This reaction is a competitor to the metal-based Lewis acid catalysis which also lowers the LUMO. It is important to recognize that a covalent bond is formed in the catalysis which transfers the chiral information to the product.

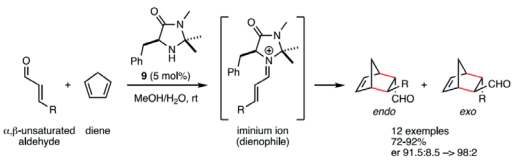


Figure 2. Catalysed Diels-Alder reaction by an imidazolidinone compound. [1]

The Nobel committee specifically recognized two applications of asymmetric organocatalysis. Firstly, the committee addressed the importance of catalysis to reduce environmental impact by increasing the efficiency of the reaction pathways and secondly, the committee acknowledged the value of asymmetric catalysis for pharmaceutical research. Asymmetric catalysis is important because of the high enantiomeric ratio (er) of a reaction. This ratio is also shown in the reactions above. The enantiomeric ratio is important because different enantiomers can have different effects when they are used in drugs.

(1) Peter Somfai; Scientific Background on the Nobel prize in chemistry 2021, enamine and iminium ion-mediated organocatalysis. The Royal Swedish Academy Of Science, 2021. https://www.nobelprize.org/uploads/2021/10/advanced-chemistry-prize2021-3.pdf (accessed Oct 22, 2021).

Meet the Freshmen!

What was your best experience this summer?
Taco: Boating with my friends in Broek op Langedijk.
Evelien: I've been working a lot behind the cash desk, so I didn't experience anything special.
Maaike: I did some performances with my drama group; we sang songs in nursing homes.
Daniella: I visited family in Italy; they live close to Turin, but we also visited Venetia and Milan.

Why did you choose to study chemistry?
Taco: I wanted to learn more in-depth chemistry, and I like that this study involves a lot of practical work as well.
Evelien: Chemistry is a wonderful fundamental science, and I noticed I missed the chemistry aspect in some other beta studies.
Maaike: Chemistry was one of the few studies where I felt I could make a good contribution for society, for example by fixing problems around plastic pollution.
Daniella: I liked that chemistry is overlapping with many other fields, so you have a broad education in beta studies.

Which course are you looking forward to?
Taco: Mathematics 2, I hope to see more mathematics applied to chemistry there.
Evelien: Chemistry of Life, but also learning more about synthesis in Organic Chemistry.
Maaike: Chemistry of Life seems really interesting! I'm especially interested in plant chemistry.
Daniella: Quantum Chemistry, as I really like the theory about orbitals we're learning now.

What was the most exciting thing about the first few weeks of study?
Taco: I attended the introduction week, so I got to know a lot of new people. I also like that no one is excluded; everyone can talk with each other.
Evelien: I like that too! Everyone is really accepting. It was also fun to watch how different friend groups were formed.
Maaike: It is very interesting to see the diversity in people at this study!
Daniella: Getting to know all these new people was awesome! I was also impressed by all the apparatus on the lab, especially the Rotavap is really cool.

Do you have a quote from your first few weeks of study?
Taco: 'I'd like some house wine' – which actually is a bottle Jäger.
Evelien: I shared this quote with Maaike: 'I feel like a round bottom flask – because I want to fall over after a long lab day, but I can't'.
Daniella: 'I've barely heard any quotes!'

Which chemicals would you like to put together just out of curiosity?
Taco: I'd like to make aero-gel once.
Evelien: Hypothetically, putting the undiscovered ununennium and tennessine together.
Maaike: As a demonstration experiment for children, I'd like to put sodium and chlorine together in a low-burning fire. I also wanted to make nitrogen-triiodide.
Daniella: Everything with liquid nitrogen seems interesting!


Taco


Maaike


Evelien


Daniella

Meet the Masters!

Henk Hoekstra

Premaster

What was your most favourite experience this summer?

My most favourite experience was looking at the rings of Saturn in June by using a telescope. For me, this was quite special because you've seen the rings in documentaries and video clips, but witnessing it with your own eyes is truly something special.

Which part of chemistry do you find most interesting?

Well, I want to follow the analytical Masters track, so I find analytical chemistry the most interesting, and in particular the instrumental analysis. Instrumental analysis, while simple in the basics (everybody is able to pipette and inject a sample), requires a certain elegance to obtain usable results. As one of our teachers said: "Sometimes analytical chemistry is more like an art than a 'hard science'".

What was your reason for studying chemistry at the UvA/VU?

The UvA is the only university in the Netherlands that has a specialized analytical chemistry Masters track. I also considered going abroad, but there might be a gap between my skills and the required skills, as I come from a university of applied sciences (hbo). The UvA offers a premaster program that is designed to bridge the gap, while other (abroad) universities do not offer such a program.

If you could combine any two compounds out of pure curiosity, which compounds would you choose and why?

I think this is a question for organic chemists to answer. If we would talk about which instrumental technique I prefer, then I would choose mass spectroscopy (LC-MS). It is a powerful technique and it's really cool that we can separate compounds based on their m/z ratio.

What is your favourite drink?

Skuumkoppe, which is a dark wheat beer from Texel

How will you survive the winter this year?

I don't really know; I just do it. For me, winter is nothing special compared to other seasons like the summer (in terms of survival).

How are you feeling about going back to the university again?

I didn't take any courses last year, so I can't relate to the period where online lectures were 'the thing'. Therefore, I will approach this question from a different angle: I worked last year and I really like to go back to the university now, so that I can expand my knowledge again and learn new stuff.

José Nijman

Analytical Sciences track

What was your most favourite experience this summer?

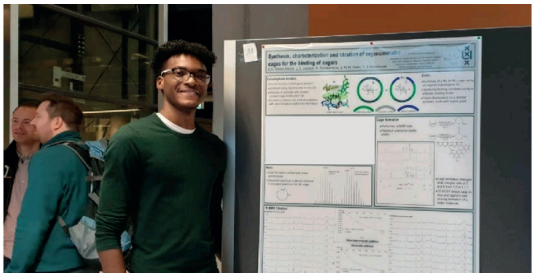
Going to France with my family for one week. Especially because this was the first time in another country in Europe besides the Netherlands. We went to Paris for three days where we visited Disneyland, which was an awesome experience, and three days to Allard, which is in the South of France near Lyon. The ride to Allard was very impressive because we went past a lot of huge mountains.

Which part of chemistry do you find most interesting?

The most interesting part of chemistry for me is environmental chemistry. I find it really interesting to discover all these chemical pollutants that I didn't even know existed. For example, in a course I learned that even the tea bags can cause plastic getting into our body and there are many more examples identical to this one. That's why I want to go for a career in environmental chemistry: to learn more about this and to come up with ideas to prevent these pollutants entering our body and environment in general.

Why study chemistry at the UvA/VU?

Well to be honest, chemistry was not my first choice after I had graduated from high school. I always wanted to become a dentist. But because I didn't meet the numerus fixus qualifications I was forced to pick another study. So, I chose chemistry because that was the course I enjoyed the most in high school, mainly because of my teacher since she was always enthusiastic. And about why I chose for UvA/VU: mainly because the chemistry bachelor is a joint degree. Therefore, I knew it was better suited for me because I could get to know professors from two universities.



If you could combine any two compounds out of pure curiosity, which compounds would you choose and why?

I would combine acetone with hydrogen peroxide haha. No just kidding, probably helium and N_2O. I would like to know what would happen if a person would then inhale this new gas. It would for sure be a laughable result I think.

What is your favourite drink?

My favorite drink normally is "IJwit". In my opinion that is like the best "witbeer" ever. And in the summer my favorite drink to consume is Desperados. I don't really know why, but in the summer the desperados just hit me differently.

How will you survive the winter this year?

I really hate the winter. So if it snows again for like a week as last year, I will probably not leave my house for that week. But in general, I will just wear like three layers of clothes. I already started to wear my winter coat since two weeks ago, so I am already prepared for the winter.

How are you feeling about going back to the university again?

In the first week I was really enthusiastic about going back to the uni. The first month I went to all my classes (and even staying at the uni while having three hours between classes). But I must say that in the second month this enthusiasm has almost vanished; I started skipping a lot of classes during October. Nevertheless, I was really happy that we had classes at the uni again, since I am in the first year of the master and I was able to make new friends with some fellow students.

Anna May Inzenhofer

Molecular Sciences track

What was your most favourite experience this summer?

I actually can think of two such experiences. The first one is a vacation to France with my family, where we stayed at the beach for two weeks. The other one is meeting really friendly people in person, who I met online during the Advanced Spectroscopic Techniques course. It was amazing to finally see each other directly and realizing: "Hey, it's you!" and we still have contact with each other.

Which part of chemistry do you find most interesting?

That's a hard question because I find many parts very interesting, but I think it comes down to understanding chemical reactivity and from that, applying it to organic chemistry and other areas within chemistry. I am actually starting to like spectroscopy more and more, and I want to get to the bottom of some of these chemical processes, and find out to how they work.

Why study chemistry at the UvA/VU?

The main reason was that the UvA/VU explicitly has a green chemistry program (track Science for Energy & Sustainability), and the university even has a research group for green chemistry. Before I came to the UvA/VU, I did my Bachelors in Konstanz, where students did not have the opportunity to specialize in green chemistry. Another reason was to finally be able to move to a big city and Amsterdam meets this requirement.

If you could combine any two compounds out of pure curiosity, which compounds would you choose and why?

I cannot think of two compounds specifically, but something I definitely would like to do is using a glove box to mix two compounds!

What is your favourite drink?

Frappuccino, so a mixture of coffee (or cream), milk, and ice.

How will you survive the winter this year?

With a lot of previously mentioned Frappuccino's of course! While I don't like the cold temperatures during the winter, I have several hobbies which can make the winter period more pleasant. I have a museum pass for instance, which I want to use to discover the cultural activities in Amsterdam, hopefully with some friends I make during my study. Furthermore, I am a diving instructor, so I could dive in the winter to keep myself sane, or I could play some piano.

How are you feeling about going back to the university again?

I'm so happy to be able to look at the professor when he explains the material and to meet up with other students during the tutorials. Basically, I enjoy seeing other people again in person and it actually speeds up the learning process when you can discuss the material with classmates! Also, finding places to study was really difficult during the corona period and I'm glad it is easier now.

Self-made chicken cordon bleu with pan fried zucchini and potato mash

by Tim Lugtenburg

With autumn all around us it is a fitting time to warm yourself up with this dish! We have a so called 'AVG' or potatoes, meat and vegetables, but each of the components just have that extra bit of flavour to them in this recipe (which AVG definitely is in need of). Growing up I never liked eating vegetables, but by pan frying or sauteing instead of boiling (albeit slightly less healthy) they can be very tasty. The filling and crust of the cordon bleu add an extra dimension to the chicken taste and the additions to the potato mash result in it being more creamy. So lets see how to make it!

Chemical detail:

This time, let's take a closer look at what is happening in the breading process and what its effects on the eventual taste are. By doing all three steps with flour egg and breadcrumbs, we make sure the crust will stick to the chicken. Especially the function of the egg as a binding agent is important, which it is capable of because when the protein in it starts denaturing, it traps other ingredients with it, resulting in a nice strong layer.

Similar to bread being fluffy on the inside and crunchy on the outside due to the difference in max temperature during heating, the breading on the cordon bleu reaches high temperatures and turns nice and crunchy, while the chicken inside remains tender. We add it in the oven after pan frying to make sure the core gets heated as well, without losing all the moisture. Finally, using the panko breadcrumbs instead of regular ones, we get a much crunchier crust because panko has a lot airier texture, allowing less oil to get absorbed and thereby turning less soggy.

Ingredients (for ~2 people):

Cordon bleu:

- 2 chicken filets
- 25 g panko breadcrumbs
- Egg
- 2 slices of ham
- 1 piece of Gruyère cheese
- All-purpose flour

Zucchini:

- 1 Zucchini

Potato mash:

- 500g starchy potatoes
- 2 tsp rough mustard
- 1 tbsp butter
- Splash of milk

Preparation:

1. Cordon bleu: Preheat oven to 200 °C. Grab a meat hammer or rolling pin and punch the chicken filet until it is flattened a bit (also good for stress relief). Then, cut open the filet along the side, add a slice of ham and some Gruyere and fold it closed. Prepare 3 plates, one with flour, one with beaten egg and one with panko. First pull the filet through the flour, then the egg and finally through the panko bread crumbs. Heat some olive oil on medium high, and cook the filet until it has a nice golden brown crust. Place the cordon bleu in the oven for 15-20 minutes, to evenly heat the core of it.

2. Zucchini: Cut the zucchini into thin circular slices. Heat 3 to 4 tbsp of olive oil at medium high heat and place the zucchini slices in it. Timing is important, so check the bottom frequently for browning. When slightly brown, flip them over and heat until they are nicely crisp and brown.

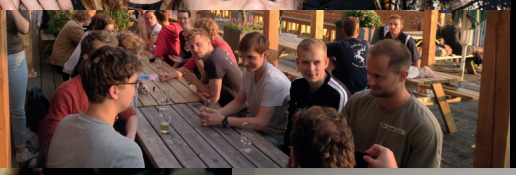
3. Potato mash: Peel the potatoes and cut them in small chunks. Boil for 15 minutes and mash the potatoes. Add a splash of milk, 1 tbsp of butter, and 2 tsp of rough mustard. Mix together well.

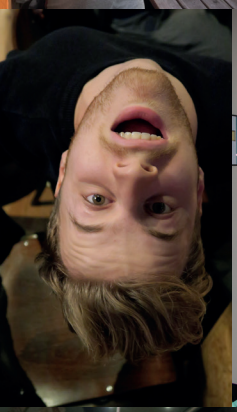
1. Hello fresh recipe
2. Brown A. (2011). Understanding Food: Principles and Preparation, Fifth Edition, Cengage Learning, Stamford, Connecticut, USA



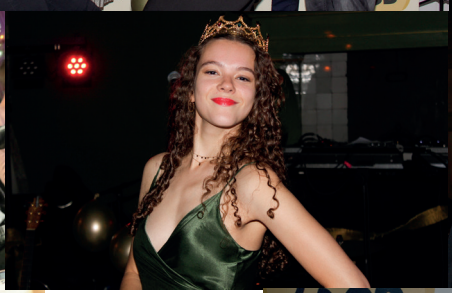















Being an Exchange Student in Amsterdam

Can you tell us about yourself? Who are you and what is your background?
My name is Sam Dettmer, I started my undergraduate in chemistry in Birmingham, in my third year I took part in the Erasmus exchange program just before Brexit. I recently completed my undergraduate program with an integrated Master and I just started my PhD in Chemistry at Birmingham in the Hannon group within Chemical Biology.

What made you decide to go on exchange to Amsterdam?
I didn't have many options for English-speaking European countries, but Amsterdam stuck out because the program had a much wider variety of courses. When I looked at the courses, I knew I would like the Mathematics for Quantum Chemistry course, the Computational Chemistry course, and the History and Philosophy of Science course. I liked that it wasn't all chemistry. The more I looked into the city and Dutch culture it started to sound cooler and I definitely wanted to go there.

What was the thing you learned the most from your semester here?
I liked how universities in the Netherlands are very forgiving due to being able to retake exams. I learned a lot about computational chemistry, which shaped where I did my master's thesis back home. It helped me find my feet within the field with what I enjoy the most! In terms of the year abroad, probably the Netherlands and Europe, in general, have much better public transport compared to the UK. I also re-learned how to ride a bike!

Do you have a favourite moment from your studies?
My favourite moment was the welcome week with the International Student Network, where they put up a week of events like a trip to the zoo, and a couple of nights. There was a night out at the Melkweg and we got to experience a boat tour.

Where did you end up after your exchange?
When I got back from my exchange, I had one more year of my undergrad which was my integrated masters, so I did that computational project which led to my PhD. I looked at the computational aspects with molecular dynamics for the Frameshifting Stimulation Element (FSE) in Covid-19. It stimulates ribosomal frameshifting by blocking the RNA chain to move the frame one base to control the proportion of viral proteins used for replication of the virus (see figures).

Do you have any closing remarks?
Internationals should try to be a bit more extroverted, whereas Dutch students should try to make them feel welcome. It's very daunting for internationals to come into a classroom and hear everyone speaking Dutch. Lastly, just enjoy it and make the most out of it!

Chemistry at Home

Arthur Grooteman

Chemistry is not just a fun subject to study or to work with, it's also quite useful if you know what to look for! In this article, I will show you some useful chemistry-at-home lifehacks that you can use to make your life just a little bit easier (and show off at the same time to those not in-the-know)!

1. Cleaning your silver

Most people know about the fact that silver is a semi-precious metal; the tendency to react happens under specific circumstances. One of these circumstances is that silver can react with sulphides in the air and form silver sulphide from hydrogen sulphide:

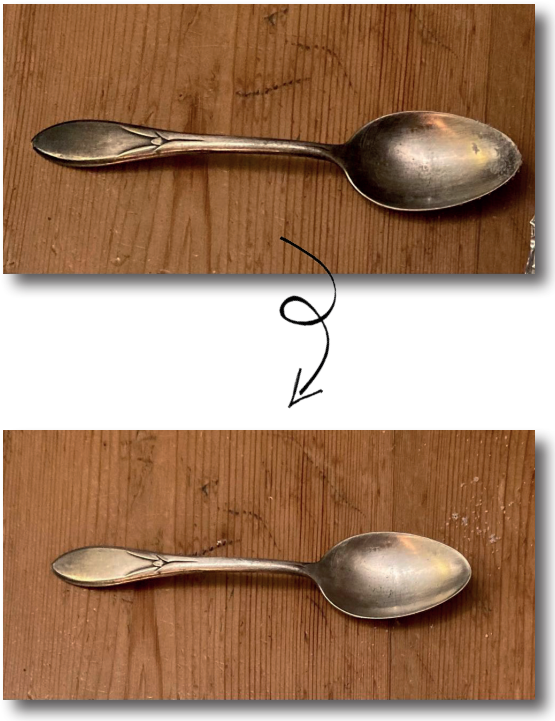
$$2\ Ag\ (s) + H_2S\ (g) \rightarrow Ag_2S\ (s) + H_2\ (g)$$

This causes the ugly black tarnish present on your silverware when you leave it for a while. Silver polishing cloths exist to remove this tarnish from the objects, however that also means you remove a little bit of your silver over time and this can damage your objects in the long run. Luckily, chemistry offers a solution that is a little less abrasive than using silver polish! The only things you need are: A plastic (not metal!) container, some aluminium foil, baking soda, and hot (not boiling) water.

If you want to clean your silver, all you need to do is cover the bottom of your container with aluminium foil, pour the hot water in the container, add a few teaspoons of baking soda and your silver items. The baking soda acts as a basic catalyst and will facilitate the transfer of electrons between the silver sulphide and aluminium:

$$3\ Ag_2S\ (s) + 2\ Al\ (s) + 3\ H_2O\ (l) \rightarrow 6\ Ag\ (s) + 3\ H_2S\ (aq) + Al_2O_3\ (s)$$

Tada! The result is clean silver without any abrasion, using simple household chemicals. Your jewellery and cutlery will thank you. Don't forget to wipe it down to remove any excess ions from the baking soda solution to prevent precipitation of aluminium oxide on your silverware!



2. Removing stains and smells

Baking soda is also very useful to clean stains and smells from objects that you cannot throw in the wash. Examples are mattresses, couch cushions, and carpets. The only things you need are hot water, baking soda and a vacuum cleaner. Simply dissolve the baking soda until the mixture becomes like a paste, apply a generous amount of

the paste to the stain and let it sit. The water will soak into the fabric, while the baking soda slowly precipitates back into a solid as the volume of the liquid reduces. As a result, the particles that cause the smell and colour of the stain get trapped in the crystals of the baking soda as it precipitates. You can then easily vacuum up the crystals!

3. Storing your produce properly

Almost all of us have experienced how fast bananas seem to ripen after you buy them, but did you know you can exploit them to help ripen your other fruits faster? In fact, there are a lot of fruits and vegetables that use the same molecule to regulate their ripening: ethylene!

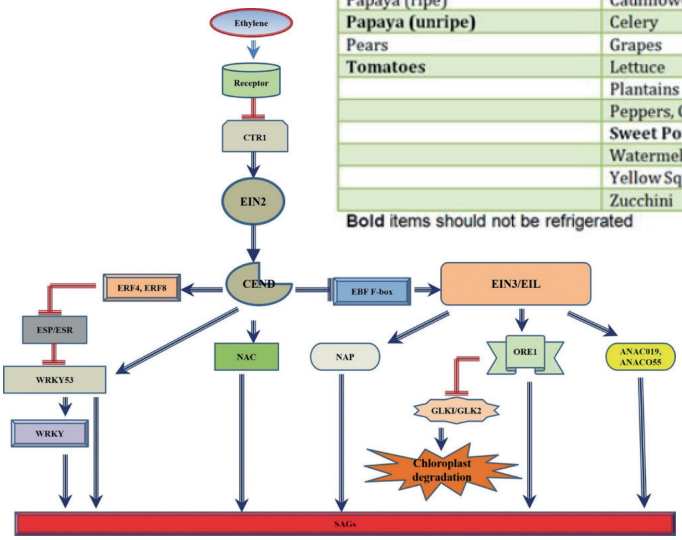
Ethylene acts as a senescence hormone, helping a plant (and the fruits) determine when to break down chloroplasts and ripen as a result. Some fruits and vegetables produce a lot of ethylene, whereas others do not. At the same time, some are more sensitive to this mechanism. As you can imagine, it can be quite difficult to determine how to make your fruit last the longest.

The general rule of thumb is that if you want to ripen your produce quickly, put them in a bag with those that produce a lot of ethylene until ripe, then remove whatever you want to last longer. This also works with individual fruits! For example, if you separate bananas from each other after they reach the preferred ripeness, they will last longer. I have included a handy chart to help you determine which ones to store with each other!

Ethylene Sensitivity Chart

Ethylene Producing & Sensitive	Ethylene Sensitive	Not Ethylene Sensitive
Apples	Acorn Squash	Bell Peppers
Avocados (ripe)	Avocados (unripe)	Cactus (Nopales)
Bananas	Asparagus	Collard Greens
Cantaloupe	Broccoli	Corn
Kiwifruit	Butternut Squash	Cucumber
Mango	Cabbage	Eggplant
Nectarines	Carrots	Grapefruit
Papaya (ripe)	Cauliflower	Green Beans
Papaya (unripe)	Celery	**Jicama**
Pears	Grapes	Kale
Tomatoes	Lettuce	Okra
	Plantains	**Onions**
	Peppers, Chile	Oranges
	Sweet Potatoes	**Pineapple**
	Watermelon	Spinach
	Yellow Squash	Strawberries
	Zucchini	

Bold items should not be refrigerated



The Scent of Rain

Siebe Lekanne Deprez

Typically, Dutch people associate autumn with a lot of wind and rain. There is actually a ridiculous number of words for describing rainfall and the weather in the Dutch language.[1] While rain can be considered annoying when you have to travel through it, I think rain also has a really interesting aspect because you can smell it. I am sure this sounds familiar: after a dry period, you suddenly smell a distinct earthy scent. Then, when it starts to rain (lightly) the odor can be surprisingly quite pleasant. However, the scent could certainly not be coming from the water, I thought, since water does not have a distinctive smell. This raises the question: what do we really smell when you 'smell rain'? It turns out that I am not the only one that has contemplated this and the story of 'the smell of rain' is definitely one worth telling.

Let us start by introducing the phenomenon. It has been studied from as early as the 1890s, during which the 'rain' scent was commonly perceived and people started to wonder what its origin was. In 1964, the phenomenon had gained even more attention and was named 'petrichor' after the Greek words petra and īchōr, meaning rock and the fluid that runs through the veins of Greek Gods. At that time, scientists had already realized that compounds must enter the nose and bind to a receptor in order for humans to smell them. However, scientists did not yet understand which compounds were entering the nose and from where these compounds came from. Luckily, current scientists know a lot more by having the right tools to study petrichor.

I will consider first the 'from where' part. Since petrichor can be smelled when it rains, one could hypothesize that rain causes either compounds in clouds to fall down, or compounds to be shot into the air when rain hits the earth's surface. The first suggestion is most likely not true because chemicals would have to evaporate in order to reach the clouds; in this scenario, smelling rain would occur much more often and not only during rainfall. So, what about the second hypothesis? Well, it was confirmed only six years ago by a MIT study that showed how chemicals on the ground could be launched into the air by rain droplets through the formation of aerosols[2] (Figure 1).[3]

The researchers used high-speed cameras, sophisticated setups and some interesting equations. The cameras not only show how aerosols form, but also quantifies the their formation rate depending on the speed of rain droplets, the impact angle, and the permeability of the surface. If this sounds impressive, then you are in good company. The study highlighted the mechanism of aerosol formation on different types of soil and it turns out that soil in general has a permeability that hits the 'sweet spot' for aerosol formation. Soil surfaces are often permeable enough that they enable droplet deformations to occur - giving rise to air bubbles - but also not too permeable that would lead to the droplet being completely absorbed by the surface which would cause air bubbles to stay trapped in the droplet and preventing them from escaping into the air. In other words, aerosol formation is a delicate

1 I strongly recommend this video if you are in for a laugh: #8 How to survive the Dutch weather. https://www.youtube.com/watch?v=Ys-KP8oPdvg

2 Note that an aerosol is a suspension of fine solid particles or liquid droplets in air or another gas.

3 N Joung, Y.S.; Buie, C.R. Aerosol generation by raindrop impact on soil. *Nat. Commun.* **2015**, *6*, 6083.

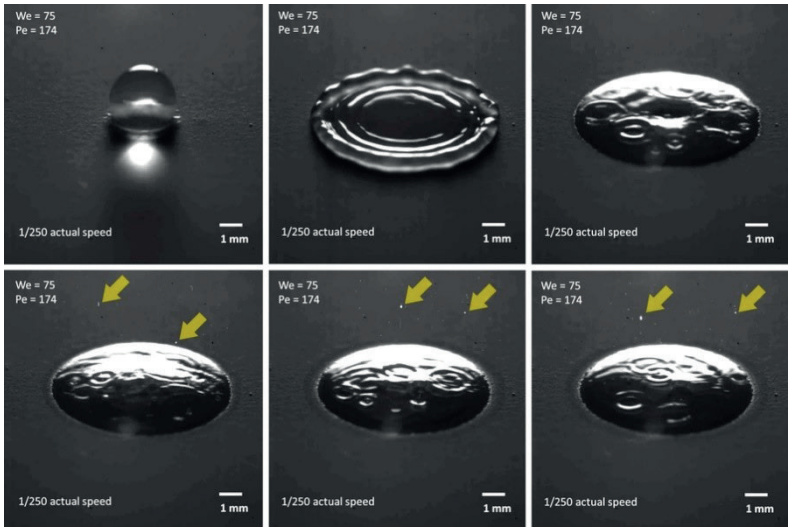


Figure 1. Images of a rain droplet hitting the surface recorded by MIT researchers.[3] The droplet's shape changes during this (short) process and causes aerosols to form as indicated by the yellow arrows. These aerosols are released as a consequence of air bubbles being trapped in the droplet. Deformations of the droplet cause air bubbles to reach the droplet's surface and consequently escape.

balance between forming air bubbles through droplet deformations and giving the air bubbles enough time to reach the surface of the droplet. When air bubbles reach the droplet's surface, they burst open and launch aerosols into the air. Another interesting outcome is that the formation rate of aerosols is highest during light rain and decreases as rainfall intensifies. Therefore, the study shows that rainfall causes compounds on ground surfaces to be released into the air and that this process will happen most often during light rain.

Now that the 'from where' part is answered, we will focus on the 'from which' part. It should not come as a surprise that this part is extremely difficult to answer exactly since there are numerous compounds in soil that all could contribute to the smell of rain. A study from 1964, conducted by Bear and Thomas, examined different soils and rocks by collecting samples, performing distillations & liquid chromatography, and analysing IR spectra of the resulting fractions.[4] They found that a yellow, oily mixture could be obtained whose smell corresponded to the 'earthy smell'. Hence, they named the smell 'petrichor'. The scent was attributed to small amounts of pyridine and quinoline with an extremely powerful odour, carboxylic acids, and neutral compounds such as aldehydes and ketones. As the samples were heated and stored in air-dry conditions, the researchers concluded that the scent had no biological origin and came from compounds in the atmosphere that had been adsorbed by the surface. So, it seemed the search for finding the compounds responsible for petrichor was over.

However, this is not yet the complete story. In the years since, another contender for the smell of rain has entered the picture: a molecule named geosmin. This compound is created during metabolic degradation of plants by certain

4 Bear I.J.; Thomas, R.G. Nature of argillaceous odour. *Nature*, **1964**, *4923*, 993–995.

bacteria called 'actinobacteria'. Through their presence, the 'earthy smell' actually does have a biological origin and the biological processes of producing geosmin are quite complex.[5] Nevertheless, the human nose is extremely sensitive to geosmin and humans can detect it at concentrations as low as 400 parts per trillion (!). Geosmin accumulates during dry periods when the actinobacteria are highly active and is trapped - together with the oily mixture – in aerosols during rainfall (Figure 2). It is this combination of compounds that humans associate with petrichor.

So there you have it. First we have seen how rain can cause aerosols to form and that the formation is influenced by the rainfall's intensity and the type of soil. Furthermore, we also have seen that oil in soil and geosmin from actinobacteria enter our nose via these aerosols and result in the typically earthy smell. As for why humans think the smell is pleasant, one could only hypothesize that the smell has an evolutionary relevance: our ancestors had to rely heavily upon rainfall for their survival and knowing when (and where) rain would fall could mean the difference between starving and having something to eat. Nowadays, a cultural argument can be made that petrichor is cleansing and refreshing for humans by being relieved from the relentless summer heat, something I certainly can relate to.

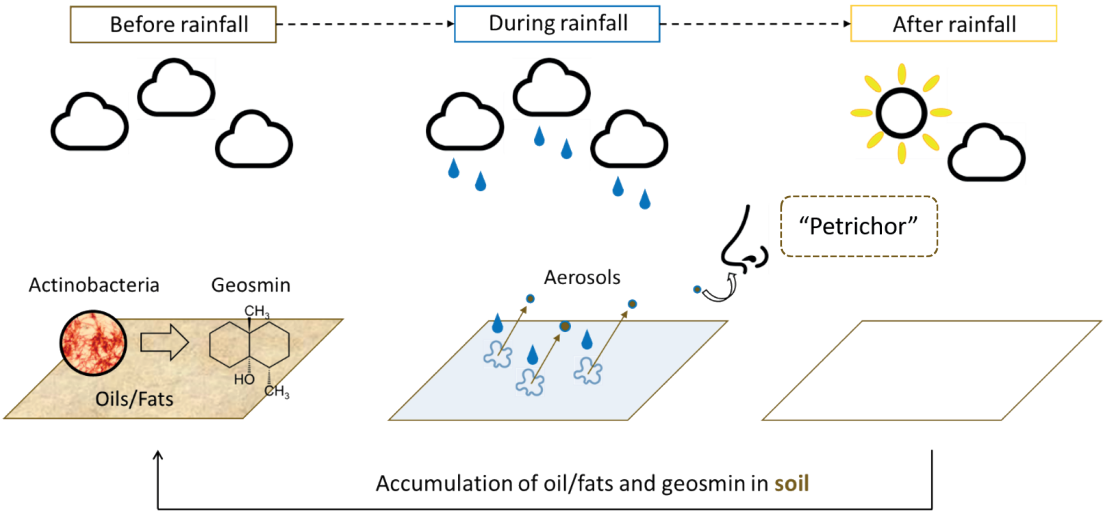


Figure 2. Overview of the petrichor phenomenon. Before rainfall, compounds such as plant oils and fats, and geosmin are present on the ground and are subsequently shot in the air during rainfall in the form of aerosols. These aerosols enter the nose and cause the well-known smell of rain: petrichor. After rainfall, the compounds will accumulate again and the cycle repeats.

5 Protein spotlight. The earth's perfume. https://www.proteinspotlight.org/back_issues/035/ (accessed Oct 30, 2021).

Working Mechanism of the mRNA Vaccine

Rianne van Diest

mRNA vaccines, before the Covid pandemic, you had probably never heard of them, but now, there is a big chance that you are vaccinated with one. During the pandemic, the development of these types of vaccines gained momentum, resulting in this technique being applied worldwide. But how exactly does this new vaccine type work? Prepare yourself for a throwback to your biochemical courses.

A good place to start this investigation is inside the injection needle. mRNA is very unstable, and without protection, the body will see it as a foreign compound and immediately destroy it.[1] So, it has to be modified a bit before it can be used as medicine. One difference with normal mRNA is that the vaccine mRNA contains pseudo-uridine instead of uridine. This modification can sometimes also be found in nature. In this pseudo-uridine, the nitrogen atom connected to the ribose (N1) is replaced by a carbon atom, and C5 in the ring is replaced with a NH group, as shown in **Figure 1**.[2] This difference increases the stability and translational capacity of the mRNA. Furthermore, just as a 'real' virus has a nice membrane to keep its RNA safe, a mRNA vaccine needs something to protect it. If the mRNA is administered without protection, it will have much trouble entering the cell and will be degraded before it could do so.[1] The solution for this problem is to put the mRNA in cationic lipid nanoparticles. Its lipid membrane not only protects the mRNA, but also facilitates uptake through the cell membrane. Cholesterol and natural phospholipids are added to this lipid membrane for extra stabilization. So, besides a physiological salt solution and sucrose, the injection needle contains modified mRNA encapsulated in lipid membranes as nanoparticles with a size of 80-200 nm.

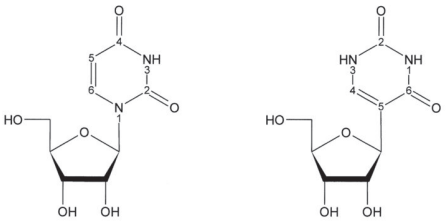


Figure 1. Normal uridine (left) and pseudo-uridine (right).[2]

The vaccine is administered in your arm muscle. This type of administration is chosen for rapid uptake, as the muscle is well perfused, and for direct entrance in the systemic blood circulation by the vaccine. Now that the vaccine is in your body, it can start with activating your immune response. The lipid particles fuse with the cell membrane, upon which the mRNA is released (see **Figure 2**).[3] This mRNA encodes for the spike protein of the coronavirus, which is a key target for your antibodies in case you get infected with the virus.[4] More information about this protein can be found in **Box 1**. The vaccine mRNA contains two point-mutations compared to the viral mRNA, to keep the spike protein in the pre-fusion conformation. Ribosomes in your cytoplasm translate the mRNA, so that the spike protein is formed.[1,3] The mRNA is eventually destroyed by the cell in the same way it destroys your own mRNA, so you don't need to be afraid that the vaccine will be in your body for the rest of your life.[5]

The spike protein can trigger your immune system in various ways; this is where it gets complicated. In the first option, the protein is broken down in smaller pieces by proteasomes (an enzyme that can break peptide bonds).[3] The pieces can form a complex with so-called major histocompatibility complex (MHC) class I proteins (see **Figure 2**). MHC is a part of the genome that codes for glycoproteins that recognize foreign substances in the body. These formed complexes are then moved to the cell membrane and presented on the outside. Here, $CD8^+$ T-cells, better known as killer T-cells, can bind and recognize them, and induce cell death.

In the second option, the spike protein is transported as a whole outside the cell via the Golgi apparatus. There, they can be taken up again via endocytosis (by the formation of a vesicle, i.e., endosome). The proteins are then broken in pieces by the endosome and complexed with an MHC class II protein. This is again presented on the outer side of the cell membrane, where it can be recognized by $CD4^+$ T-cells (T helper cells). These cells activate B-cells to transform into plasma cells, which in turn can produce antigen-specific antibodies. At the same time, B-memory cells are formed, so that the immune system can recognize the spike proteins in case you get infected and immediately produce the right antibodies. These cells can rest in your body for years. Therefore, the immune response will be much faster when a real infection with the virus takes place.

In this way, your mRNA vaccine prevents the corona virus from doing too much damage in your body and, hooray, you won't get (very) sick.

Box 1 | The corona spike protein

The outside of the viral SARS-CoV-2 envelope contains various proteins, and from these proteins, the glycosylated S-proteins or spike proteins are of special interest for vaccine development, as this protein is crucial for host cell entrance for the virus.[4] The spike protein consists of three protomers that together form a trimer. With this protein, the virus can bind to proteins of the host cell membrane, resulting in cell fusion of the virus and the host cell. The protein has a pre-fusion and a post-fusion conformation; the pre-fusion conformation triggers the immune response.

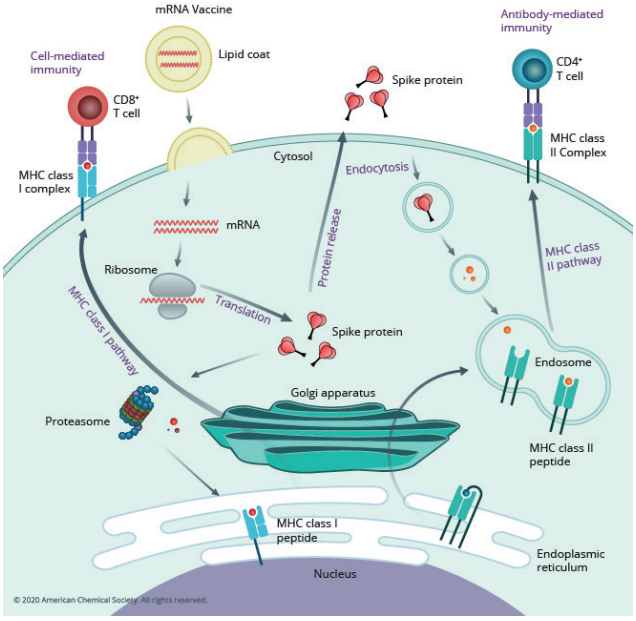


Figure 2. The pathway from mRNA vaccine administration to immune response in a human cell.[3]

1. Pardi, N.; Hogan, M. J.; Porter, F. W.; Weissman, D. MRNA Vaccines — a New Era in Vaccinology. *Nat. Rev. Drug Discov.* **2018**, *17* (4), 261–279.
2. Mengel-From, J.; Kirpekar, F. Detection of Pseudouridine and Other Modifications in TRNA by Cyanoethylation and MALDI Mass Spectrometry. *Nucleic Acids Res.* **2003**, *30*, e135.
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4. Huang, Y.; Yang, C.; Xu, X.; Xu, W.; Liu, S. Structural and Functional Properties of SARS-CoV-2 Spike Protein: Potential Antivirus Drug Development for COVID-19. *Acta Pharmacol. Sin.* **2020**, *41* (9), 1141–1149.
5. European Medicines Agency. *COVID-19 Vaccine Moderna*; Amsterdam, 2021.

Working as an Environmental Advisor

An interview with Niels Rietdijk

Anna May Inzenhofer & Rianne van Diest

This article will give you some insight into a career option that you don't hear about that much. We interviewed Niels Rietdijk; he works as an environmental advisor at 'Omgevingsdienst Noordzeekanaalgebied', an environmental protection government agency focussed on the area around the North Sea Channel (Metropolitan Region Amsterdam). Here, you can read all about the interesting aspects of his job. And who knows, you might be convinced to work as an environmental advisor at the government yourself!

Career

Niels did his bachelor's in Chemistry at the UvA/VU, so he has studied at Science Park as well. This led to some funny conversations, as he knew some of our professors (like Bas de Bruin) from his own study time. When he got his bachelor's degree, he decided to do his Masters in Chemistry in Bonn, to experience studying abroad. This education didn't have any specific tracks, which allowed for a broad, overall education. Looking back, this was a great decision, as Niels never imagined becoming a civil servant during his study. However, he followed courses in environmental and industrial chemistry, which coincidentally happened to be very useful courses for his current work field.

After his Master's, he started looking for a job. Working at an environmental protection agency appealed to him, because of the broad aspect; innovation and green, circular chemistry is a hot topic, with ongoing new developments. With this job, he could be involved with these many transitions of various companies. He now works as a junior environmental advisor, and he combines his job with an additional HBO education in air pollution and quality. The Omgevingsdienst Noordzeekanaalgebied subsidizes this position as an incentive to keep studying. This way, he can specialize himself further as an air quality advisor and work at the same time.

Working as an environmental advisor

As an environmental advisor, Niels serves as a bridge between the industry and legislation. He works with a myriad of different people—lawyers, policy-makers, industrial chemists, and business

people alike. “There is a lot of sharing of knowledge involved. The Omgevingsdienst acts as somewhat of an innovation hub.” The most challenging part of his job is staying in touch with innovation to find the newest environmental developments. For this, he does literature research and visits conferences.

With his expertise in chemistry, he advises lawyers to write suitable (technical) permits. This involves interpreting legal documents - something he learned about on the job. He also travels to different companies to supervise, for example, measurements in order to verify a claim.

His favourite part of the job, however, is negotiating with companies. A recurring theme in Niels's job is finding a balance between making money and saving the environment. Responding to our sceptical expressions he continued, "Actually, you would be amazed by how many companies are passionate about saving the environment. Of course, first they need to follow the law but anything after that you'd be surprised how far you can get with a conversation.” And that, “It's in everyone's interest that they can breathe clean air.” Fair point, Niels.

Case studies

Without going into too much detail about which companies, Niels has been working on ZZS (zeer zorgwekkende stoffen/very disturbing substances). The ministry says that ZZS (like PFAS) need to go to a zero concentration, as they are mutagenic, carcinogenic, etc. This project requires him to ask companies whether they emit said compounds and, if so, what their plan for reducing them is. He and the companies then collaborate together to implement the best available technology. A problem here is that some laws do not prioritize certain emissions correctly. For example, the persistent PFAS is treated the same as other non-persistent toxic compounds, like Cr^{6+}. While chrome will be reduced in the air, PFAS stays there and accumulates. Therefore, Niels focusses on evaluating reduction programs on these persistent ZZS.

Finally, an interesting fact about Niels’ job: many complaints the Omgevingsdienst gets are actually about odour control. Instances like these require... a certified nose of course! This is someone who has an average nose; not too good at smelling, but not too bad. The results of this smell test can be converted with a model to ‘odour units’, which are then used for policy making (e.g., the levels need to be lower than one odour unit).

Advice

When we asked Niels for advice for students considering this career option, he indicated that we are actually going in the right direction by studying chemistry. Courses in environmental and industrial chemistry he found especially useful, but also the mathematical skills we learn have great value. “Not many people learn mathematics to this degree in their studies, so being able to do this makes you quite exceptional.” Moreover, he advised not to specialize too much in your studies; with a general chemistry education, you keep a lot of career options open. Specific skills and knowledge, like legislation, you can always learn at your job. Learning doesn’t stop after your graduation!

Additionally, we talked about whether to do a PhD or not. He said to only do a PhD if you are really passionate about it. Many companies or organisations will already hire you with a Master’s degree, and starting to work right away will give you the opportunity to build relevant work experience.

As a final piece of advice, he mentioned: “Don’t be afraid to change directions or leave chemistry.” His job involves a lot of law and politics, but thinking in such an interdisciplinary manner has fared him well.

Chemistry vs. History

Stijn Engelaar

Always wondered what different disciplines think about chemistry(students)? Look no further, because in 'chemistry vs ...' we answer exactly this question! In this edition we went to the humanities department of the UvA to interview a history student!

The History student on Chemistry

What is your name and why do you study history?
My name is Maurits and I am in the fourth year of my bachelor working on my thesis. I have been interested in history from a young age. About eight years ago the Second World War started to fascinate me, especially after spending holidays in Normandy and speaking with war veterans. These conversations have given me an insight into what conflict and war might actually entail. My interest in history was even more amplified by the teachers I had in high school, who always spoke of history with a lot of passion!

What does chemistry entail exactly?
Chemistry entails studying chemical processes. These processes are the foundation of the world around us, which makes chemistry, also physics, important in other sciences like biology.

What is the most important thing you have learned in the study?
History is complex, every event consists of many layers which can all be studied. In addition, you always have to be critical about the things you read and hear, if ten people describe the same event they will all tell it differently. Another important subject in history is writing!

Who is the chemistry student?
The chemistry student does not exist. Neither does the history student exist, or a student in general. Surely, it is safe to say that the chemistry student must be good in beta subjects such as physics and mathematics, but I do not think they have a certain general character trait.

In what does the chemistry student overestimate himself?
Statistics are not 'the truth' even though it might be the best way of approaching certain phenomena. Statistics are not flawless because the researchers make decisions in what to measure and what they think is important. Statistics are not neutral!

In what does the history student overestimate himself?
Historians tend to give one explanation for a subject that cannot be explained by one thing. This means that certain nuances and more difficult parts of the history are left out. Some historians also tend to justify their view of the world through things that happened in history.

What are history students better at than chemistry students?
Writing! Also thinking outside of the given framework. Chemistry is stricter in what is allowed and what is not, after all it must describe nature. In history it is not possible to design an experiment to test a hypothesis, which allows for multiple ways of looking at an event.

What are chemistry students better at?
Mathematics and statistics. Just everything that involves calculations.

What does the chemistry student do all day?
Experiments in the lab.

The Chemistry Student on History

What is your name and why do you study history?
J: My name is José and I am a first year master student of the Analytic track. I wanted to study chemistry because it was the class that I enjoyed the most in high school. At that time, I was not interested in a particular part of chemistry, this came in the last year of my bachelor. Another reason why I chose to study chemistry was because of my high school teacher! She explained everything with much enthusiasm. After this I was 'in love' with chemistry.
L: I am Lars. I chose to study Chemistry as it is a broad study with many different directions.

What does history entail exactly?
J: History students learn what happened in different periods in time. I think that history also has different programmes just like chemistry! Different programmes would range from cultural history to studying objects that were used in the past and comparing these to today's items.
L: Everything that has happened before now

What is the most important thing you have learned in the study?
J: An important thing that the chemistry study has taught me is critically reading articles. Not just reading something because you like it but being able to ask critical questions after reading it.
L: Analytical thinking.

Who is the history student?
J: The history student is a social person. They also might read more articles and books than we do.
L: A slightly alternative type with a yellow/brownish jacket which is just a bit too large. Always wearing a peaky blinders hat.

In what does the history student overestimate himself?
J: I think this is a very hard question. If I have to say something, it might be that history students do not merely look at the facts. Some historians can have an opinion about a certain topic and portray this on things that happened in the past.
L: Their political opinion.

In what does the chemistry student overestimate himself?
J: Some chemistry students think that chemistry is a better discipline than others, and therefore they sometimes look down on other disciplines.
L: Their social abilities.

What are history students better at than chemistry students?
J: That must be writing for sure!
L: Being social.

What are chemistry students better at?
J: Chemistry students are better at visualizing ideas because we are using more abstract theories.
L: getting a job.

What does the history student do all day?
J: Philosophising about how different events in the past could have been handled 'better'.
L: Reading books and watching NPO Politiek.

Smaakmatrix

Inspired by the Parool

Scientific

Beer-related

Horrible

Brilliant

After the intelligent lockdown, partial lockdown and severe lockdown we have now made it to a new stage: the evening lockdown

After many years, the Dutch finally qualified for the World Cup again

SO MANY RAINBOWS!!!

Shell moved to the UK

because they didn't like our taxes

The lustrum party was a blast!