Ontwikkelingen

- https://www.nature.com/immersive/d41586-024-03969-z/index.html

leergang levenswetenschappen

Celbiologie (introductiecursus, najaar 2023)
=> Hoe werkt leven?

Biotechnologie (voorjaar 2024)
=> Het manipuleren van leven

Afweer (najaar 2024)
=> hoe blijven we in leven

Ontwikkelingen in de levenswetenschappen (voorjaar 2025)
=> elke 2 jaar?

=> Wat is leven?

excursie

- 27 Maart, donderdag 14h-16h

⇒ Geeske van Woerden, ErasmusMC

=> 4 colleges + excursie

Ontwikkelingen

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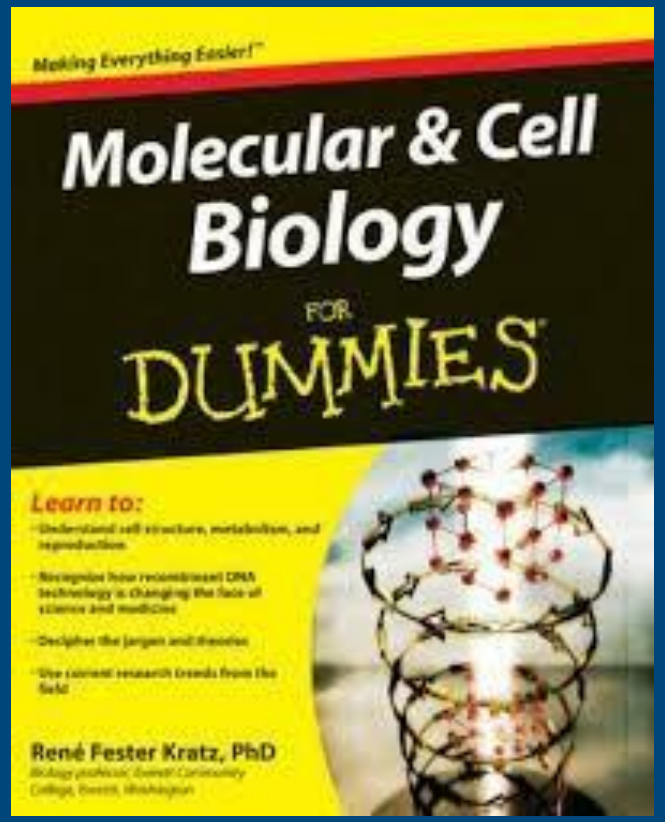
=> elke 2 jaar?

=> Wat is leven?

Celbiologie:



Boek ter ondersteuning (Engels)

MCB H.4

Onderdelen

Informatie	**(DNA/RNA)**
Energie	**(mitochondriën, atomen)**
Biochemie	**(eiwitten, lading)**
Communicatie	**(samenwerking)**

Afweer

Het zenuwstelsel

Stamcellen

De toekomst van de celbiologie

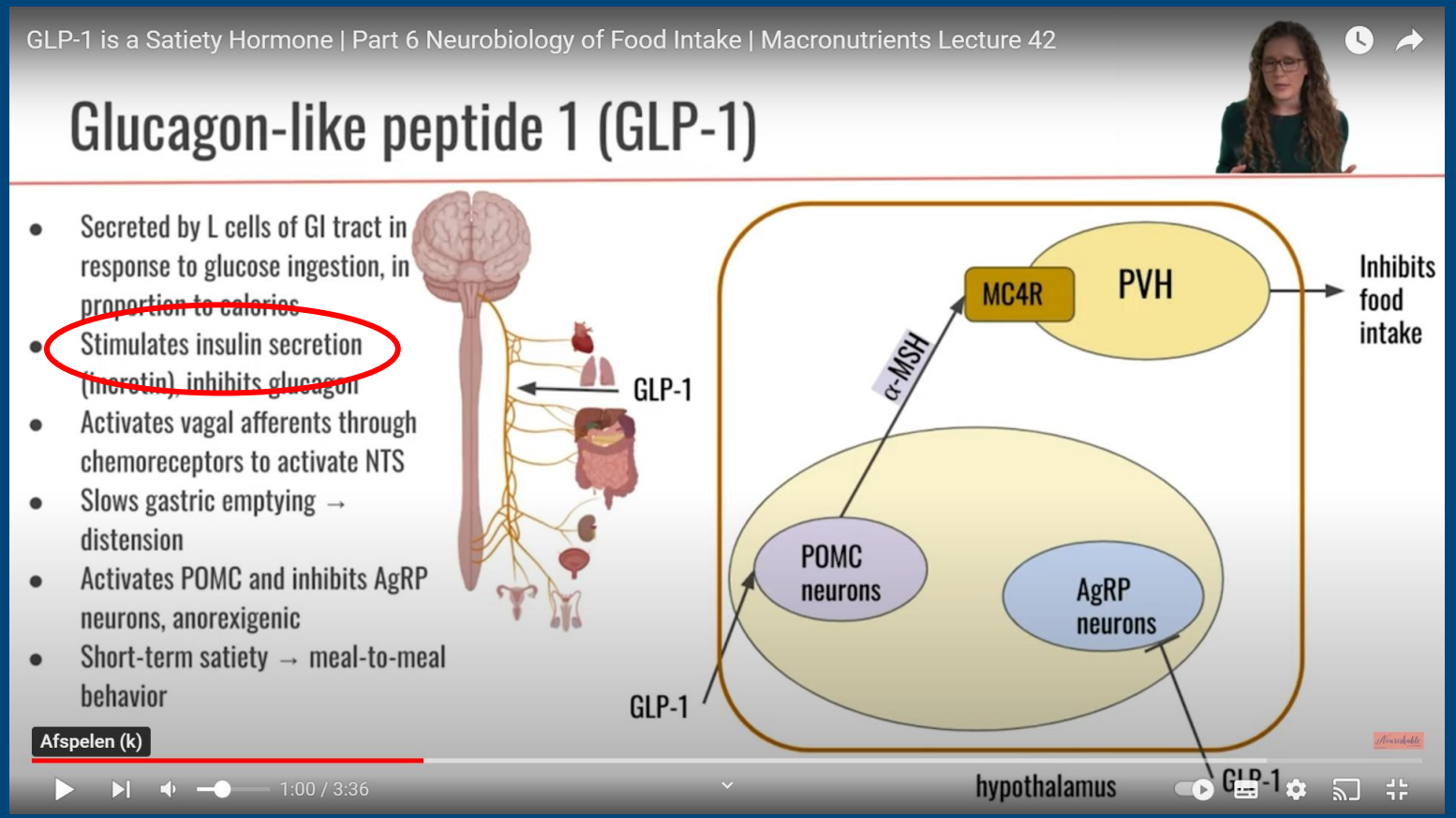
Ozempic

- Semaglutide is a glucagon-like peptide-1 receptor agonist.[11][12][13] By mimicking the action of the incretin glucagon-like peptide-1 (GLP-1), it increases the production of insulin, the hormone that lowers the blood sugar level.[29] It also appears to enhance growth of pancreatic beta cells, which are responsible for insulin production and release.[21][30] Additionally, it inhibits the production of glucagon, the hormone that increases glycogenolysis (release of stored carbohydrate from the liver) and gluconeogenesis (synthesis of new glucose). It reduces food intake by lowering appetite and slowing down digestion in the stomach,[20] helping reduce body fat.[31] It reduces hunger, food craving, and body fat.[32][33]
- https://en.wikipedia.org/wiki/Semaglutide

Possible side effects include nausea, diarrhea, vomiting, constipation, abdominal pain, headache, fatigue, indigestion/heartburn, dizziness, abdominal distension, belching, hypoglycemia (low blood glucose) in patients with type 2 diabetes, flatulence, gastroenteritis, and gastroesophageal reflux disease (GERD).It can also cause pancreatitis, gastroparesis, and bowel obstruction

=> alles liever dan minder eten!

GLP-1



https://youtu.be/ll4qDb08cLE
Bedoeld tegen diabetes

⇒ Maar ook gewicht!
⇒ Helpt tegen algemene verslaving
⇒ Obesity on the brain!

=> GLP-1 agonisten in basispakket!

https://youtu.be/QnmMSMF7wO4

En mensen eten minder
=> klimaatwinst!

Voeding en klimaat

- De voedselindustrie is wereldwijd verantwoordelijk voor 20 à 30% van de totale CO_2-uitstoot.
- Daarvan is veeteelt verantwoordelijk voor zo'n 14,5% van de uitstoot. Dat is dus ongeveer de helft van de uitstoot uit de voedselindustrie.

=> minder hamburgers door ozempic is goed nieuws

2023 Breakthrough of the Year

- Weight loss drugs show promise for a wider range of health benefits
- Are GLP-1 agonists “forever” drugs that people have to take indefinitely to preserve weight loss?
- Doctors worry about people who aren’t overweight or obese turning to the treatment to slim down.
- 1.7% of people in the U.S. have been prescribed either Wegovy or Ozempic this year. Novo Nordisk’s market value now exceeds the gross domestic product of Denmark, its home country.
- https://www.science.org/content/article/breakthrough-of-the-year-2023
- https://youtu.be/QnmMSMF7wO4

=> celbiologie, college 2/4

Dozens of new obesity drugs are coming: these are the ones to watch

- 12 February 2025
- Next-generation obesity drugs will work differently from Ozempic and Wegovy — aiming to deliver greater weight loss with fewer side effects.
- https://www.nature.com/articles/d41586-025-00404-9

Next up in obesity drugs

Expected dates of US approval for new types of weight-loss drugs heading to market.

Estimated year	Drug	Company	Description
2026	Orforglipron	Eli Lilly	An oral, small-molecule drug that activates the glucagon-like peptide 1 (GLP-1) receptor.
2026	CagriSema	Novo Nordisk	An injectable that activates the amylin and GLP-1 receptors.
2027	Survodutide	Boehringer Ingelheim	An injectable that activates the glucagon and GLP-1 receptors.
2027	Retatrutide	Eli Lilly	An injectable that activates GLP-1, gastric inhibitory polypeptide (GIP) and glucagon receptors.
2028 and beyond	MariTide	Amgen	An injectable that activates the GLP-1 receptor while blocking GIP signalling.
2028 and beyond	Bimagrumab	Eli Lilly	An injectable that blocks receptors involved in myostatin signalling.
2028 and beyond	Monlunabant	Novo Nordisk	An oral drug that inhibits the CB1 cannabinoid receptor.

Celbio:
Glucose en diabetes

Insuline (boodschapper)

=> laat glucose binnen

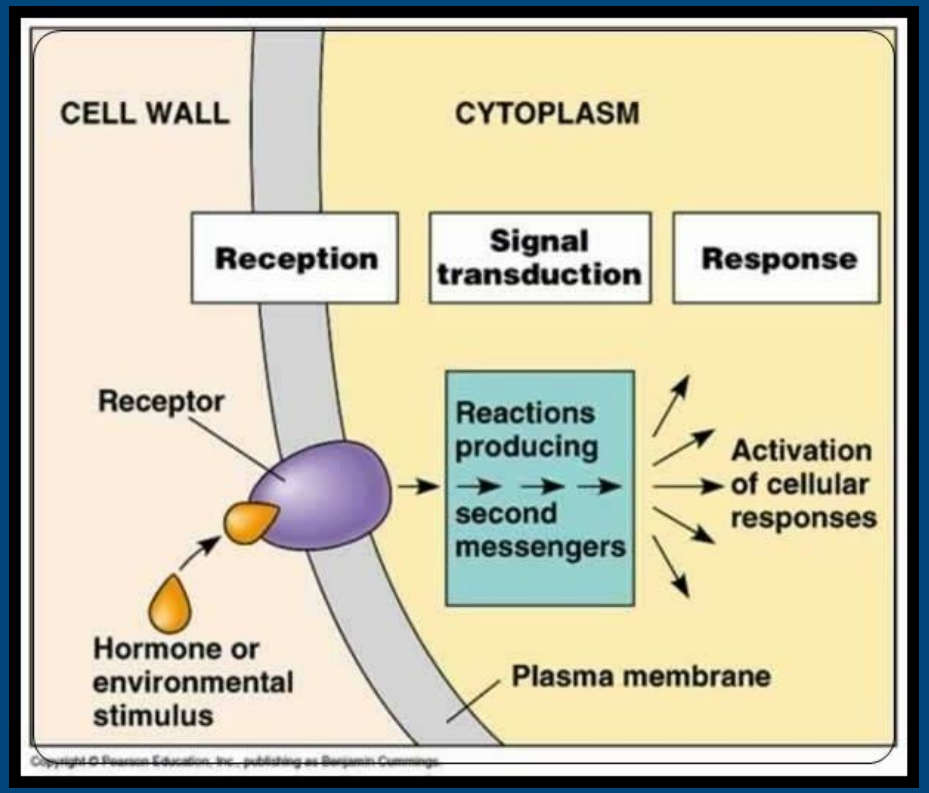
Problemen met insuline

=> Diabetes

Diabetes I = auto-immuun

Diabetes II = verstoring regulatie

GLP-1ra => meer insuline



https://www.youtube.com/watch?v=OXAe3eOjqCk

Ontvanger / boodschapper
(Receptor / ligand)

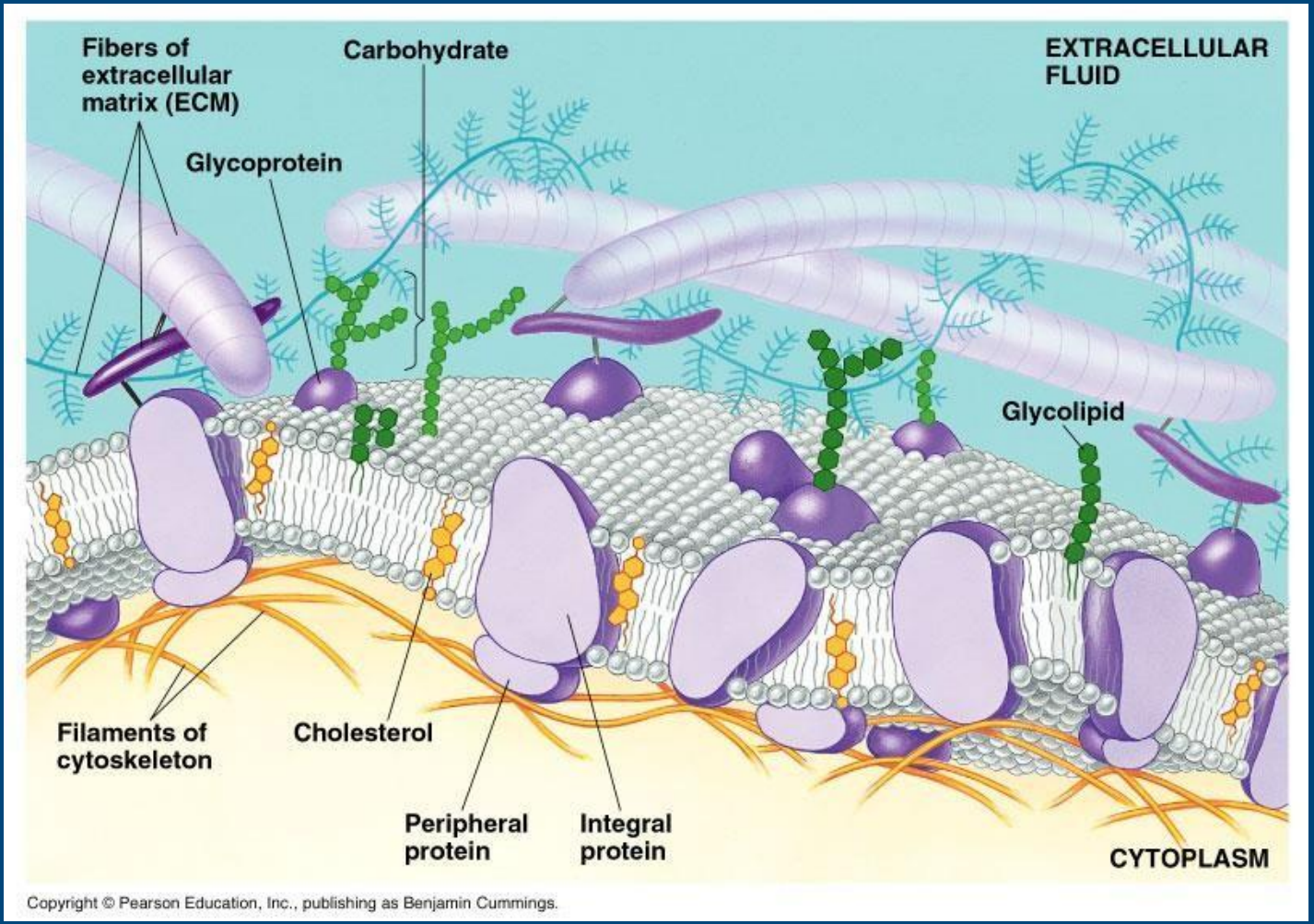
- Vaak target voor geneesmiddelen (buitenkant van de cel, dus makkelijk bereikbaar)

- Beta-adrenoreceptor blocker (Beta blocker) => hart
- Dopamine receptor blocker => hersenen

- EPO
- GLP-1

https://youtu.be/pZpZUqX10WE

Celmembraan



https://www.bioplek.org/animaties/celtotaal/membranenx.html

Ondertussen..

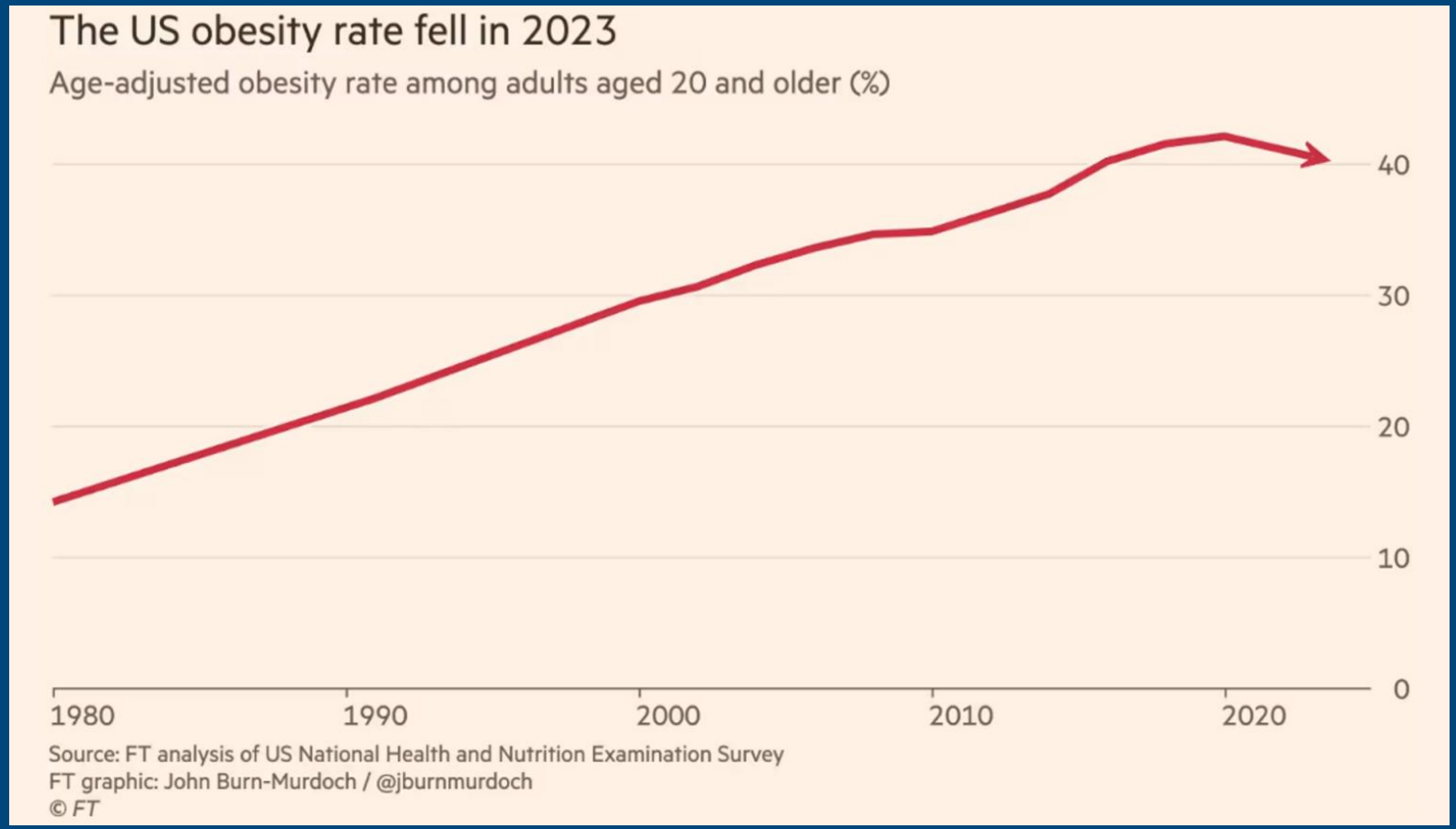
- Doen mensen uit zichzelf de gekste dingen waar je nooit toestemming voor zou krijgen van een ethische commissie: Roken, drinken, virussen verspreiden, teveel eten, teveel zitten, ozempic gebruiken (off-label) etc.

=> buitenkans voor de medische wetenschap

=> Als je iets wilt verkopen (of veranderen) moet je mensen het idee geven dat ze het zelf willen..

We may have passed peak obesity

- Weight loss drugs appear to be having an effect at the population level
- https://www.ft.com/content/21bd0b9c-a3c4-4c7c-bc6e-7bb6c3556a56



Medicalisering van sociaal probleem

- Insuline resistentie (diabetes)
- Verstoorde afweer (IL-6, Corona)
- Gewrichtsproblemen
- Sociale exclusie

=> 80 miljard schade

⇒ Gevolg van levensstijl

⇒ In hoeverre is dit een keuze?

https://www.youtube.com/watch?v=KYoV3RxwFD8

https://nos.nl/nieuwsuur/artikel/2553503-gebruik-dure-afslankspuit-groeit-snel-versterkt-gezondheidskloof

https://npo.nl/start/serie/nieuwsuur/seizoen-2025/nieuwsuur_4976/afspelen

Dik Pic

De strijd tegen dikmakend ultrabewerkt voedsel is zwaar en ondankbaar.

- Volgens Elon Musk daarentegen is de enige remedie tegen de obesitasepidemie om eetlustremmers supergoedkoop te maken.
- Musk heeft met zijn pleidooi voor eetlustremmers de wind mee. Ze zijn in de VS niet aan te slepen, zelfs al zijn ze daar vijf keer zo duur als bij ons. Die prijs zal dalen als over vijf tot tien jaar de patenten verlopen. Bovendien worden ze steeds vaker vergoed door de verzekering; eetlustremmers zijn meer dan een cosmetische behandeling, ze leiden tot minder diabetes, hartinfarcten, beroertes en nierziekten. Slaap-apneu hangt ook sterk samen met obesitas en eetlustremmers helpen er goed tegen. Daarom krijgen in de VS mensen met slaap-apneu nu eetlustremmers vergoed. Ze blijken ook de lust naar alcohol, sigaretten en drugs te remmen; dat gaat een extra argument worden voor vergoeding. Als de halve mensheid ze eenmaal spuit of slikt komen er ongetwijfeld zeldzame bijwerkingen boven water, maar die zullen niet opwegen tegen de vele nare ziekten die mensen nu krijgen van obesitas.
- https://www.nrc.nl/nieuws/2025/01/16/kennedy-musk-en-de-strijd-om-de-slanke-lijn-a4879580?t=1737191042
- Liever technologische oplossing dan maatschappelijk

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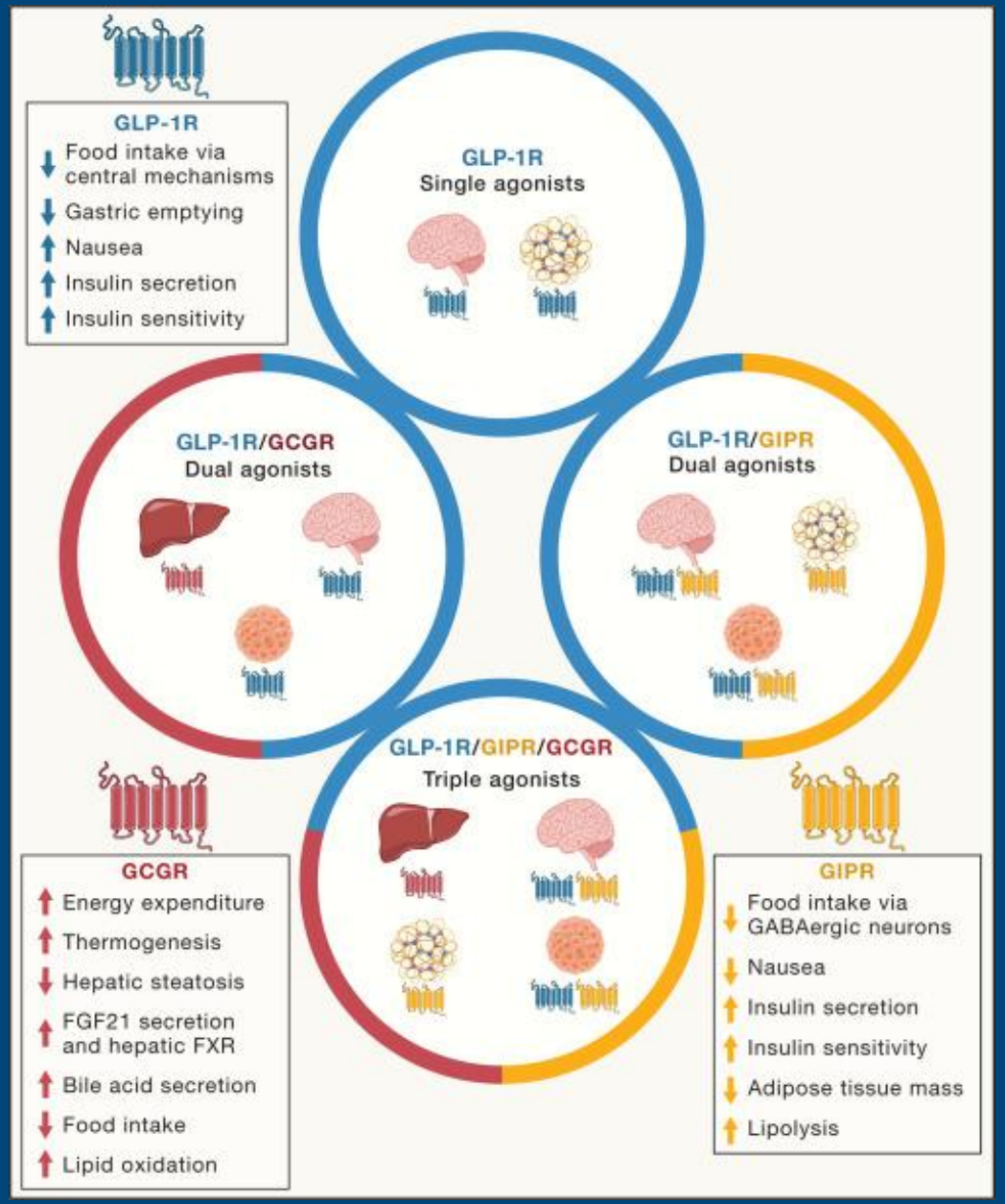
Transforming obesity:
The advancement of multi-receptor drugs

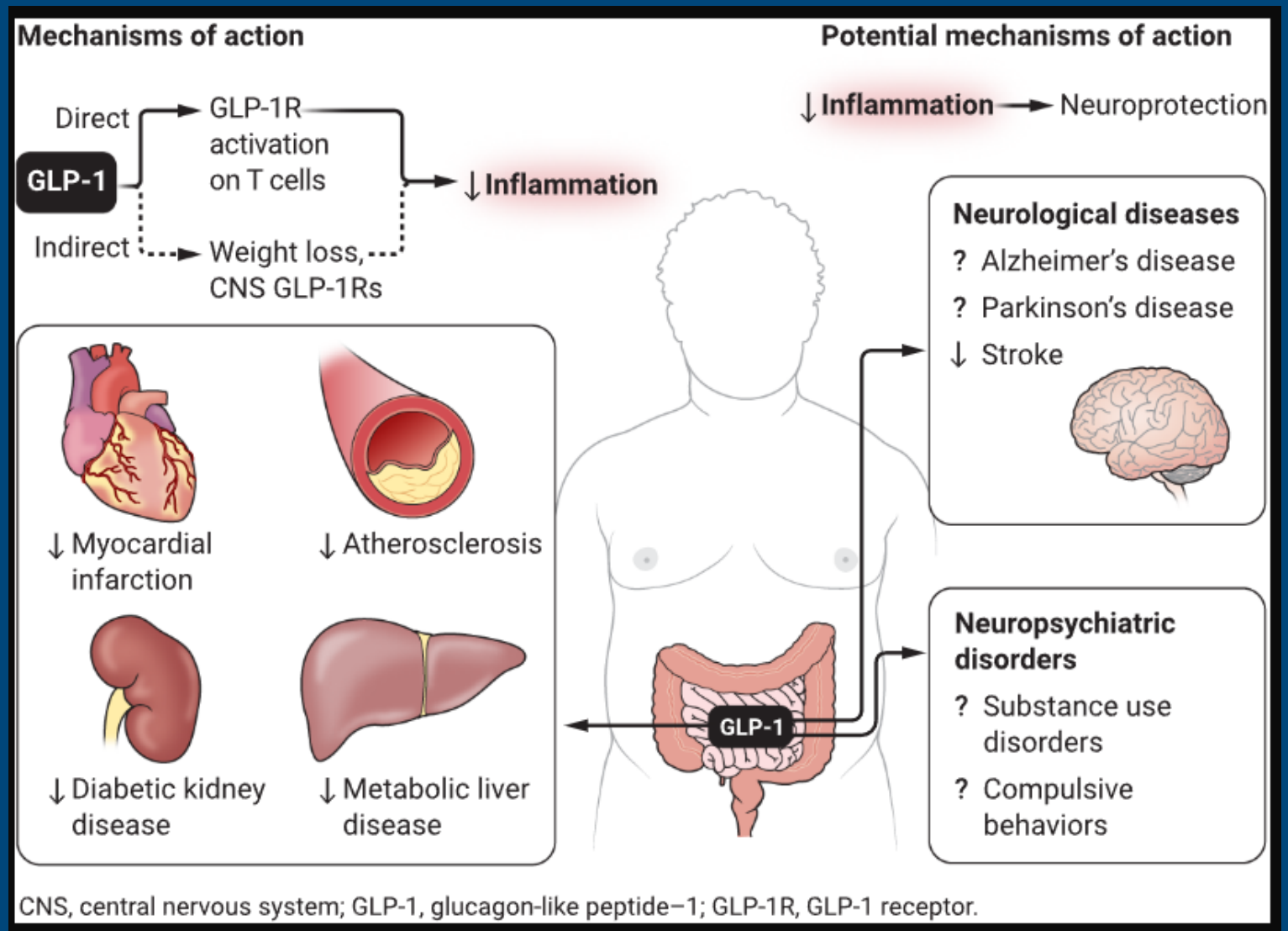
For more than a century, physicians have searched for ways to pharmacologically reduce excess body fat. The tide has finally turned with recent advances in biochemically engineered agonists for the receptor of glucagon-like peptide-1 (GLP-1) and their use in GLP-1-based polyagonists. These polyagonists reduce body weight through complementary pharmacology by incorporating the receptors for glucagon and/or the glucose-dependent insulinotropic polypeptide (GIP). In their most advanced forms, gut-hormone polyagonists achieve an unprecedented weight reduction of up to ~20%–30%, offering a pharmacological alternative to bariatric surgery. Along with favorable effects on glycemia, fatty liver, and kidney disease, they also offer beneficial effects on the cardiovascular system and adipose tissue. These new interventions, therefore, hold great promise for the future of anti-obesity medications.



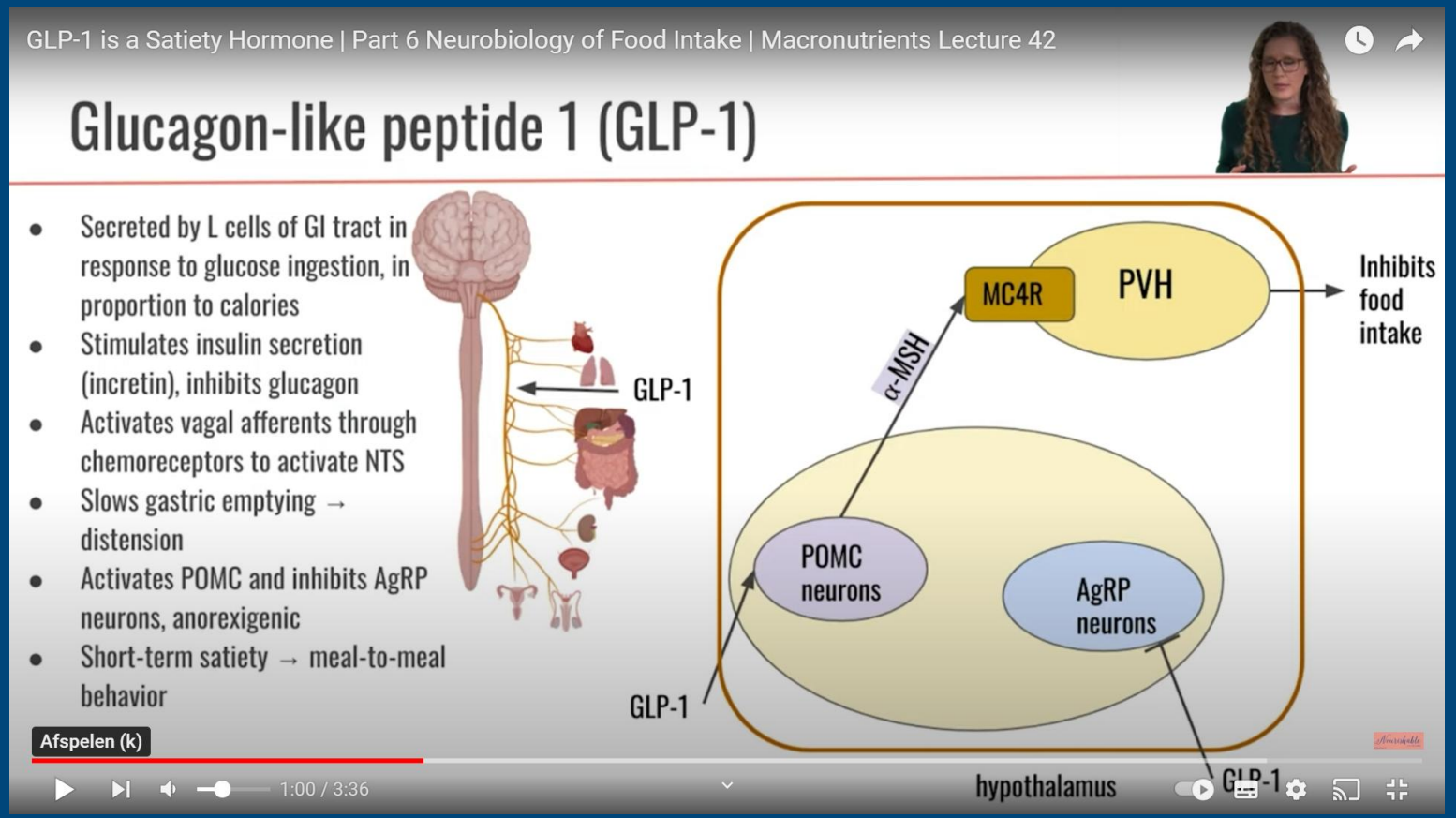
The benefits of GLP-1 drugs beyond obesity

- Glucagon-like peptide–1–based medicines have weight loss–independent actions

- https://www.nature.com/articles/d41586-024-03074-1



GLP-1



https://youtu.be/ll4qDb08cLE
Bedoeld tegen diabetes

⇒ Maar ook gewicht!
⇒ Obesity on the brain!
⇒ Helpt tegen algemene verslaving
=> GLP-1 agonisten in basispakket!

https://youtu.be/QnmMSMF7wO4

En mensen eten minder
=> klimaatwinst!

Popular weight loss drug could stifle alcohol abuse

- Semaglutide, a mimic of the hormone glucagonlike peptide-1 marketed as Ozempic and Wegovy, slashed alcohol consumption versus a placebo
- The first clinical trial testing a wildly popular weight loss drug in people with alcohol use disorder suggests the injectable medicine helped curb cravings, *The Guardian* reports. The results bolster hopes that semaglutide, a mimic of the hormone glucagonlike peptide-1 (GLP-1) marketed as Ozempic and Wegovy, may treat addictions. GLP-1 is released after eating, and GLP-1 mimics are a potent treatment for diabetes and, more recently, obesity. But anecdotal reports that people also lost interest in wine and cigarettes left doctors wondering whether it might work on drug or alcohol addiction as well. In the new study in *JAMA Psychiatry*, 48 people with a drinking problem were randomized to get either 9 weeks of semaglutide or a placebo. Those getting semaglutide consumed about 40% less than the people getting placebo shots when offered their favorite alcoholic beverages. Scientists say trials with more people are now needed.
- https://www.science.org/content/article/popular-weight-loss-drug-could-stifle-alcohol-abuse

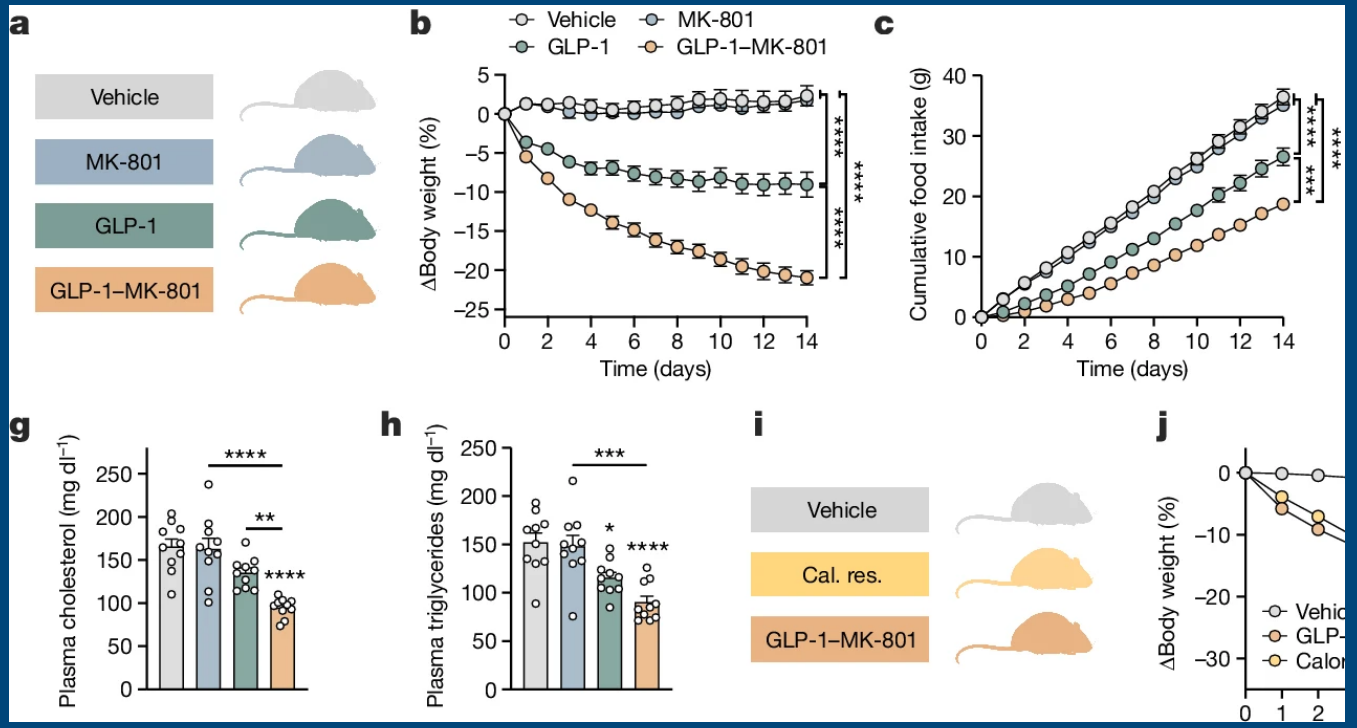
Social media verslaving

- Informatie dieet (Harari)
- https://www.youtube.com/shorts/aEWhNK9b-CM?feature=share

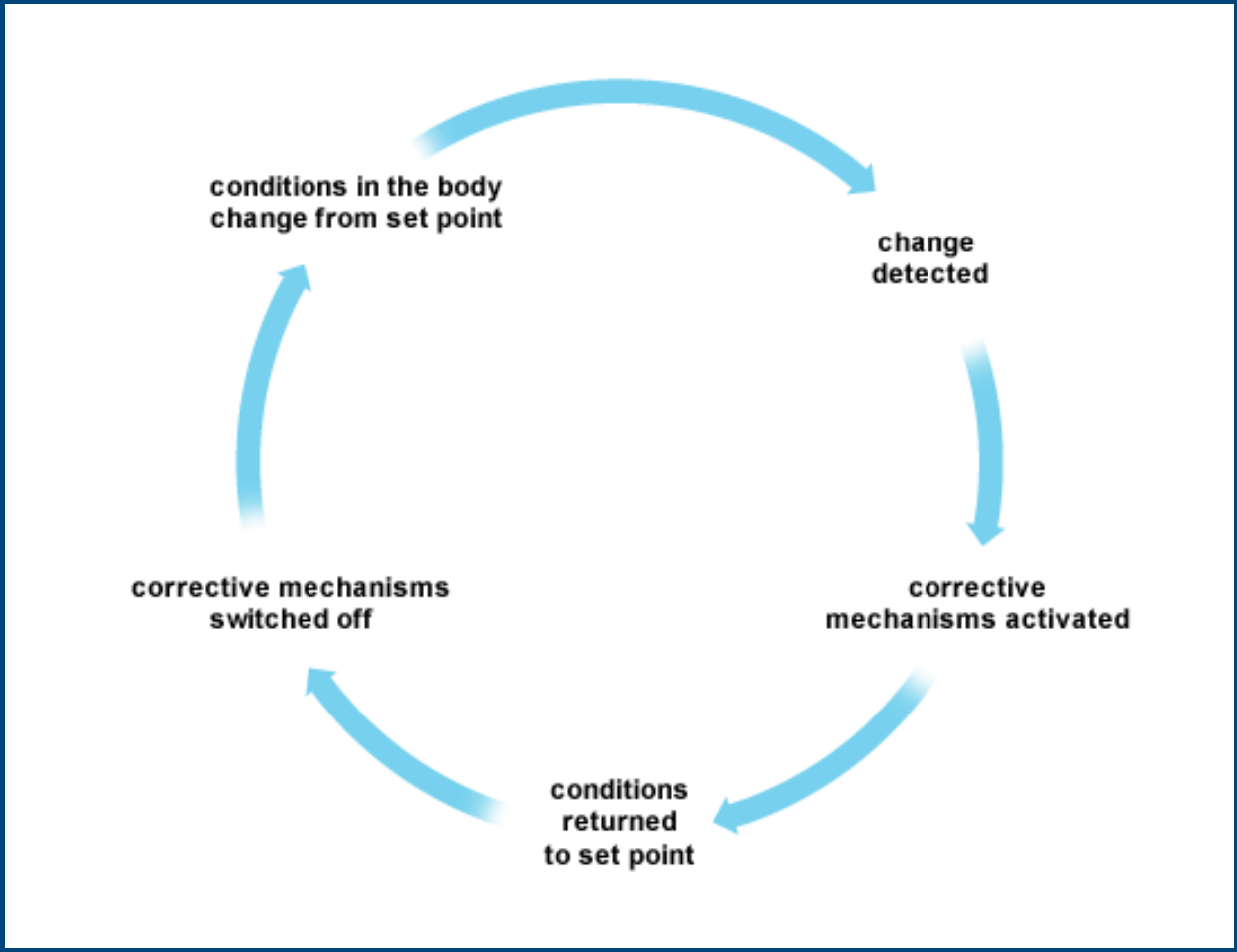
=> Ozempic voor social media!

GLP-1–MK-801 corrects metabolic disease

- The N-methyl-D-aspartate (NMDA) receptor is a glutamate-activated cation channel that is critical to many processes in the brain. Genome-wide association studies suggest that glutamatergic neurotransmission and NMDA receptor-mediated synaptic plasticity are important for body weight homeostasis1. Here we report the engineering and preclinical development of a bimodal molecule that integrates NMDA receptor antagonism with glucagon-like peptide-1 (GLP-1) receptor agonism to effectively reverse obesity, hyperglycaemia and dyslipidaemia in rodent models of metabolic disease.
- https://www.nature.com/articles/s41586-024-07419-8



Feedback in biology:
=> Control and regulation

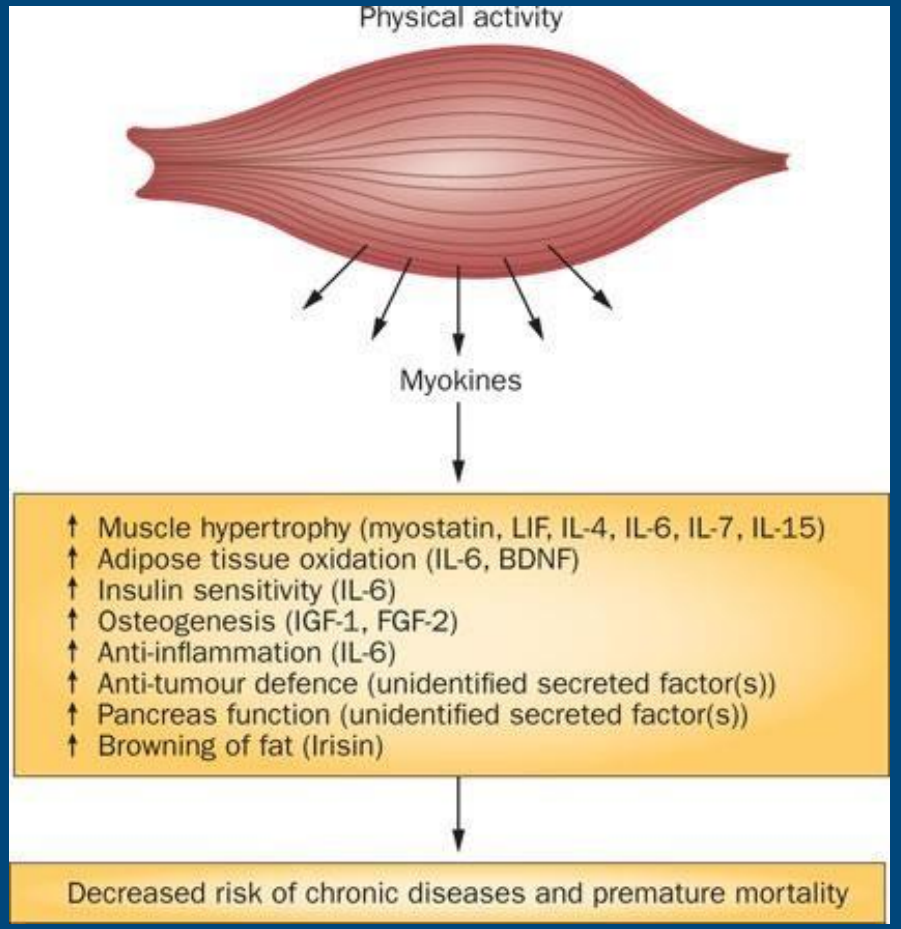


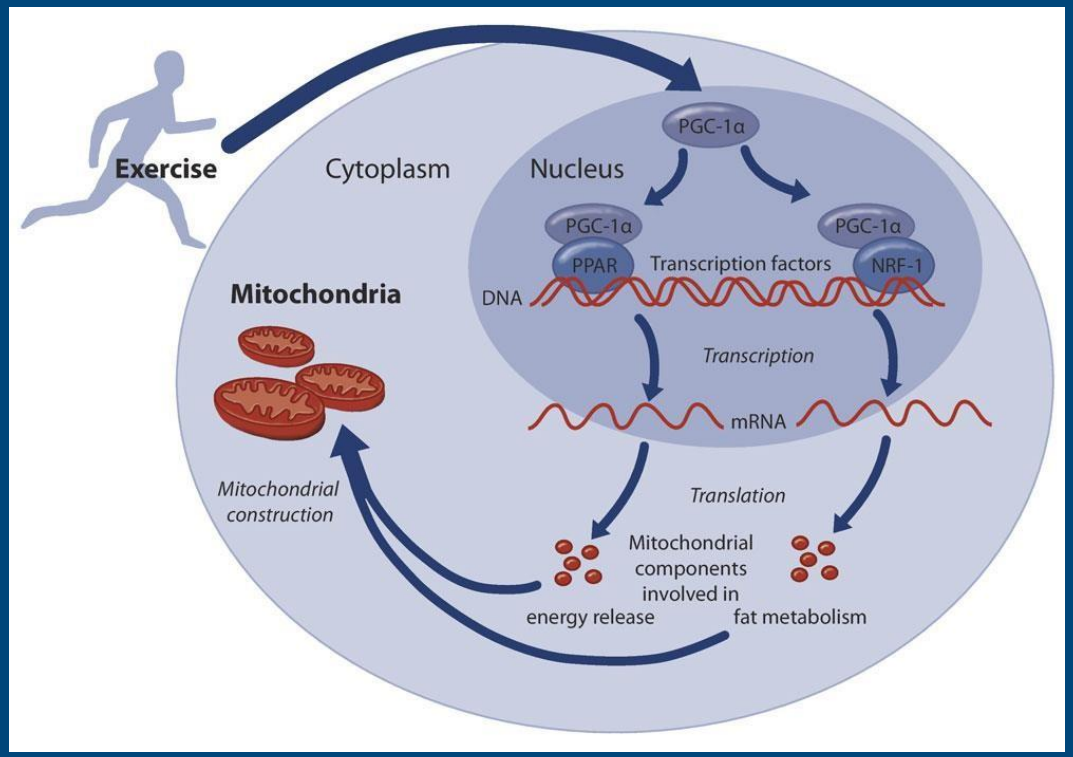
Zit ingebakken in biologische systemen:
Ze verwachten feedback en hebben deze zelfs nodig voor correct functioneren

Nobel 2017
Biologische klok

https://www.youtube.com/watch?v=AZUeKoD_3y0

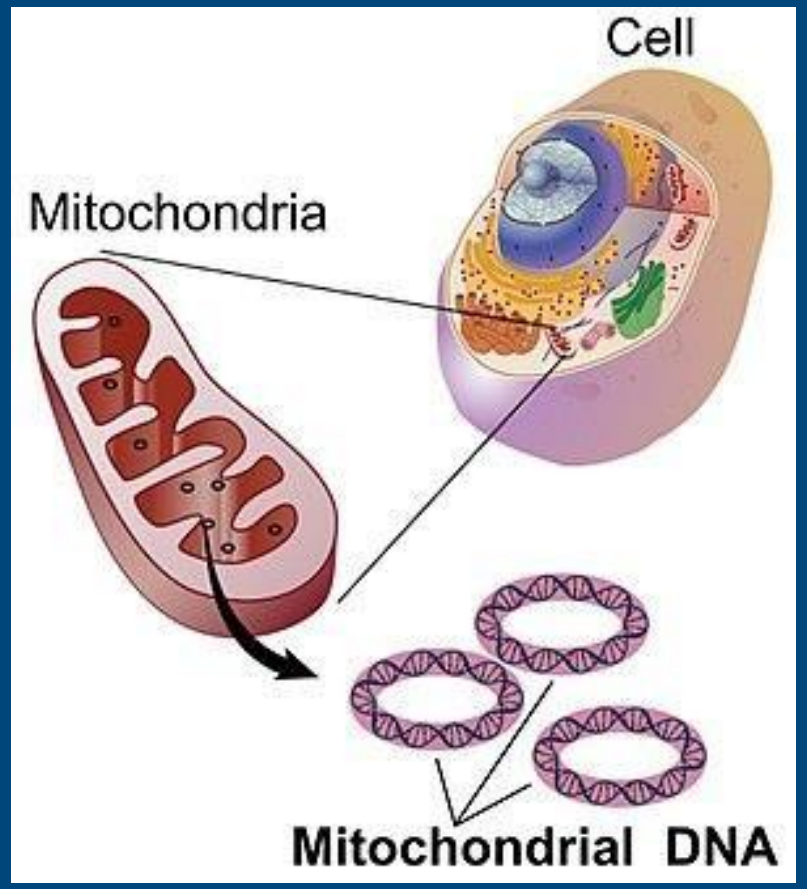
Activiteit en energiehuishouding





http://science.howstuffworks.com/life/cellular-microscopic/fat-cell2.htm

Celbio 2: Het Mitochondrium: De energiefabriek van de cel



Mitochondria waren ooit vrij levende organismen, en hebben nog steeds hun eigen DNA.

Nadeel: Het genoom in de celkern en in de mitochondrien moeten samenwerken

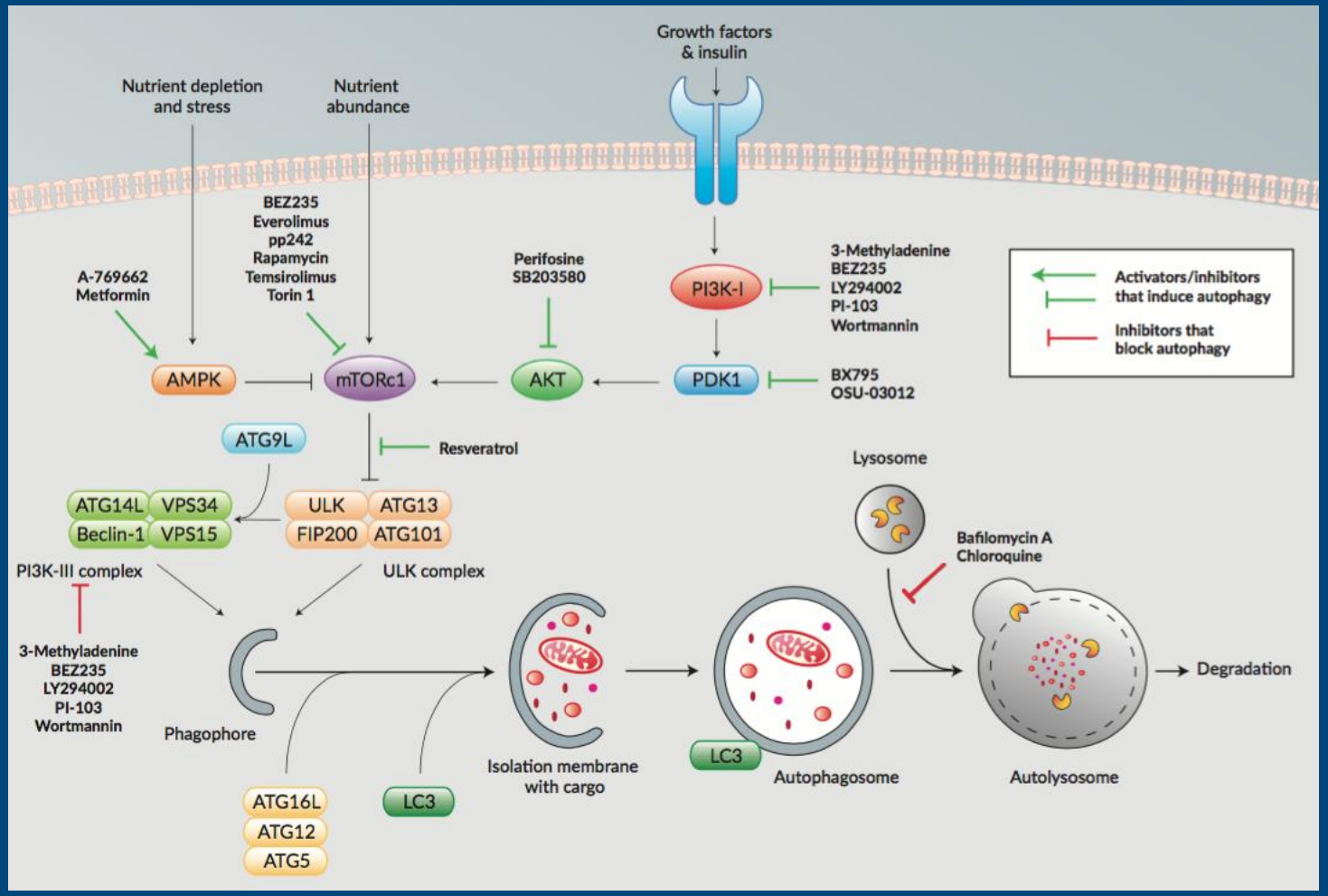
Gevolg: Al het (eukaryote) leven is symbiotisch
⇒ Endosymbiose (beiden hebben voordeel)
Concept: Leven berust op samenwerking

Voordeel: Geen last van sommige beperkingen van de thermodynamica (opp/inhoud)
⇒ Diffusie

https://nl.wikipedia.org/wiki/Endosymbiontentheorie

https://nl.wikipedia.org/wiki/Diffusie

Celbio 8: nutrient sensing and longevity



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6424591/

Studies using yeasts, worms, flies and mice have demonstrated a broad requirement for autophagy-related genes in lifespan extension.

Selective types of autophagy may be crucial for longevity by specifically targeting dysfunctional cellular components and preventing their accumulation

=> Caloric restriction (fasting)

Autophagy, aging, and age-related neurodegeneration

- Autophagy is a conserved mechanism that degrades damaged or superfluous cellular contents and enables nutrient recycling under starvation conditions. Many neurodegeneration-associated proteins are autophagy substrates, and autophagy upregulation ameliorates disease in many animal models of neurodegeneration by enhancing the clearance of toxic proteins, proinflammatory molecules, and dysfunctional organelles. Autophagy inhibition also induces neuronal and glial senescence, a phenomenon that occurs with increasing age in non-diseased brains as well as in response to neurodegeneration-associated stresses. However, aging and many neurodegeneration-associated proteins and mutations impair autophagy. This creates a potentially detrimental feedback loop whereby the accumulation of these disease-associated proteins impairs their autophagic clearance, facilitating their further accumulation and aggregation. Thus, understanding how autophagy interacts with aging, senescence, and neurodegenerative diseases in a temporal, cellular, and genetic context is important for the future clinical application of autophagy-modulating therapies in aging and neurodegeneration.
- https://pubmed.ncbi.nlm.nih.gov/39406236/

=> vasten, ozempic?

Longevity enthusiasts want to create their own independent state.

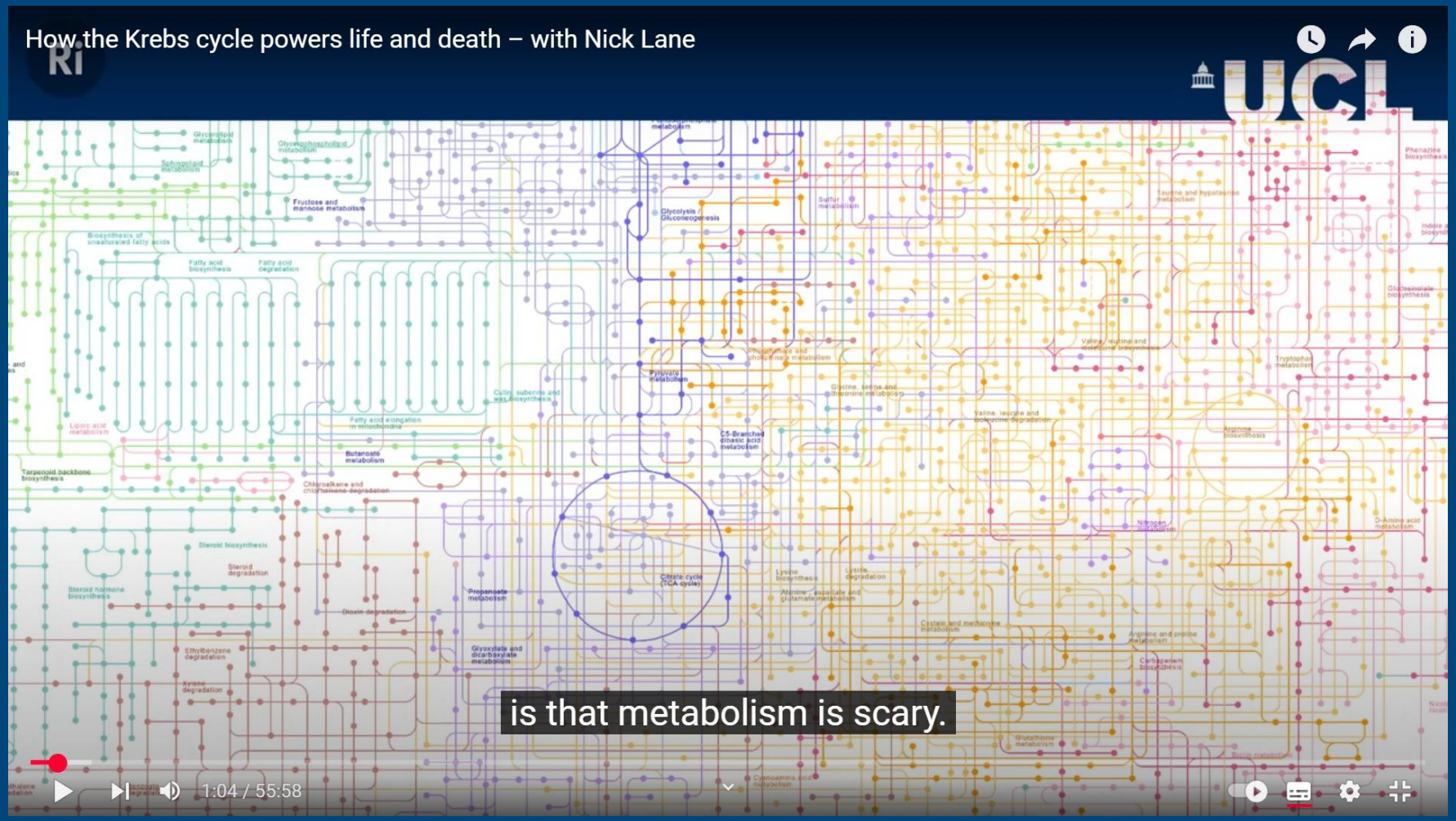
- **<u>BIOTECHNOLOGY AND HEALTH</u>**
- Zuzalu, a pop-up city in Montenegro has provided a temporary home for people who plan to set up a new jurisdiction to encourage biohacking and fast-track drugs that slow or reverse aging.

=> regels vertragen het onderzoek

Energy generation

- https://youtu.be/vBiIDwBOqQA

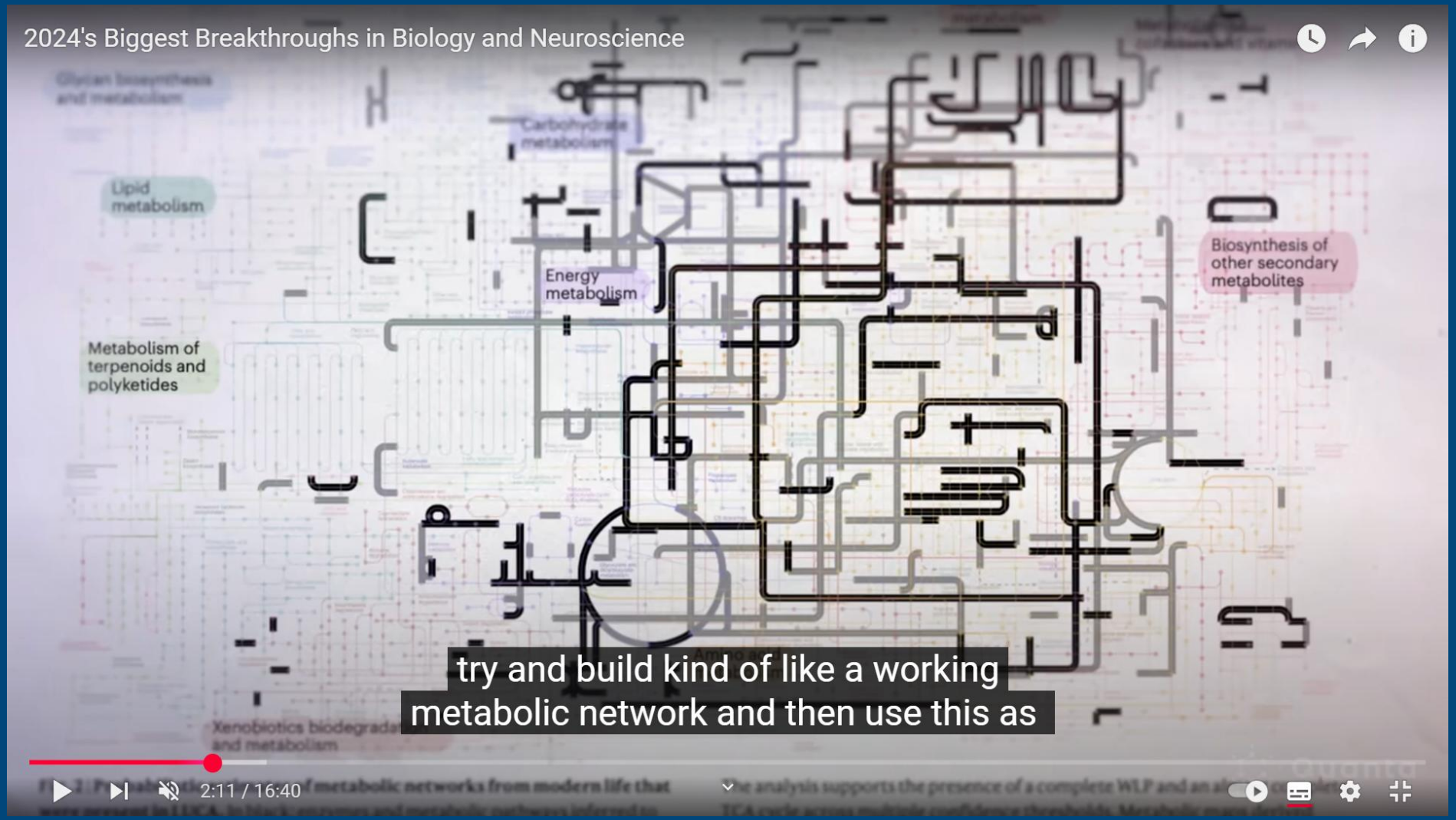
=> AI



AI and science

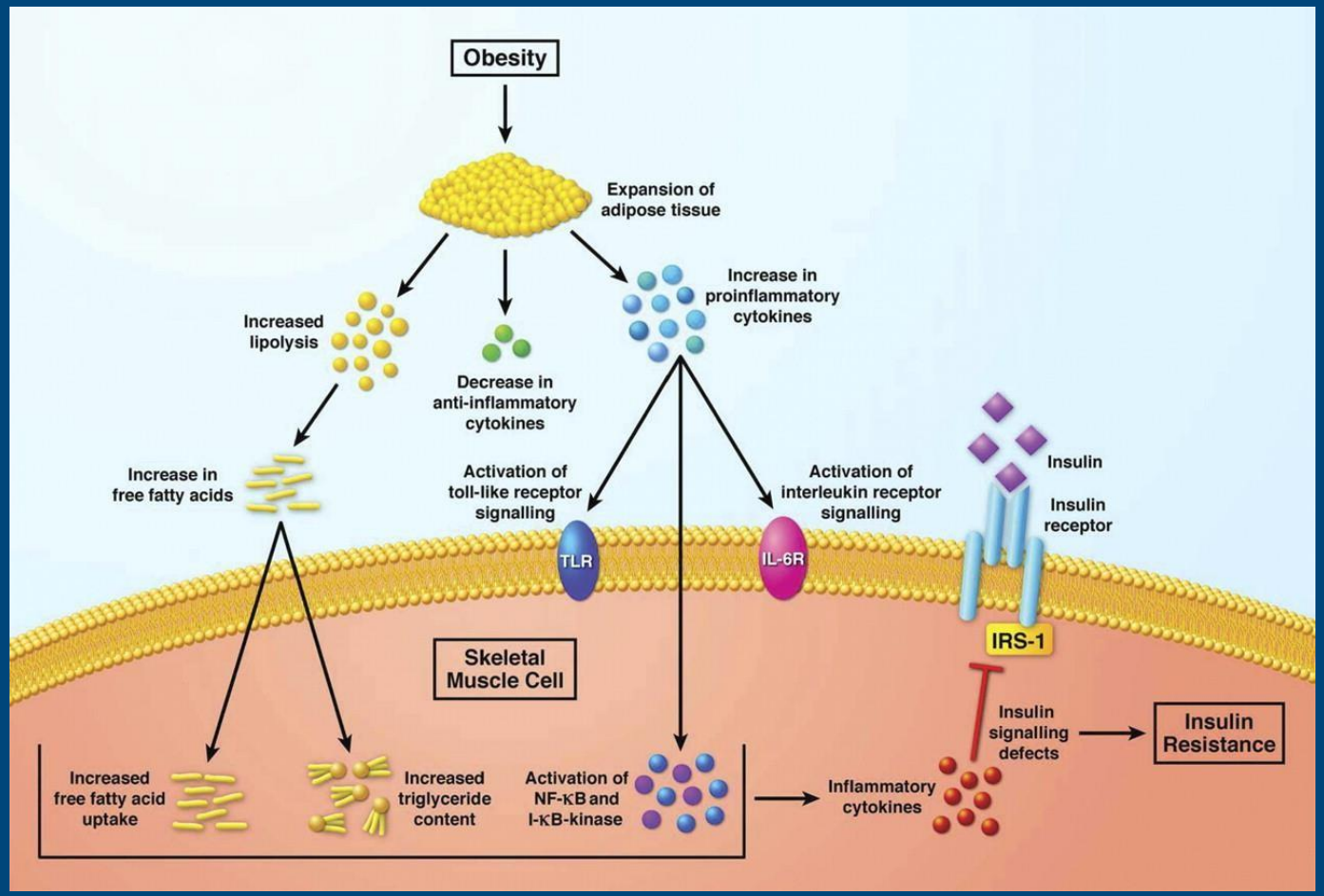
- Across disciplines as varied as biology, physics, mathematics and social science, artificial intelligence (AI) is transforming the scientific enterprise. From machine-learning techniques that hunt for patterns in data, to the latest general-purpose algorithms that can generate realistic synthetic outputs from vast corpuses of text and code, AI tools are accelerating the pace of research and providing fresh directions for scientific exploration.

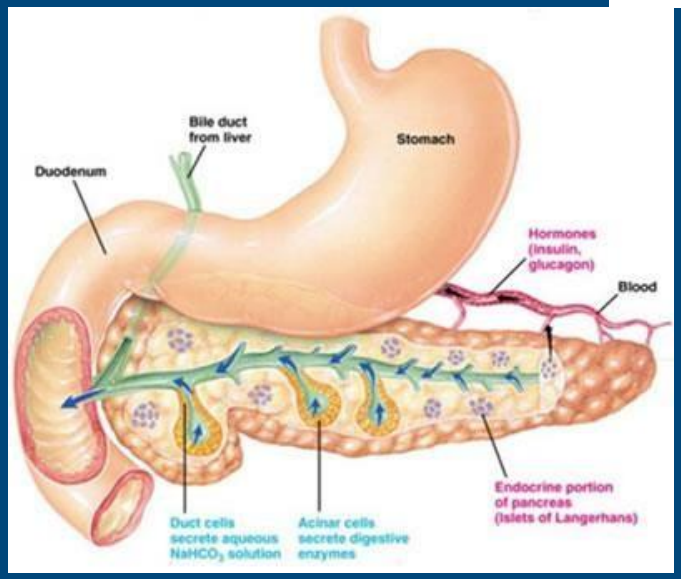
LUCA metabolism



https://youtu.be/p9XHI_26cPE

Insuline resistentie
Teveel eten, te weinig beweging





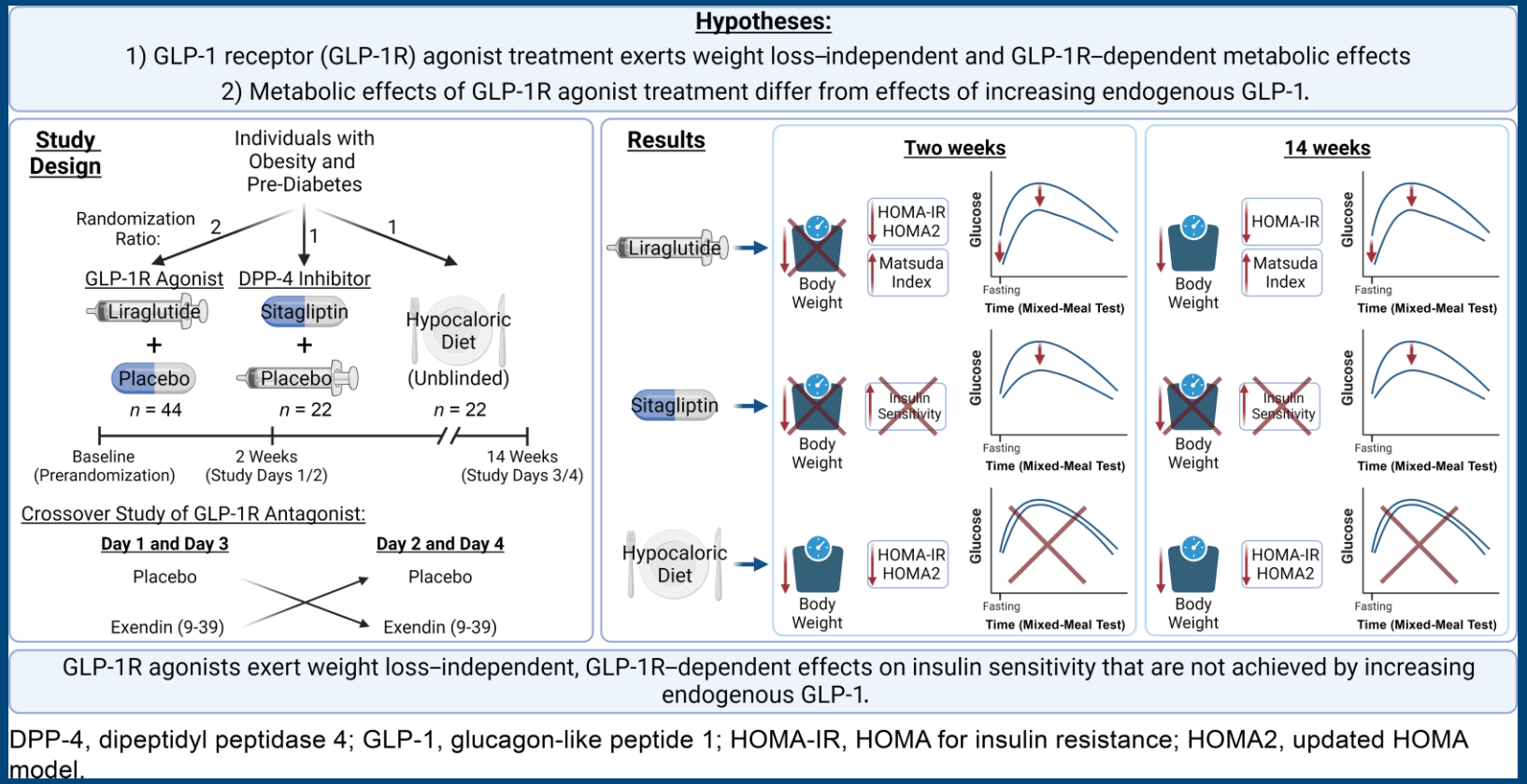
Teveel suikers

=> Suikers worden omgezet in vet.

https://www.youtube.com/watch?v=KYoV3RxwFD8

Weight Loss–Independent Effect of Liraglutide on Insulin Sensitivity in Individuals With Obesity and Prediabetes

- https://diabetesjournals.org/diabetes/article/73/1/38/153785/Weight-Loss-Independent-Effect-of-Liraglutide-on



DPP-4, dipeptidyl peptidase 4; GLP-1, glucagon-like peptide 1; HOMA-IR, HOMA for insulin resistance; HOMA2, updated HOMA model.

Central glucagon-like peptide 1 receptor activation inhibits Toll-like receptor agonist-induced inflammation

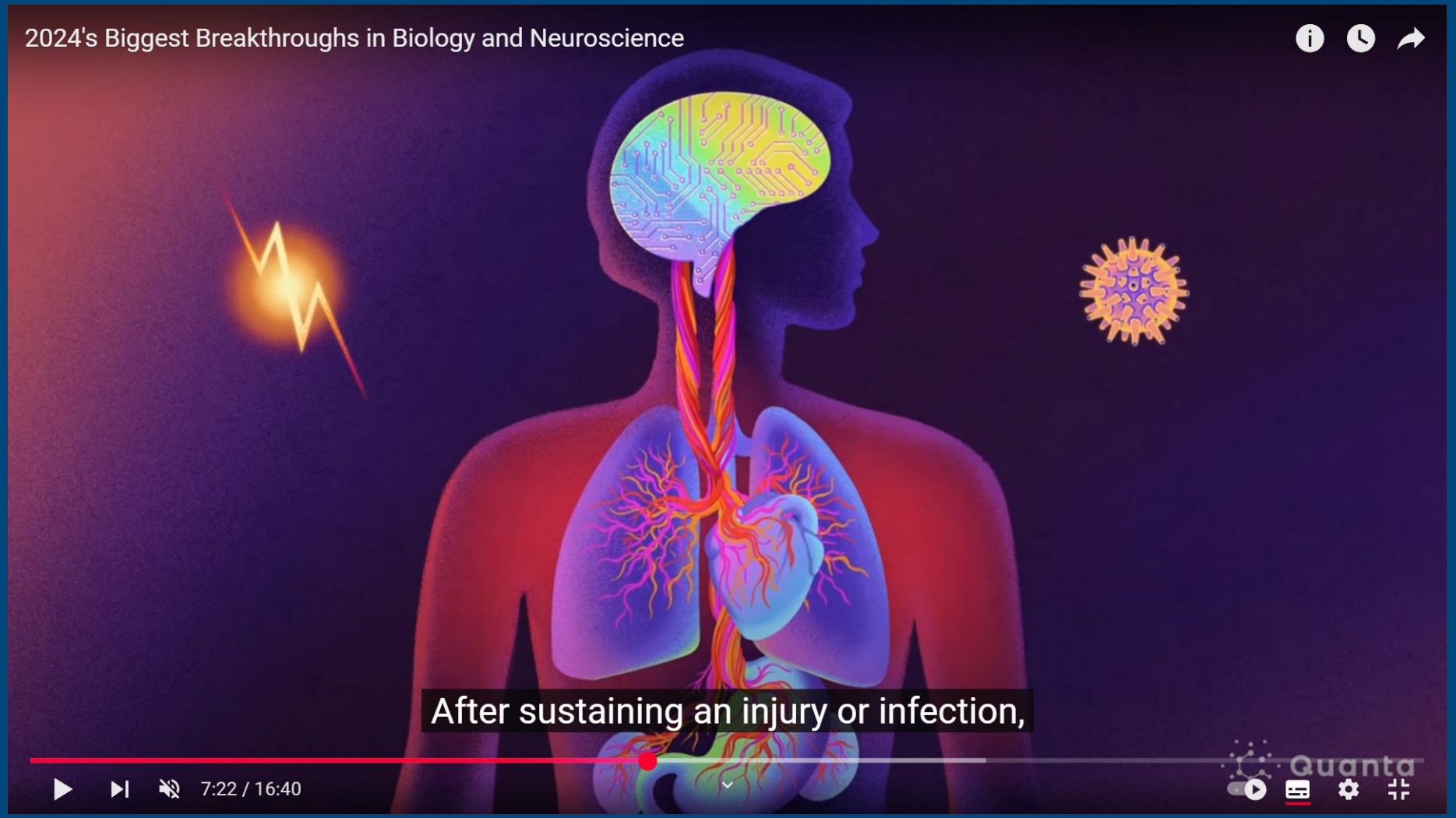
- Mechanistically, GLP-1R activation leads to reduced TNF-α via α_1-adrenergic, δ-opioid, and κ-opioid receptor signaling. These data extend emerging concepts of brain-immune networks and posit a new gut-brain GLP-1R axis for suppression of peripheral inflammation.

- Chi Kin Wong[1], Brent A McLean[1], Laurie L Baggio[1], Jacqueline A Koehler[1], Rola Hammoud[1], Nikolaj Rittig[2], Julian M Yabut[1], Randy J Seeley[3], Theodore J Brown[4], Daniel J Drucker[5]

- Declaration of interests D.J.D. has consulted for Altimmune, Amgen, Kallyope, Merck, Novo Nordisk, Pfizer Inc., and Sanofi Inc. Mt. Sinai Hospital receives operating grant support from Amgen, Novo Nordisk, and Pfizer Inc. for studies in the Drucker lab. R.J.S. has consulted for Novo Nordisk, Scohia, CinRx, Fractyl, Structure Therapeutics, Congruenc Therapeutics, Calibrate, and Rewind and receives operating grant support from Novo Nordisk, Astra Zeneca, Fractyl, and Eli Lilly Inc

- https://pubmed.ncbi.nlm.nih.gov/38113888/
- https://www.science.org/doi/10.1126/science.adn4128

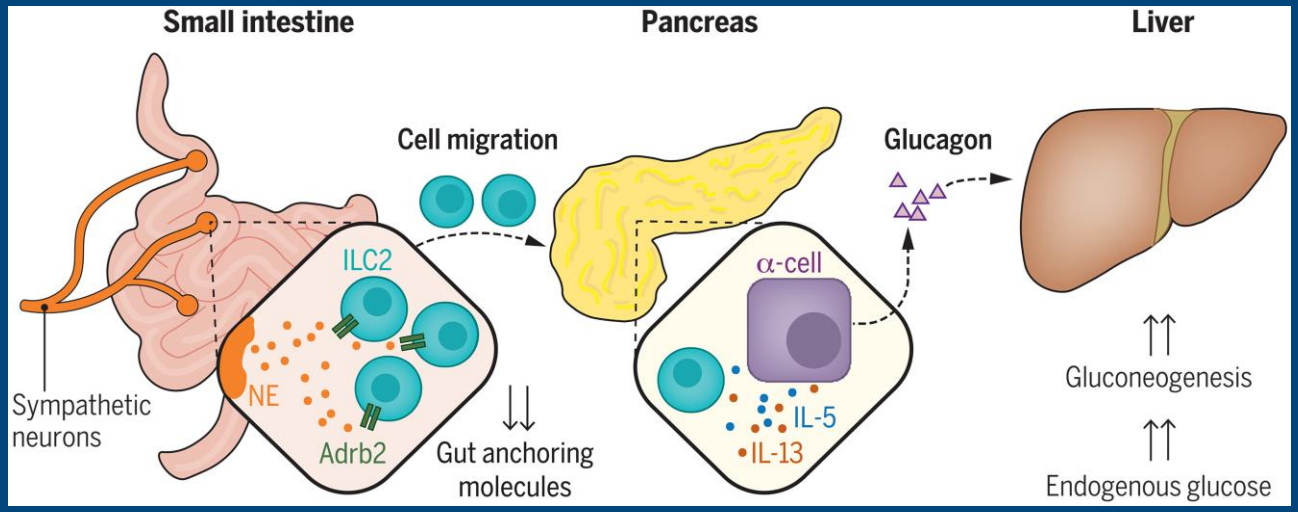
Vagus en ontsteking



https://youtu.be/p9XHI_26cPE

Neuronal-ILC2 interactions regulate pancreatic glucagon and glucose homeostasis

- In addition to host defense, the immune system aids homeostasis within and between tissues.
- Šestan *et al*. found a role for immune cells in regulating blood glucose levels in mice. Upon fasting, a type of innate lymphoid cell called ILC2s increased in number in the pancreas and contributed to the production of glucagon, a hormone required to prevent blood sugar levels from becoming extremely low. ILC2s migrated to the pancreas from the gut in a process dependent on the activation of neurons that innervate the gut from areas of the brain associated with glucose sensing. Cytokines produced by ILC2s could induce pancreatic cells to express glucagon.



Immunity and nutrient sensing

Aged neurons don’t register energy need

- Neuronal activity and mitochondrial gene expression become decoupled in aged mice
- As highly efficient energy factories of the cell, mitochondria generate adenosine triphosphate (ATP), primarily through the process of oxidative phosphorylation (OXPHOS). In the aging mammalian brain, mitochondrial metabolism begins to break down, with widespread consequences for neuronal and circuit function. Degradation of the OXPHOS pathway can drive oxidative stress and mitochondrial damage during aging (*1*). Yet the process by which OXPHOS activity becomes degraded and impairs mitochondrial efficiency has remained unclear. On page 1363 of this issue, Li *et al* (*2*) demonstrate that neuronal excitation increases mitochondrial gene transcription, a process that diminishes with age in mice. Remarkably, restoration of excitation-transcription coupling in mitochondria improves memory function, identifying a potential route to reverse age-related cognitive decline.

Ontwikkelingen

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=> Hoe werkt leven?

Biotechnologie (voorjaar 2024)
=> Het manipuleren van leven

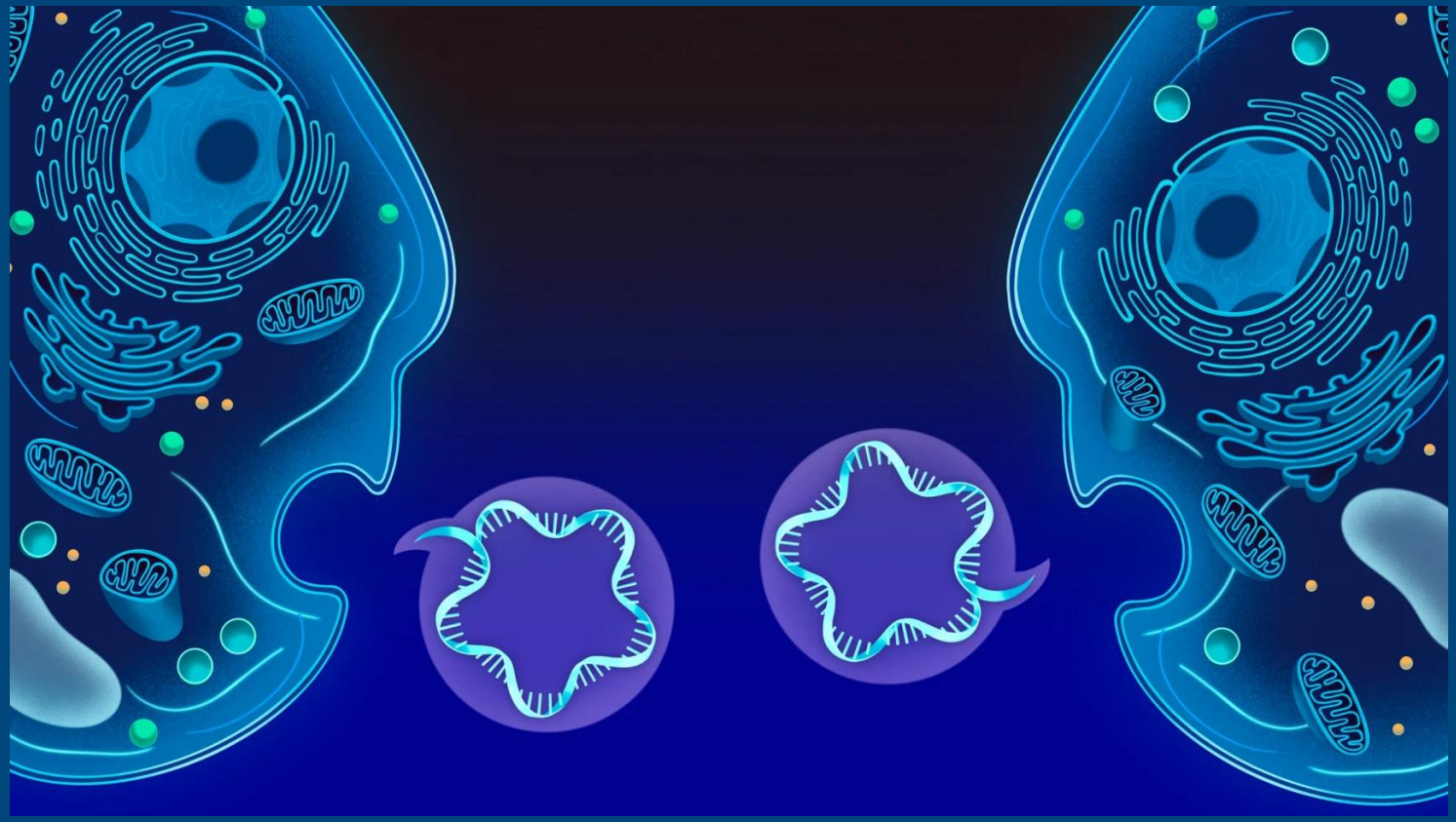
Afweer (najaar 2024)
=> hoe blijven we in leven

Ontwikkelingen in de levenswetenschappen (voorjaar 2025)
=> elke 2 jaar?

=> Wat is leven?

RNA exosomes

- https://www.quantamagazine.org/cells-across-the-tree-of-life-exchange-text-messages-using-rna-20240916

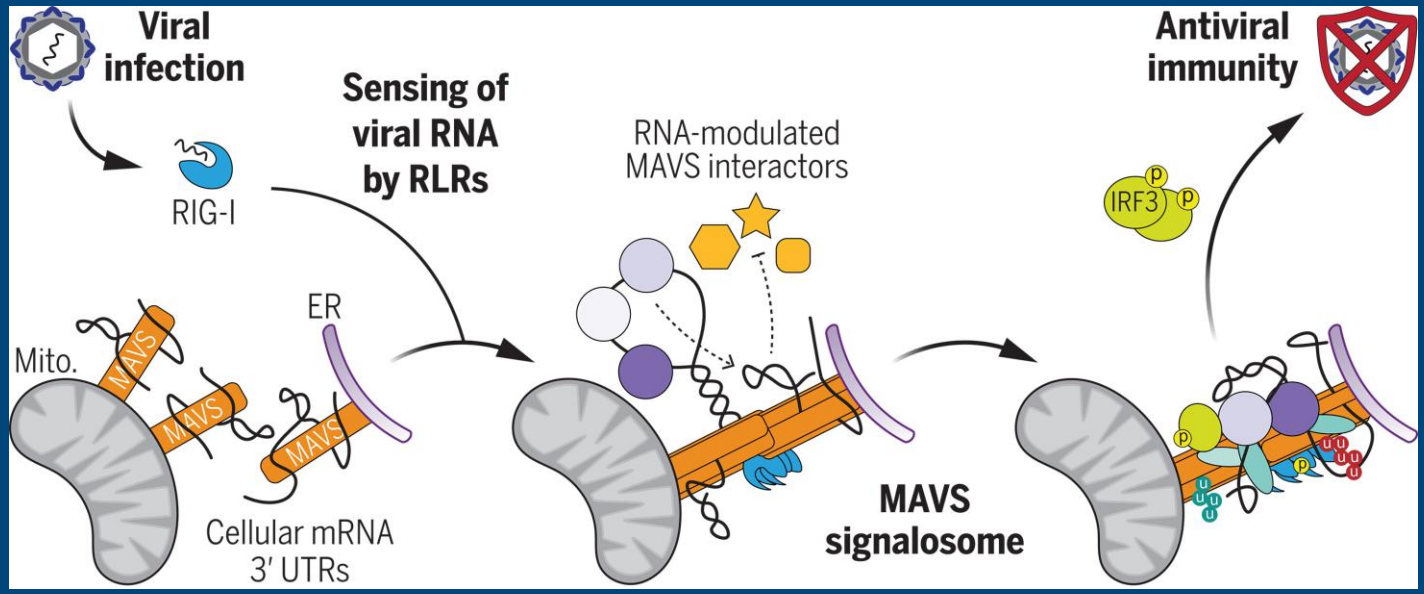


Dark proteome’ survey reveals thousands of new human genes

- Database confirms that overlooked segments of the genome code for a multitude of tiny proteins

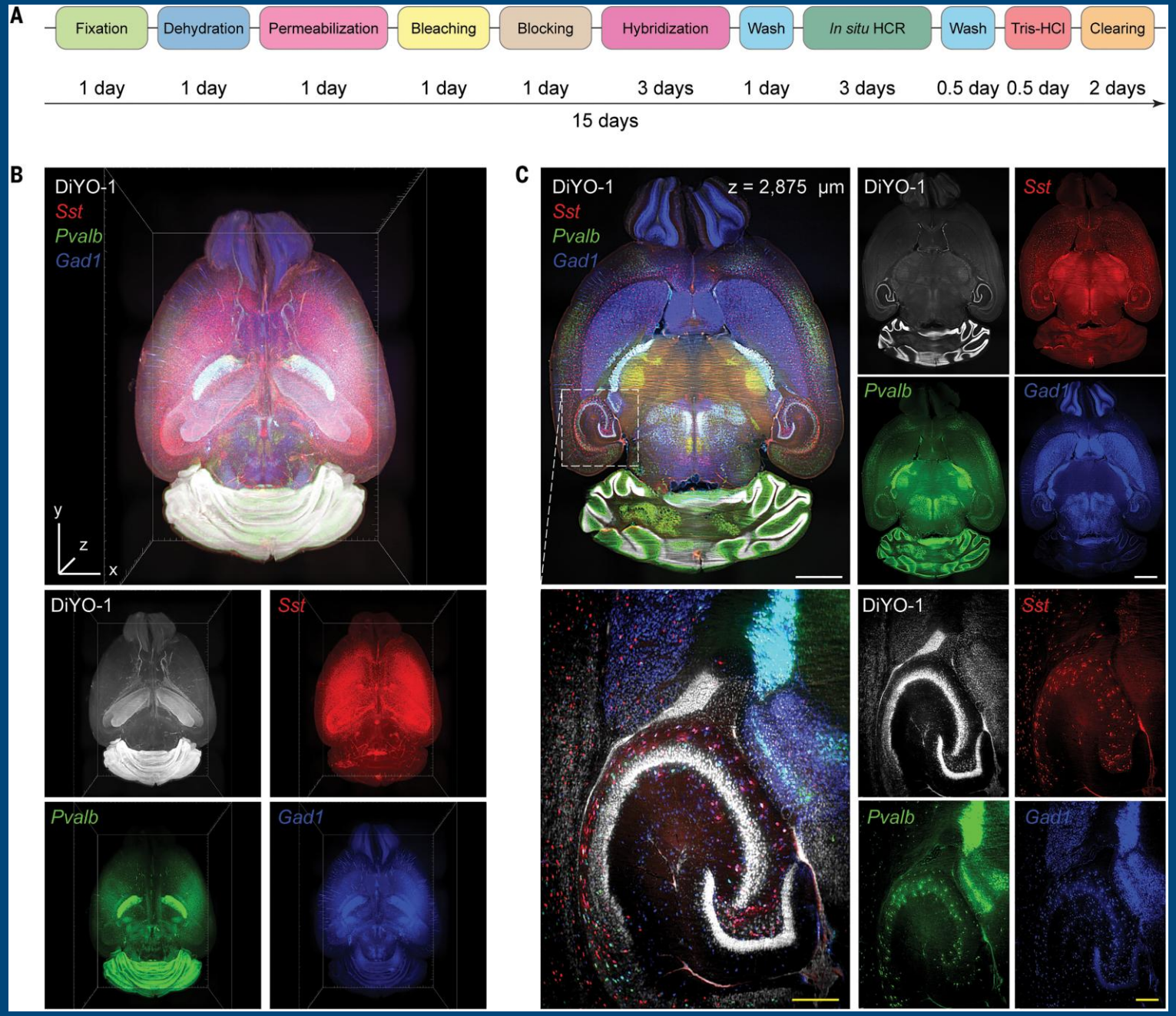
mRNA controleert op viraal RNA en mitochondrien zijn betrokken

- **RNA regulatory control of the MAVS signalosome.**
- The adaptor protein MAVS binds to the 3'UTRs of cellular mRNAs through its central disordered region. After sensing of viral RNA by RLRs, cellular RNA promotes antiviral signaling through the MAVS signalosome by altering MAVS association with RNA-modulated MAVS-interacting factors.
- https://www.science.org/doi/10.1126/science.adl0429



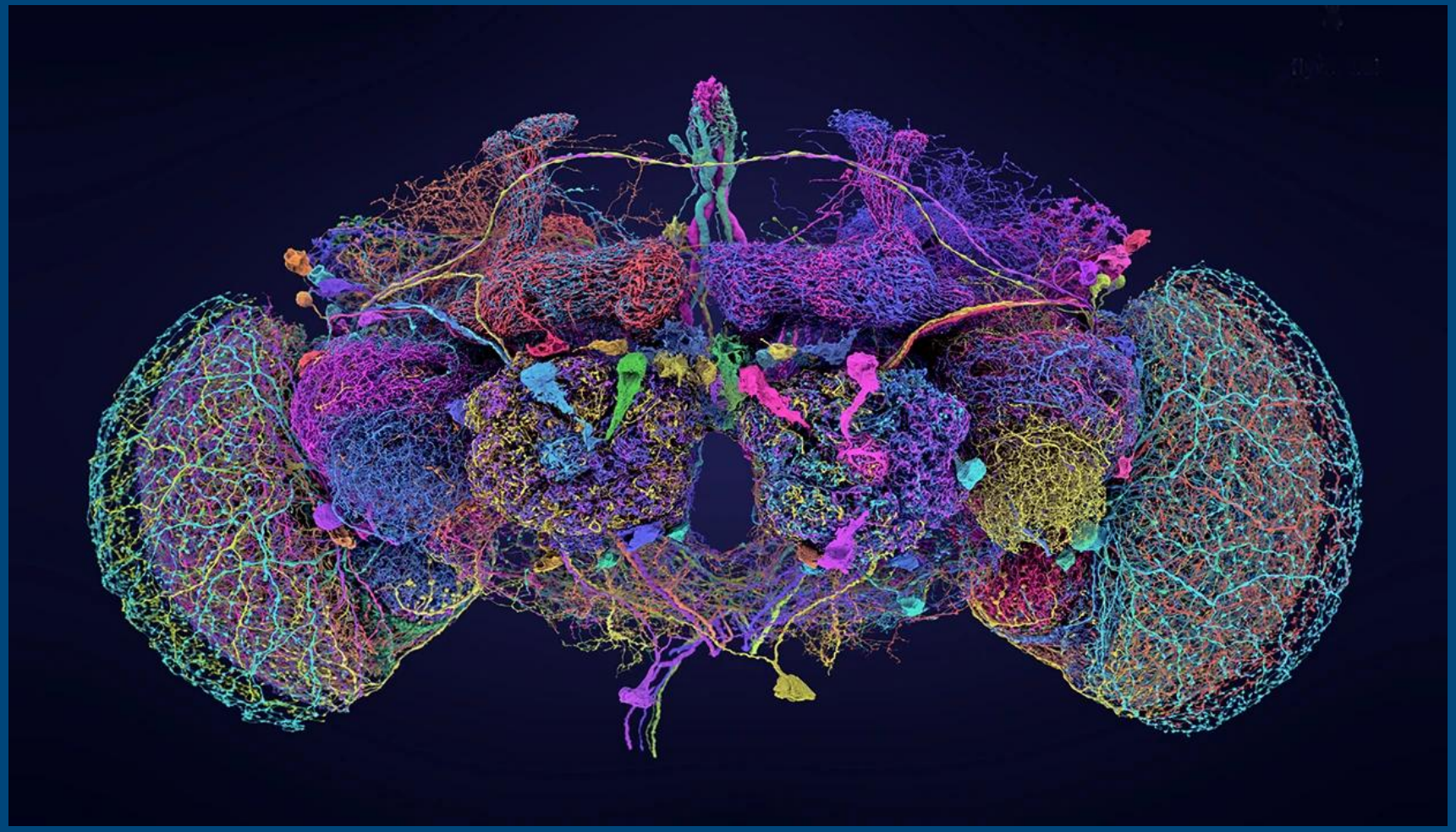
Whole mouse brain imaging of mRNA

- This light-sheet microscopy three-dimensional rendering shows a first-of-its-kind mouse whole-brain mRNA analysis at single-cell resolution
- 3D rendering of the whole brain from an 8-week-old adult mouse stained using TRISCO for cortical interneuron transcripts



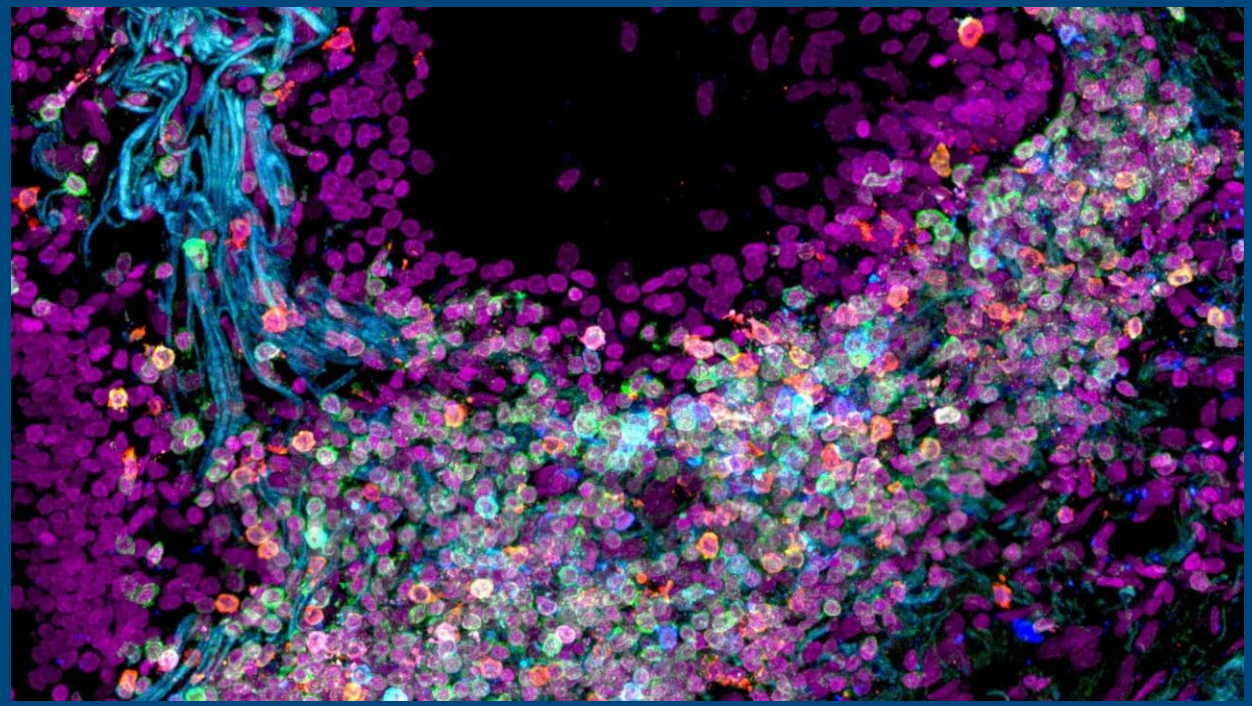
Largest brain map ever reveals fruit fly's neurons in exquisite detail

- Nature 02 October 2024
- **Wiring diagram lays out connections between nearly 140,000 neurons and reveals new types of nerve cell.**



Cell atlas

- https://www.nature.com/immersive/d41859-024-00060-5/index.html
- https://www.nrc.nl/nieuws/2024/11/20/het-landschap-van-alle-menselijke-cellen-in-kaart-a4873867



leergang levenswetenschappen

Celbiologie (introductiecursus, najaar 2024)
=> Hoe werkt leven?

Biotechnologie (voorjaar 2025)
=> Het manipuleren van leven

Afweer (najaar 2025)
=> hoe blijven we in leven

Ontwikkelingen in de levenswetenschappen (voorjaar 2026)
=> elke 2 jaar?

=> Wat is leven?

Living skin helps robot make a happy face

- Anchors inspired by skin ligaments connect cell-based composite to robotic visage.

Pokon Powerplanten

- Planten die appen, als ze verzorging nodig hebben

Massive solar farms could provoke rainclouds in the desert

- **6 FEB 2024**
- Updrafts from dark solar panels could fuel storms—an alternative to cloud seeding
- In the United Arab Emirates, water is more valuable than oil. To support the needs of its desert-dwelling residents, the UAE relies on expensive desalination plants and campaigns of cloud seeding from aircraft, which spray particles into passing clouds to trigger rainfall.
- But according to a new modeling study, there may be another way to stir up a rainmaker: with city-size solar farms that create their own weather. The heat from large expanses of dark solar panels can cause updrafts that, in the right conditions, lead to rainstorms, providing water for tens of thousands of people. “Some solar farms are getting up to the right size right now,” says Oliver Branch, a climate scientist at the University of Hohenheim who led the work, published last week in the journal *Earth System Dynamics*. “Maybe it’s not science fiction that we can produce this effect.”

Australie als oplossing:

Genoeg oppervlak (solar influx)

Veel woestijn (70%)

Goede instituten

"Venture capital”

Beplanting woestijn:

=> Extra voedsel voor miljarden

=> CO2 opname vgl met jaarlijkse uitstoot van de wereld

Sequestratie (via koeien)

⇒ Vlees eten wordt goed voor milieu

⇒ Vet opslaan ook

Genoeg water (oceaan)

Hydrolyse => waterstof => lokale waterproductie in de woestijn (mijnbouw), en verkopen van de rest.

Vooral een poging om noodzakelijke verandering een positieve draai te geven. Het verhaal is nu vooral negatief.

“Advocating less does not sell well”

Voedselproductie Australie kan flink omhoog => nieuwe inkomsten

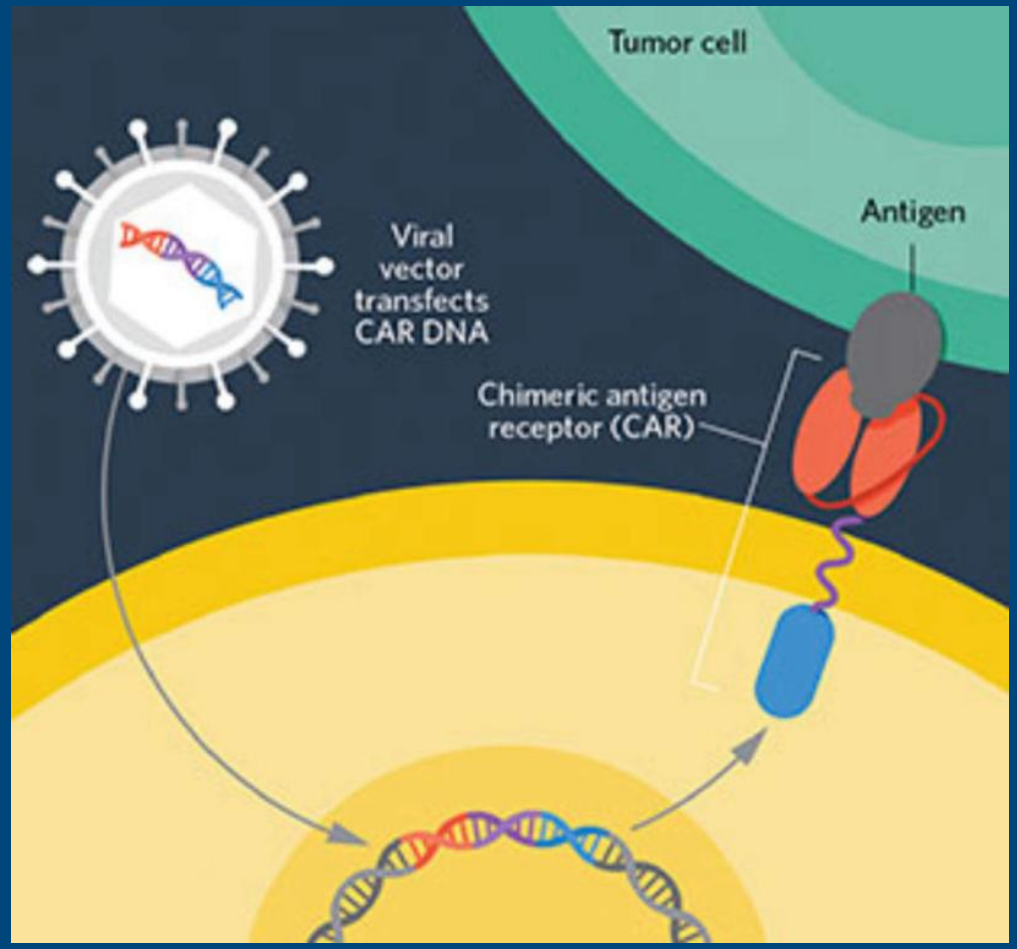
En met 10% van Australie vol met zonnepanelen kan je meer waterstof maken dan de wereld nodig heeft => nieuwe sjeiks

Durable CO_2 conversion in the proton-exchange membrane system

- Electrolysis that reduces carbon dioxide (CO_2) to useful chemicals can, in principle, contribute to a more sustainable and carbon-neutral future[1,2,3,4,5,6]. However, it remains challenging to develop this into a robust process because efficient conversion typically requires alkaline conditions in which CO_2 precipitates as carbonate, and this limits carbon utilization and the stability of the system[7,8,9,10,11,12]. Strategies such as physical washing, pulsed operation and the use of dipolar membranes can partially alleviate these problems but do not fully resolve them[11,13,14,15]. CO_2 electrolysis in acid electrolyte, where carbonate does not form, has therefore been explored as an ultimately more workable solution[16,17,18]. Herein we develop a proton-exchange membrane system that reduces CO_2 to formic acid at a catalyst that is derived from waste lead–acid batteries and in which a lattice carbon activation mechanism contributes. When coupling CO_2 reduction with hydrogen oxidation, formic acid is produced with over 93% Faradaic efficiency. The system is compatible with start-up/shut-down processes, achieves nearly 91% single-pass conversion efficiency for CO_2 at a current density of 600 mA cm^{-2} and cell voltage of 2.2 V and is shown to operate continuously for more than 5,200 h. We expect that this exceptional performance, enabled by the use of a robust and efficient catalyst, stable three-phase interface and durable membrane, will help advance the development of carbon-neutral technologies.
- => win win

Introductie:
CAR-T

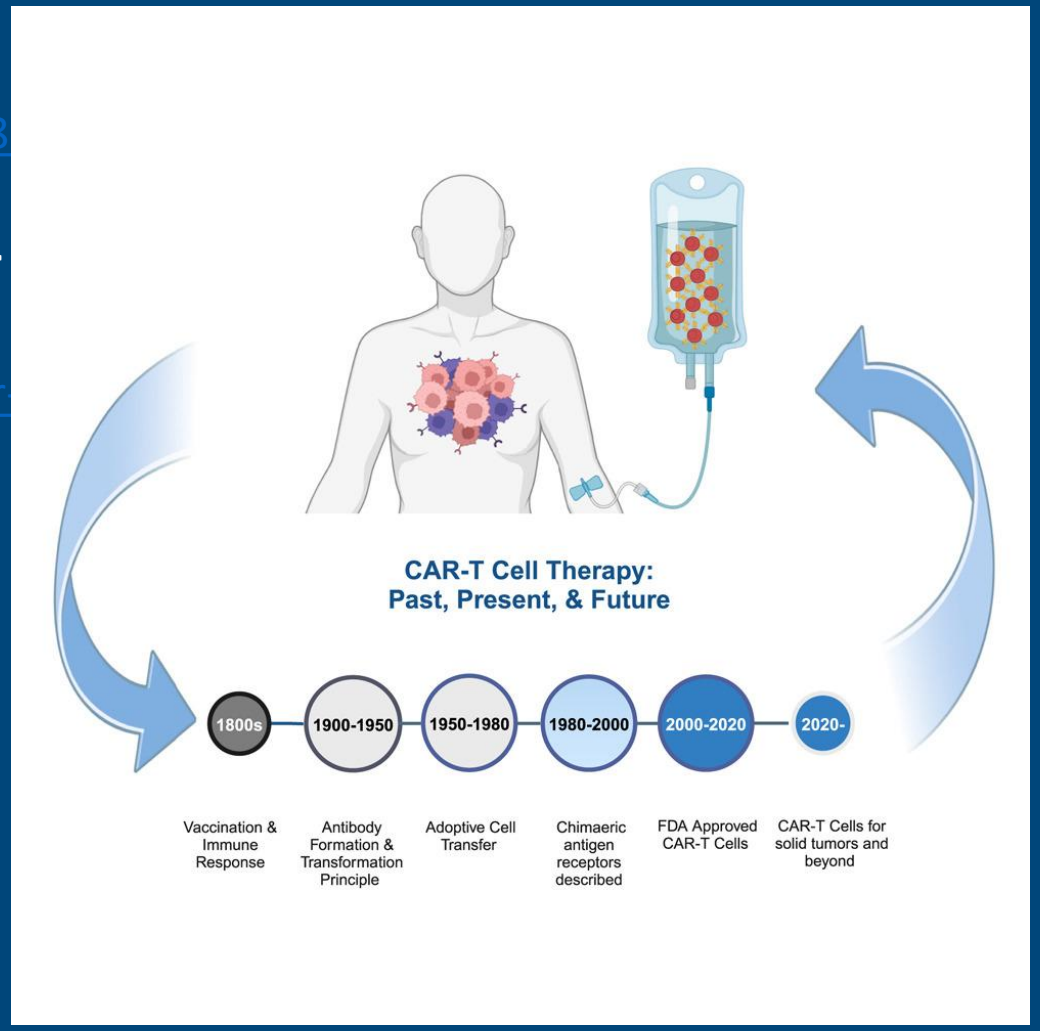
- Opvoeden van de afweer om kanker te herkennen
- Levend medicijn
- Biologische robot
- If there isn't a cure for their cancer today, there's a reasonable chance that around the corner, there's going to be one.



https://www.nature.com/articles/d41586-022-00241-0

CAR T Cells

- Off-the-shelf CAR-T cells could prove paradigm shifting for autoimmune diseases
- https://www.sciencedirect.com/science/article/abs/pii/S00928424008882
- **CAR T Cells: Engineering Patients' Immune Cells to Treat Their Cancers**
- https://www.cancer.gov/about-cancer/treatment/research/car-cells
- Direct *in vivo* CAR T cell engineering
- https://www.cell.com/trends/pharmacological-sciences/fulltext/S0165-6147(24)00052-X
- **From concept to cure: The evolution of CAR-T cell therapy**
- https://pubmed.ncbi.nlm.nih.gov/40070120/
- Chimeric Antigen Receptor Cell Therapy: Empowering Treatment Strategies for Solid Tumors
- https://pmc.ncbi.nlm.nih.gov/articles/PMC11854309/

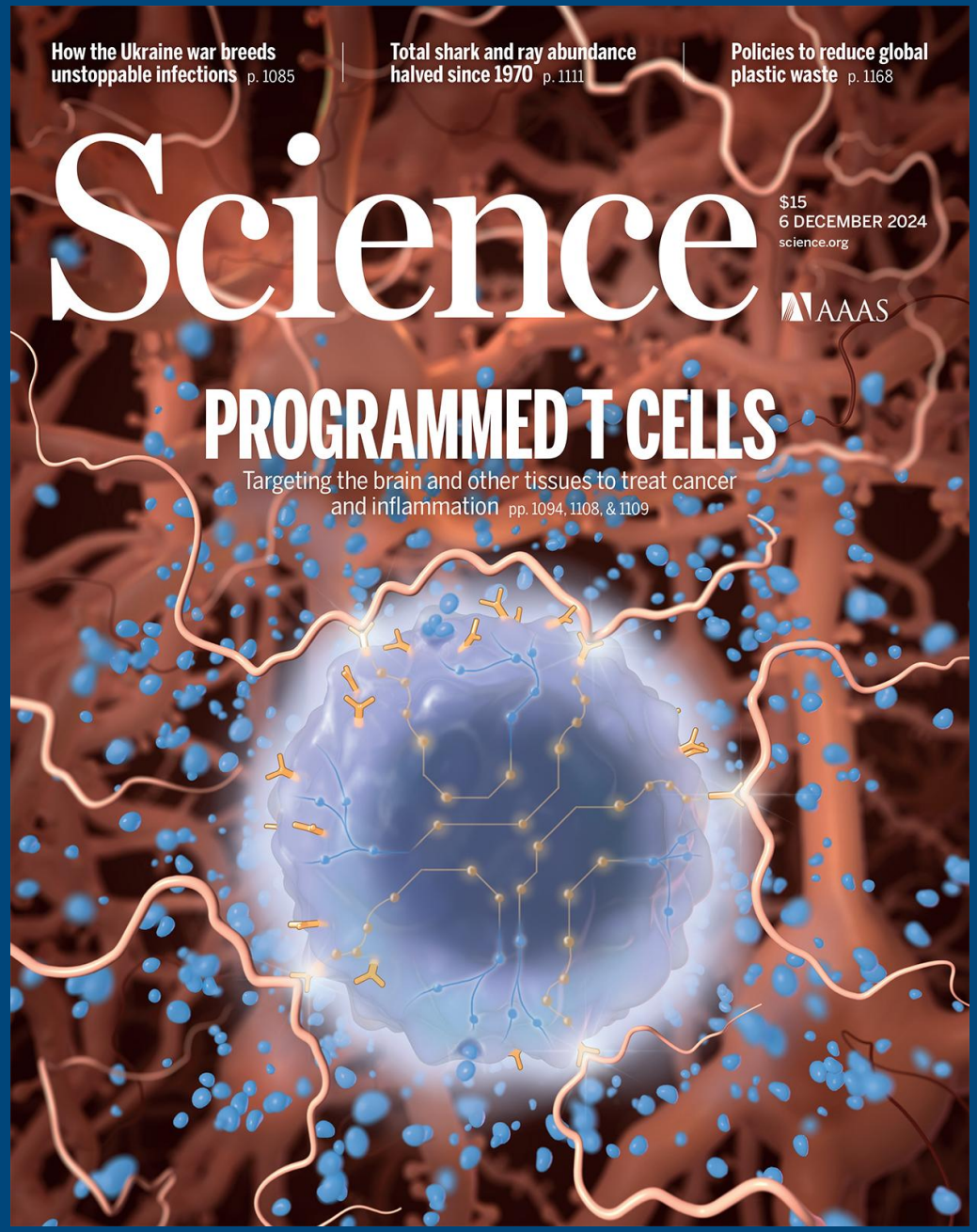


Cancer-fighting CAR T cells could be made inside body with viral injection => delivery

- **Scientists are devising ways to edit the genomes of immune cells without having to extract them from the people being treated.**
- https://www.nature.com/articles/d41586-023-03969-5

Ontwikkelingen:

- Immunotherapie 2.0
- An engineered T cell (center) is designed to deliver therapies to the brain. This T cell displays orange synthetic receptors on its surface, which recognize components of extracellular matrix fibers that are only found in the brain. Within the cell, downstream signaling pathways are programmed to initiate transcription and release a therapeutic payload—shown as light blue protein secretions
- https://www.science.org/toc/science/current
- https://www.science.org/doi/10.1126/science.adl4237



Maatschappij verandert door (bio)technologie
Niet door politici

- Kunstmest

=> 10 miljard mensen (ipv 2 miljard)

- Geboorteperking

=> Maar 10 miljard mensen

- Olie
- Telefoon

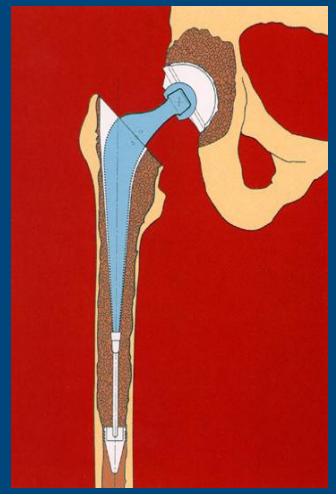
⇒Technologie is niet perse positief.

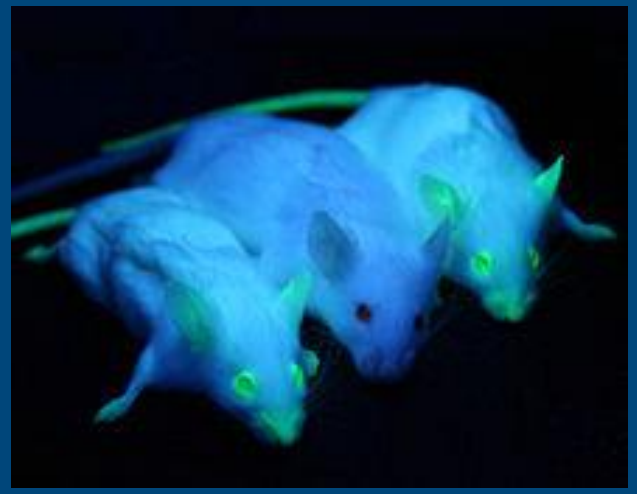
⇒Hoe ga je er mee om?

Biotechnologie, traditioneel en modern.

- Gebruik maken van gisten en schimmels, veredeling gewassen, fokken dieren

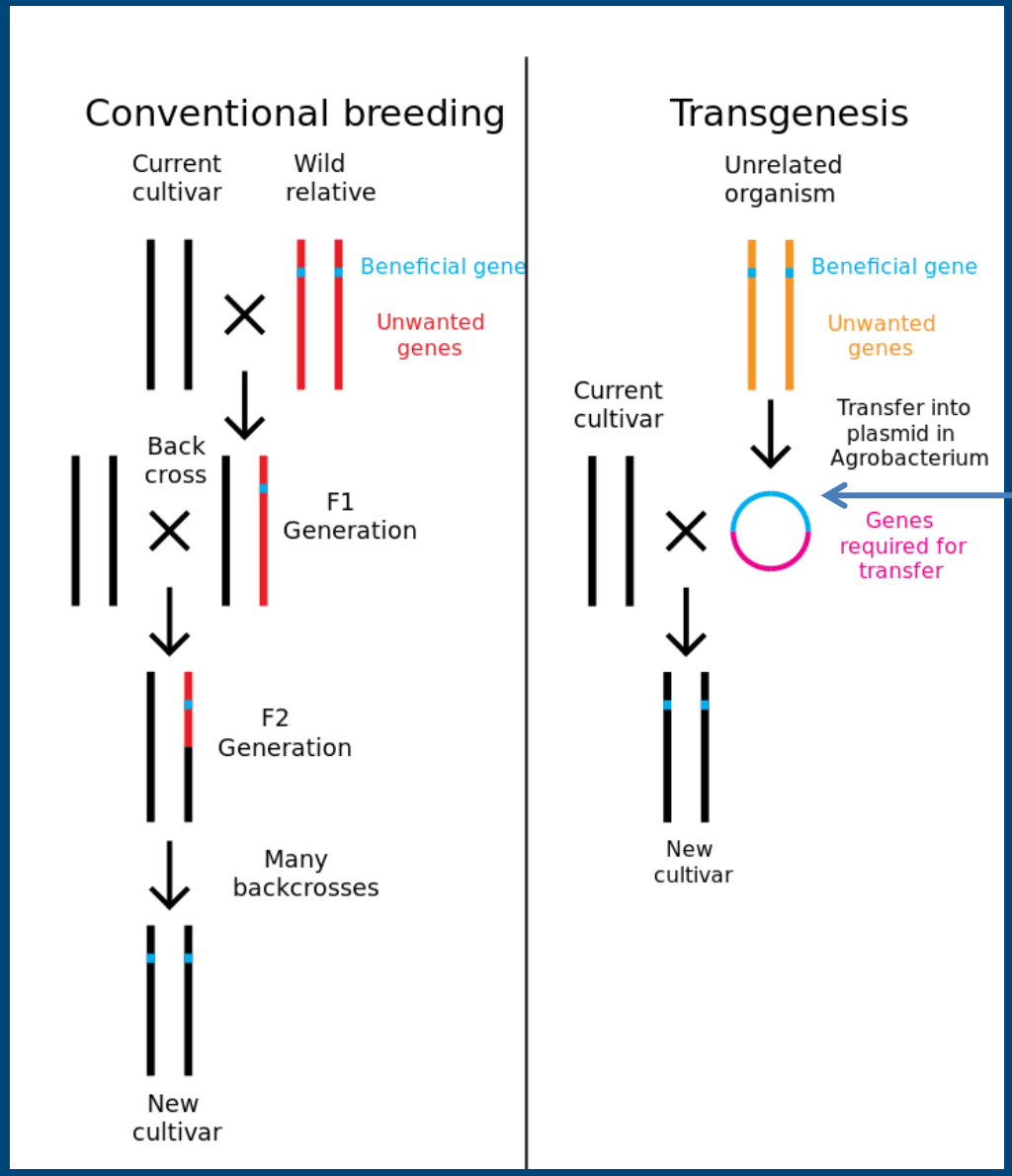
- Medische therapie
- Gentechnologie





Biotech doen we al heel lang, en wordt alleen maar belangrijker

Introductie:
Veredeling versus Genetische Manipulatie

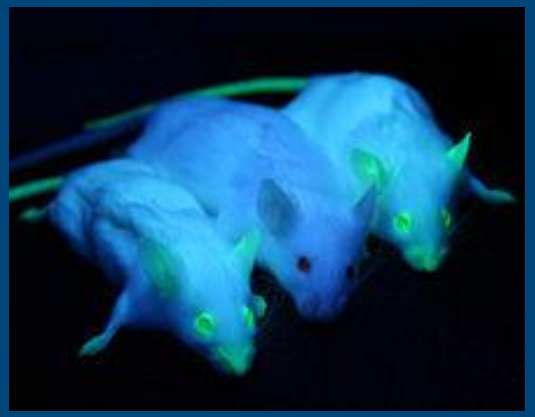


Zelfde, alleen sneller en gerichter.
Met vector (klonen).

CRISPR vervangt veel specifieker, zonder veel ballast

Introductie:

Orgaan v. systemisch (“germ-line”)



GFP-muis

Kind van 3 ouders (3^{e} nodig voor mitochondrien)

En in China (HIV resistent => CRISPR babies)

Handig voor onderzoek, maar niet voor mensen

Volgende generaties hebben de aanpassing ook

=> aanpassing van de soort

=> filosofie (biosofie)

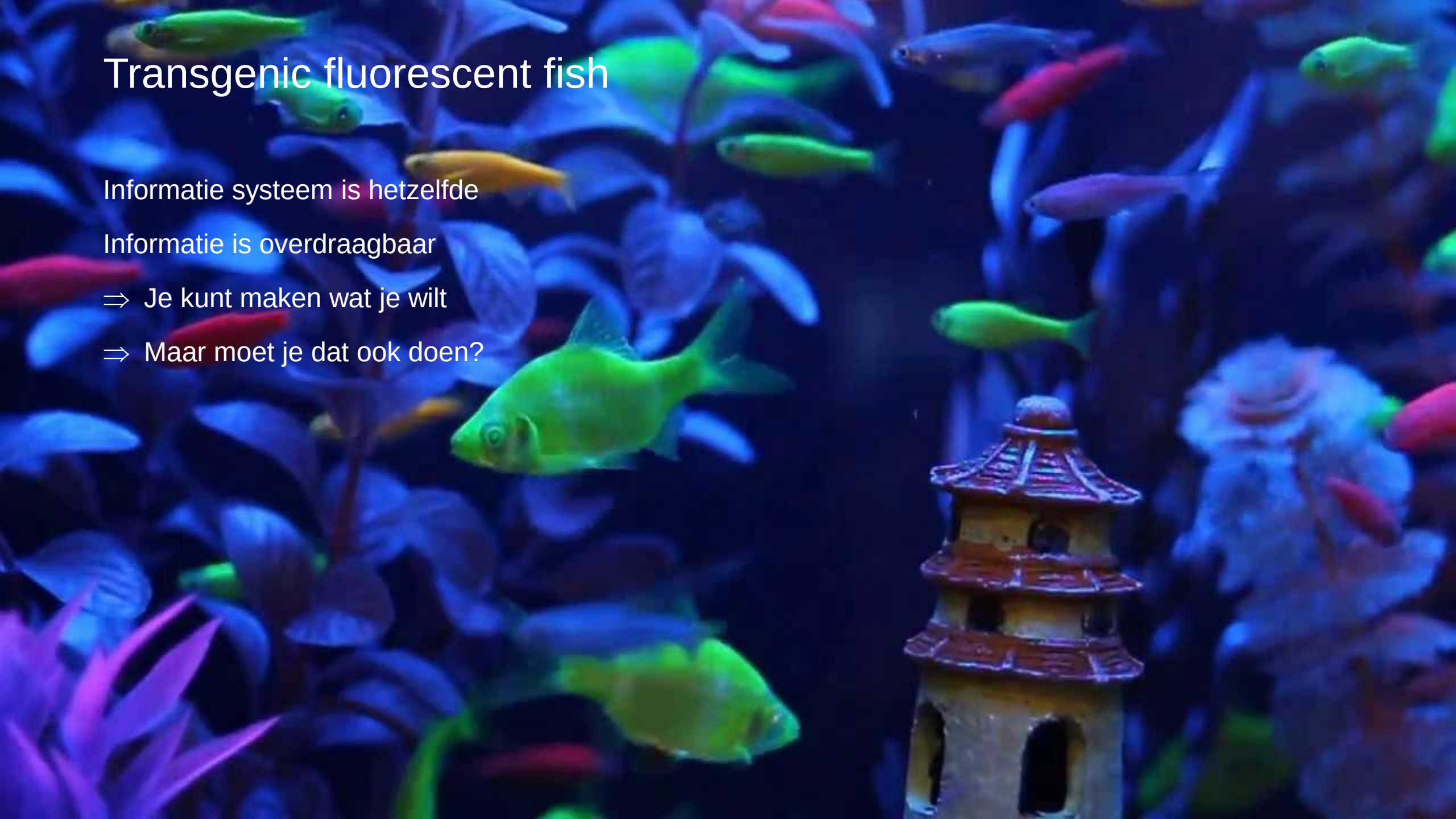
Transgenic fluorescent fish

Informatie systeem is hetzelfde

Informatie is overdraagbaar

⇒ Je kunt maken wat je wilt

⇒ Maar moet je dat ook doen?



We zijn nooit in balans geweest

- West Europa
- Australie

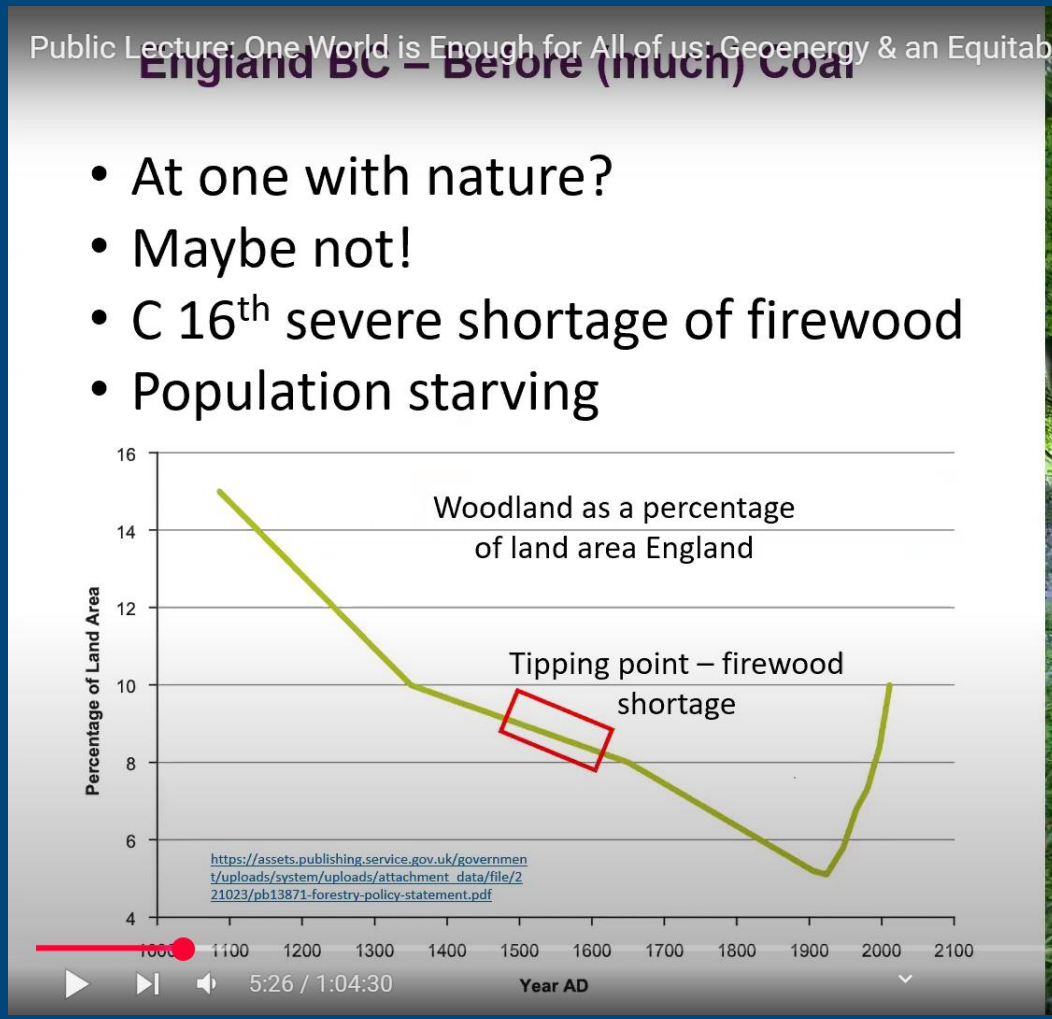
- De nobele wilde
- https://youtu.be/Uytp7WwapFI

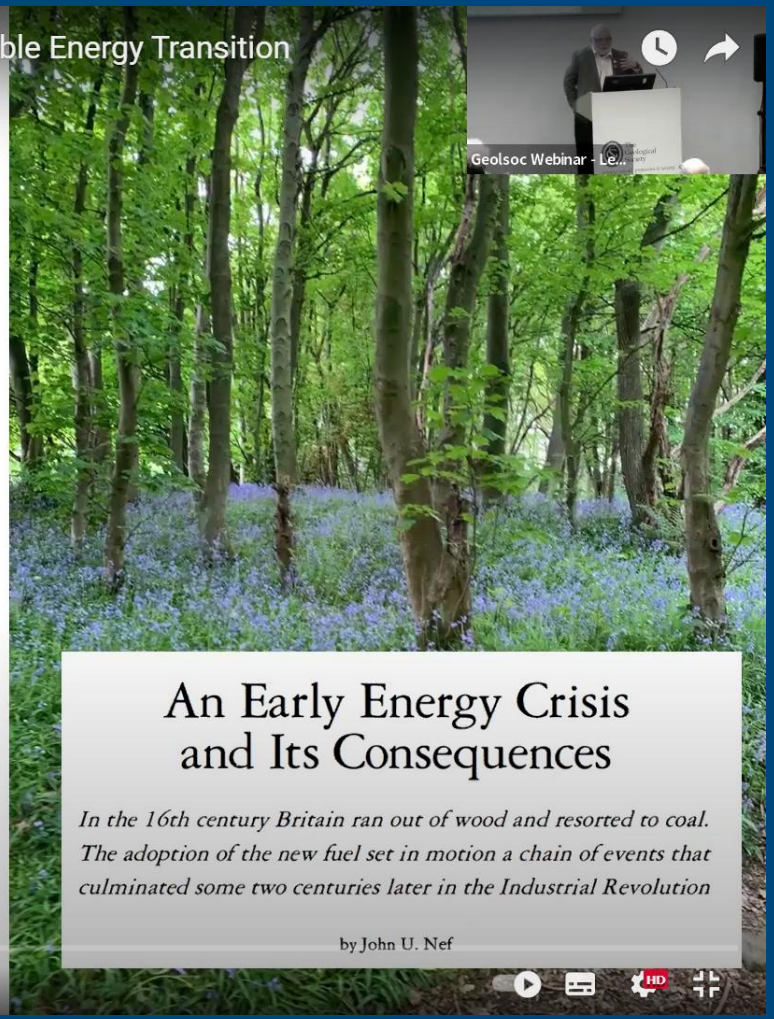
- Industriele revolutie gedreven door tekort aan hout

=> kolen,

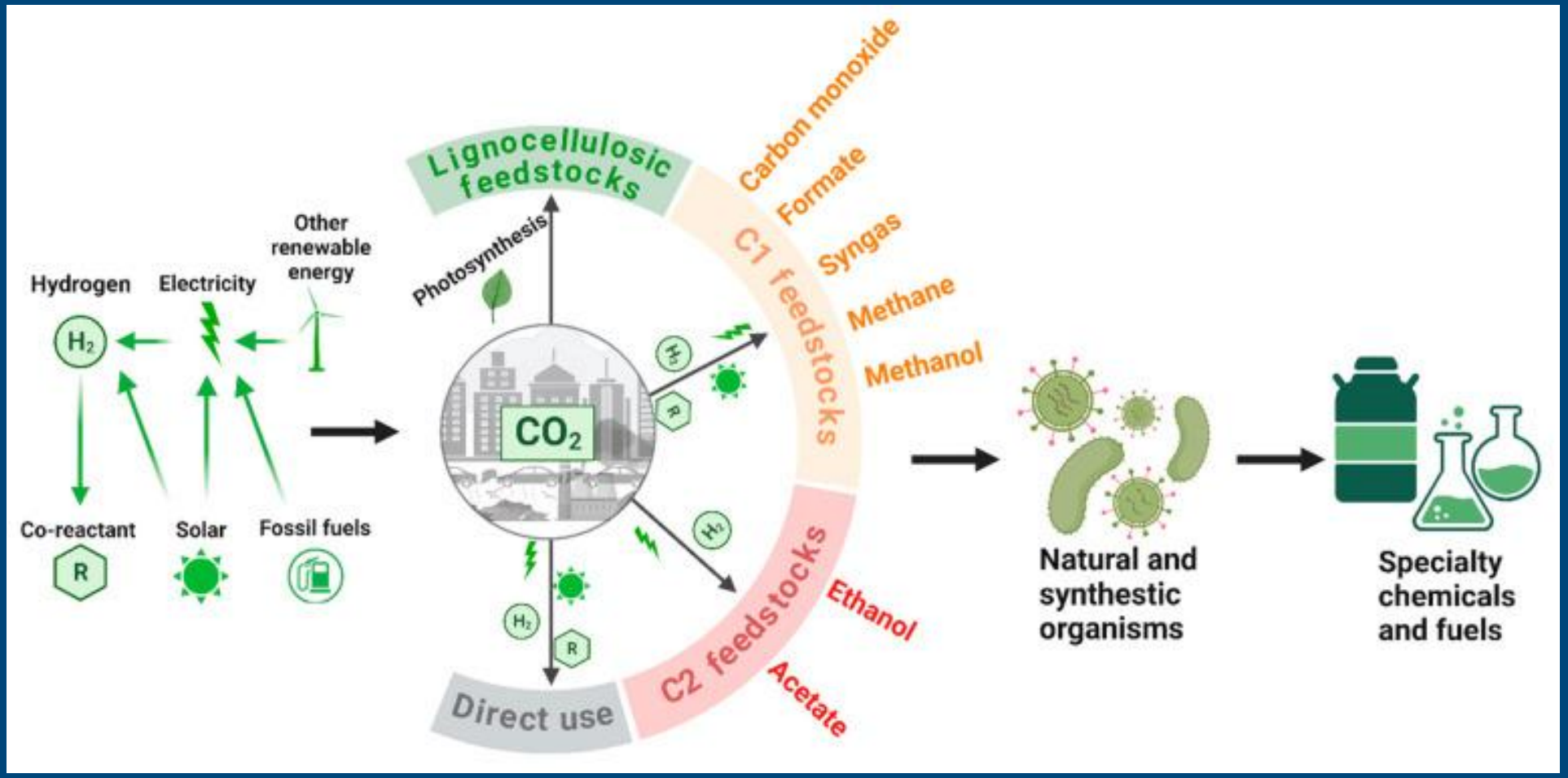
⇒ stoommachine

⇒ etc.





Perspectives for Using CO_2 as a Feedstock for Biomanufacturing of Fuels and Chemicals



https://pmc.ncbi.nlm.nih.gov/articles/PMC10740661/

Restoring forests
=> negative emissions

- The restoration of forested land at a global scale could help capture atmospheric carbon and mitigate climate change. Bastin *et al.* used direct measurements of forest cover to generate a model of forest restoration potential across the globe. Their spatially explicit maps show how much additional tree cover could exist outside of existing forests and agricultural and urban land. Ecosystems could support an additional 0.9 billion hectares of continuous forest. This would represent a greater than 25% increase in forested area, including more than 500 billion trees and more than 200 gigatonnes of additional carbon at maturity. Such a change has the potential to cut the atmospheric carbon pool by about 25%.
- The restoration of trees remains among the most effective strategies for climate change mitigation. We mapped the global potential tree coverage to show that 4.4 billion hectares of canopy cover could exist under the current climate. Excluding existing trees and agricultural and urban areas, we found that there is room for an extra 0.9 billion hectares of canopy cover, which could store 205 gigatonnes of carbon in areas that would naturally support woodlands and forests. This highlights global tree restoration as our most effective climate change solution to date. However, climate change will alter this potential tree coverage. We estimate that if we cannot deviate from the current trajectory, the global potential canopy cover may shrink by ~223 million hectares by 2050, with the vast majority of losses occurring in the tropics. Our results highlight the opportunity of climate change mitigation through global tree restoration but also the urgent need for action.
- https://science.sciencemag.org/content/365/6448/76

Bomen planten

- Nu al 40 bomen geplant

⇒ Voor de toekomst

(en is 20x vliegen naar Spanje)

Drone plant tot 40.000 bomen per dag!

- Het toestel is ontworpen om bodems te *bombarderen* met zaadcapsules waaruit bomen groeien. Vorig jaar is het op grote schaal uitgetest in Myanmar. Het land in Zuidoost-Azië heeft de afgelopen tientallen jaren 1 miljoen hectare mangrovewoud verloren, waardoor het extra kwetsbaar is geworden voor cyclonen en klimaatopwarming. De zaden die toen in de bodem zijn geschoten, zijn intussen uitgegroeid tot kloeke boompjes.
- Tegen 2060 hoopt *BioCarbon Engineering* met de drones wereldwijd een half miljard (!) bomen te hebben aangeplant.

Snotbot

https://youtu.be/AEs5HdFS46g

Wired: Drones are flying robots

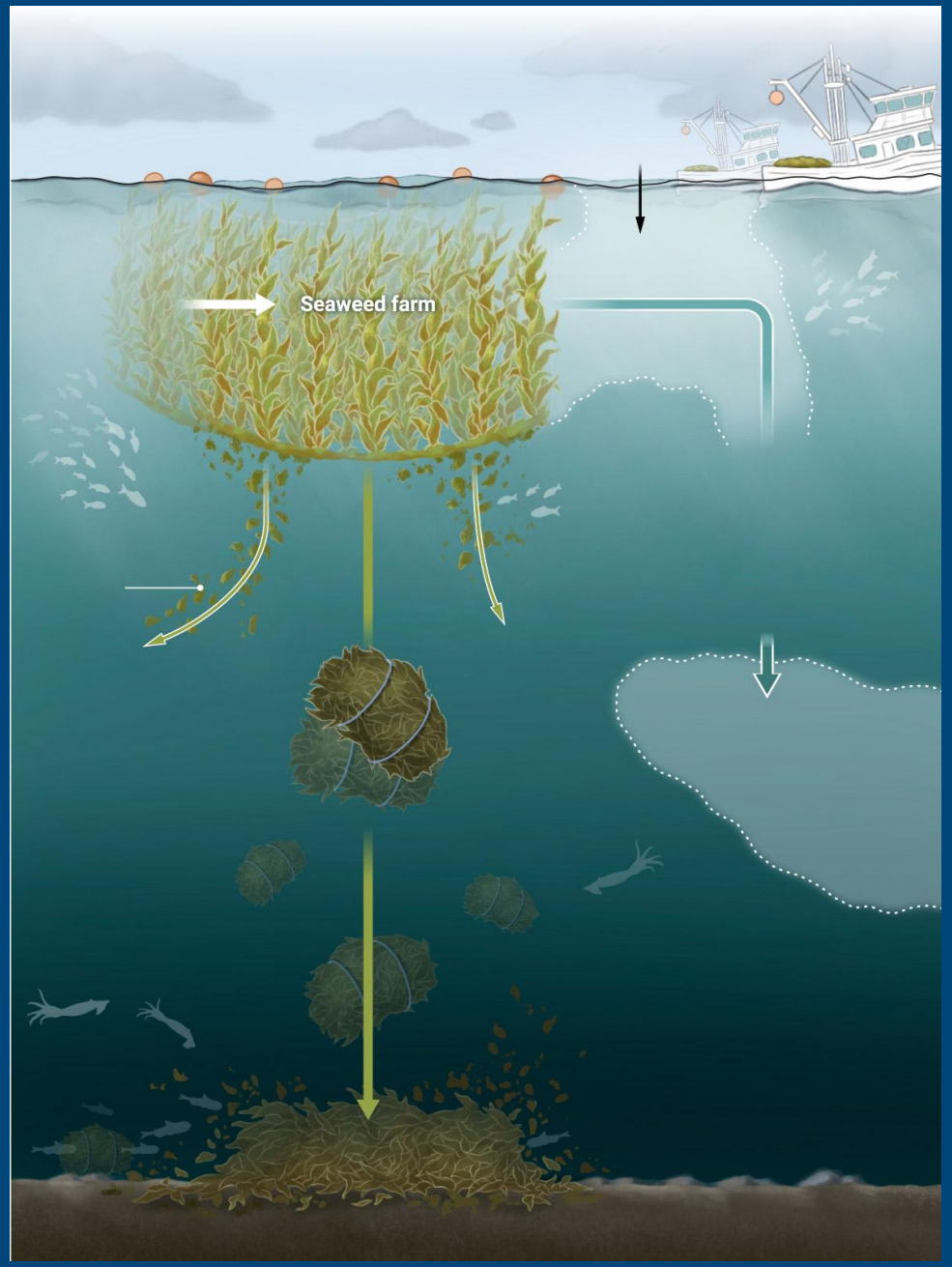
Bomen planten is niet genoeg

- Wereldwijd verdwijnt er netto bos

=> dan toch maar biotech

Dumping seaweed

- https://www.science.org/content/article/can-dumping-seaweed-sea-floor-cool-planet-some-scientists-are-skeptical



Climate capitalism

- **Climate Capitalism: Winning the Race to Zero Emissions and Solving the Crisis of Our Age**

A FUTURE TO LOOK FORWARD TO

Meaningful climate solutions can be achieved within existing market structures, argues journalist Akshat Rathi.

PODCAST

Climate Capitalism: Winning the Race to Zero Emissions and Solving the Crisis of Our Age

Akshat Rathi

Greystone Books, 2024. 272 pp.

"It's now cheaper to save the world than destroy it," writes journalist Akshat Rathi in the opening pages of *Climate Capitalism*, which explores market-based solutions to climate threats. This week on the *Science* podcast, Rathi explores how governments, entrepreneurs, and philanthropists are converging on potentially profitable strategies for moving toward a clean-energy future. https://bit.ly/3WjwuYk

10.1126/science.adr9659

Engineered microbial consortia for next-generation feedstocks

Examples of microbial engineering strategies for next-generation feedstock upcycling.

Host microbes	Feedstocks	Strategies of microbial engineering	Products	Ref.
E. coli	Carbon dioxide	Introduced the Calvin-Benson-Bassham cycle; expressed an NAD^+-coupled formate dehydrogenase	Cell biomass	8
C. autoethanogenum	Carbon monoxide	Heterologous expression of alcohol acetyltransferase	Ethyl acetate	9
S. cerevisiae	Cellulose and hemicellulose	Expressed and secreted seven lignocellulolytic enzymes; introduced a xylose catabolism pathway	Ethanol	12
C. cellulovorans	Cellulose	Evaluated 12 different enzyme combinations to determine an efficient n-butanol pathway	n-butanol	13
C. cellulovorans	Cellulose	Introduced three different aldehyde/alcohol dehydrogenases	Ethanol and n-butanol	14
Y. lipolytica	Waste cooking oil	Expressed a *cis*-aconitic acid decarboxylase; knocked out genes related to competing pathways	Itaconic acid	15
C. tyrobutyricum, *V. criceti*, *M. elsdenii*	Cellulose and xylose	Engineered spatial and metabolic niches to switch from a homogeneous to a heterogeneous reactor system	Short-chain fatty acids	22
E. limosum and *E. coli*	Carbon monoxide	Engineered an *E. coli* strain with biosynthetic pathways and co-cultivating it with *E. limosum*	3-Hydroxypropionic acid and itaconic acid	23
C. glutamicum and *E. coli*	Chitin	Engineered *E. coli* for lysine auxotrophy and chitin degradation; create synthetic mutualism with *C. glutamicum*	L-lysine	26

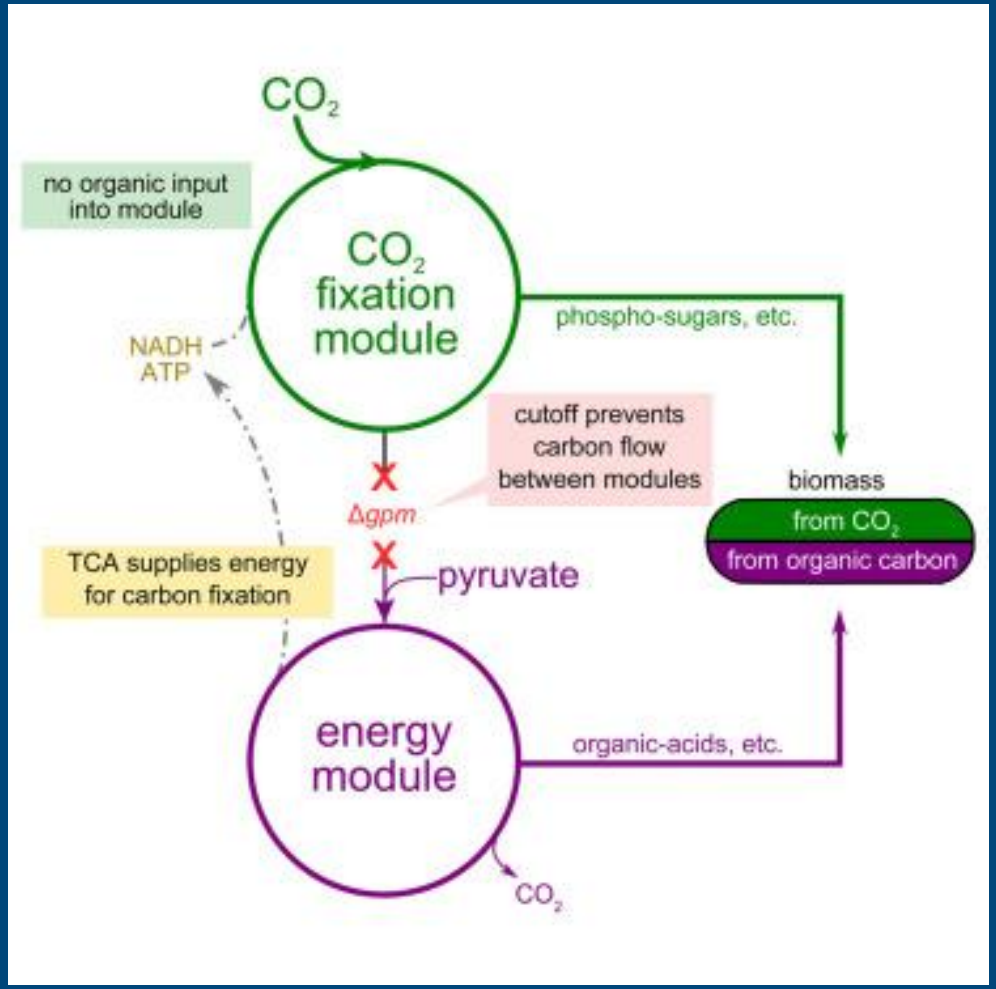
Sugar Synthesis from CO_2 in *Escherichia coli* => Quick fix for the climate !?

Biomass from CO_2 directly by E.coli.

⇒ Toepassing bij CO2 productie
⇒ Of zelfs uit atmosfeer halen

Here, we demonstrate how a combination of rational metabolic rewiring, recombinant expression, and laboratory evolution has led to the biosynthesis of sugars and other major biomass constituents in *E. coli*. But no net. negative CO2

⇒ Biotech kan de wereldproblemen helpen oplossen



https://www.nature.com/articles/d41586-019-03679-x

https://pmc.ncbi.nlm.nih.gov/articles/PMC11446362/

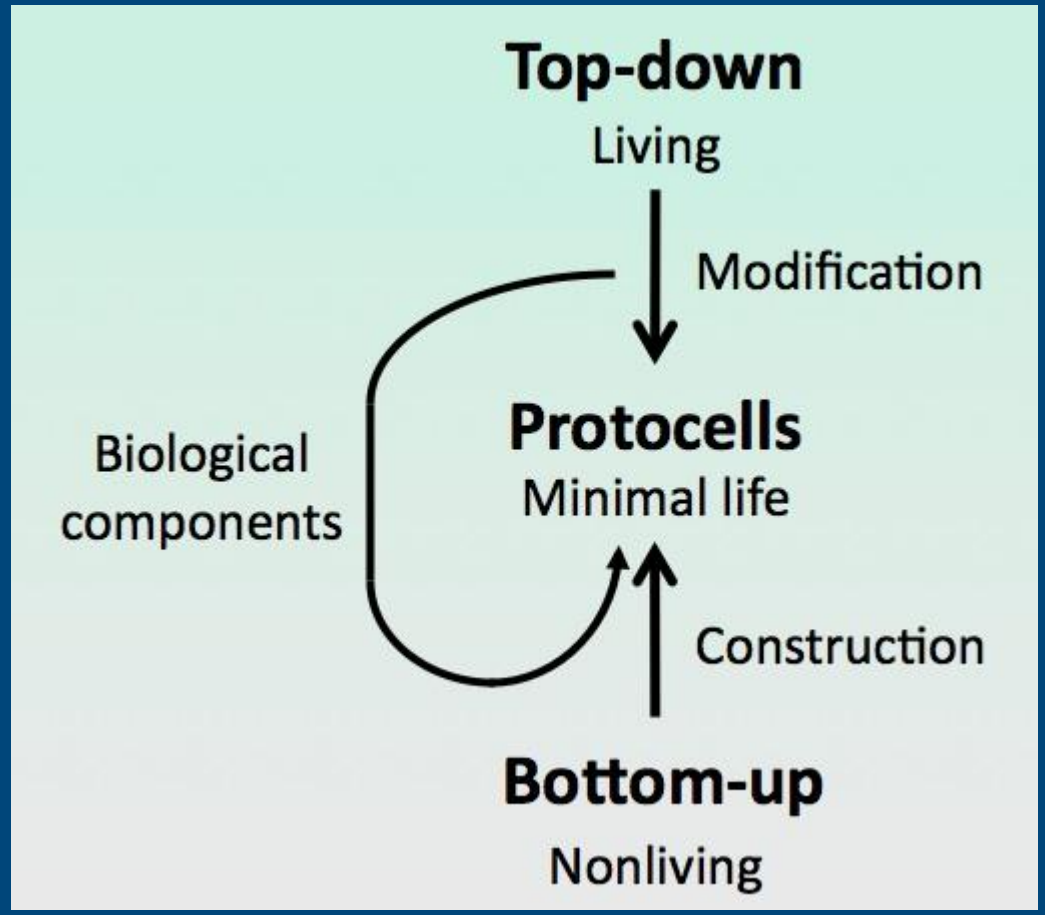
Synthetic biology
Minimal Life

What is life?

Take away genes until cells are no longer living

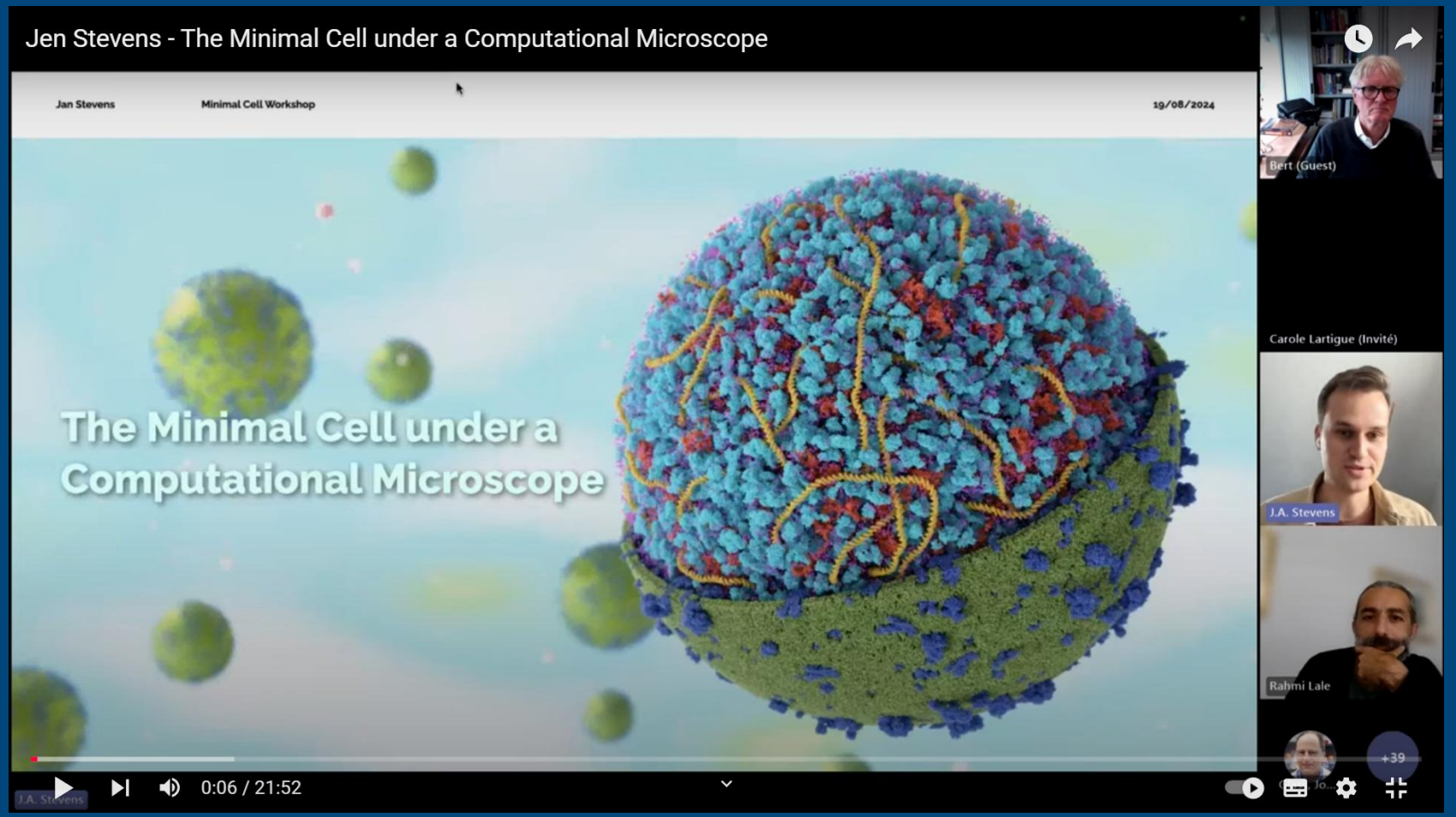
Or, plugging in various sets of genes until a cell is alive

Mycoplasma "laboratorium"



- http://flint.sdu.dk/index.php?page=overall-protocell-design
- http://www.synbioproject.org/topics/synbio101/definition/

Minimal cell



- https://youtu.be/T0Rri5oSxxI

- *Nature* **volume 638**, pages972–979 (2025)
- **Abstract**
- Most current strategies for carbon management require CO_2 removal (CDR) from the atmosphere on the multi-hundred gigatonne (Gt) scale by 2100 (refs. [1,2,3,4,5]). Mg-rich silicate minerals can remove >10^5 Gt CO_2 and sequester it as stable and innocuous carbonate minerals or dissolved bicarbonate ions[3,6,7]. However, the reaction rates of these minerals under ambient conditions are far too slow for practical use. Here we show that $CaCO_3$ and $CaSO_4$ react quantitatively with diverse Mg-rich silicates (for example, olivine, serpentine and augite) under thermochemical conditions to form Ca_2SiO_4 and MgO. On exposure to ambient air under wet conditions, Ca_2SiO_4 is converted to $CaCO_3$ and silicic acid, and MgO is partially converted into a Mg carbonate within weeks, whereas the input Mg silicate shows no reactivity over 6 months. Alternatively, Ca_2SiO_4 and MgO can be completely carbonated to $CaCO_3$ and $Mg(HCO_3)_2$ under 1 atm CO_2 at ambient temperature within hours. Using $CaCO_3$ as the Ca source, this chemistry enables a CDR process in which the output Ca_2SiO_4/MgO material is used to remove CO_2 from air or soil and the CO_2 process emissions are sequestered. Analysis of the energy requirements indicates that this process could require less than 1 MWh per tonne CO_2 removed, approximately half the energy of CO_2 capture with leading direct air capture technologies. The chemistry described here could unlock Mg-rich silicates as a vast resource for safe and permanent CDR.

Vervolgcursus Biotechnologie.

DNA/RNA-technologie

Stamcellen en Tissue-Engineering

Proefdieren en Imaging

Cybernetica (*Integratie biologie en technologie)*

Synthetische biologie en Wat is leven?

Genomics, proteomics en individuele gezondheidszorg

Lezen wetenschappelijke literatuur, hoe werkt wetenschap?

Excursie?

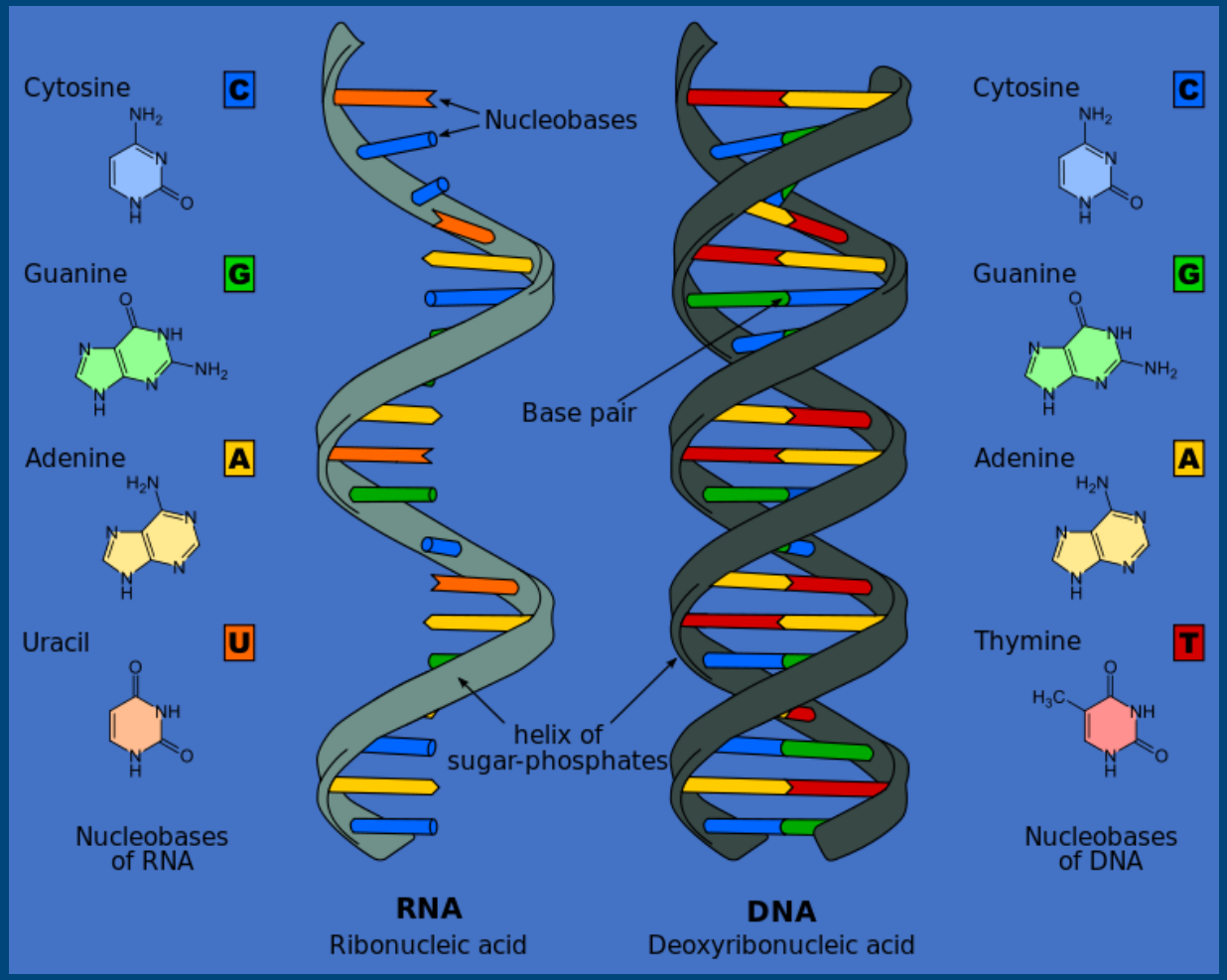
DNA/RNA, de taal (informatie) van het leven

DNA
Erfelijke eigenschappen

Toepassingen:
- Gentherapie
- Synthetische biologie

RNA
Belangrijk regelsysteem
Epigenetica

Toepassingen:
- RNAi
- Stamcellen (iPS)
- mRNA vaccins



Werken met de taal van het leven

Lezen =	Sequencing
Knippen =	Restrictie-enzymen (klonen van GFP gen)
Schrijven =	Synthese
Plakken =	Insertie => vaak nog virus (vector) voor nodig (=> CRISPR)

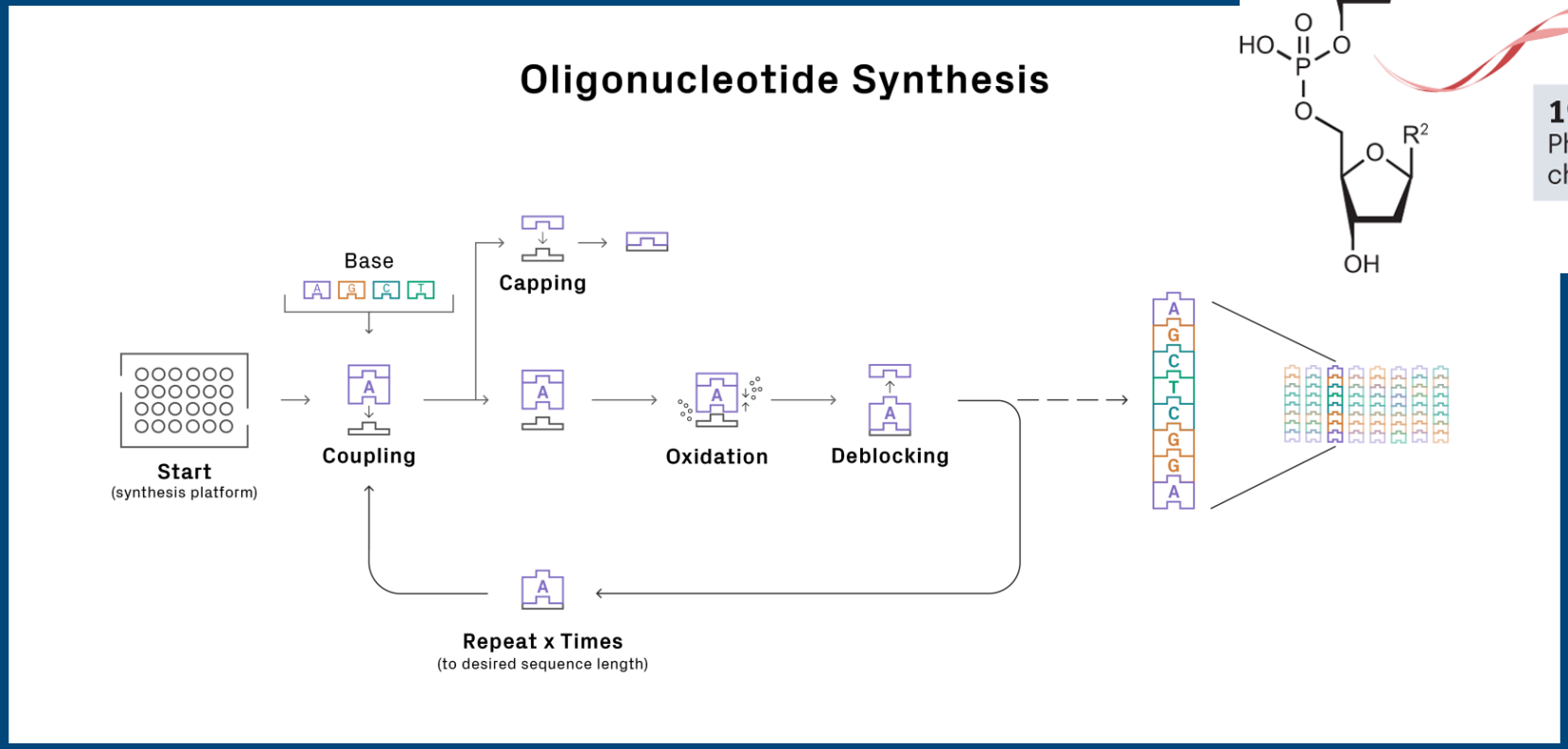
⇒Molecular Biology Toolkit

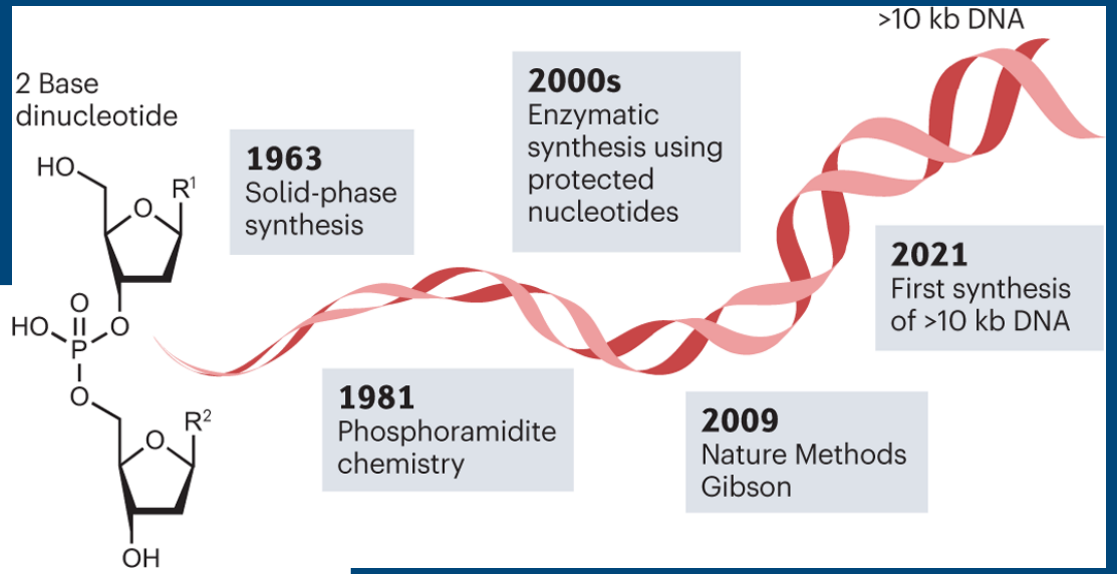
⇒DNA is een taal, en moleculaire biologie = taalkunde

https://youtu.be/fzB7tOwv4xk

DNA/RNA synthese (schrijven)

- Oligonucleotide synthesis cycle





10kb = 10.000 nucleotiden
=1 gen

Leven is..

- Een informatie systeem
- Individuele processen kunnen ook buiten een levend systeem plaatsvinden

DNA technieken (engels)
https://youtu.be/90Gsxal57-g?t=686

- https://youtu.be/8cYvyYOjzOc
- https://youtu.be/xlrwef2Y3f0
- https://youtu.be/iYaxOwZLIAk
- https://youtu.be/y7kny3Xy4k4
- https://youtu.be/buzWMKIHbB
- https://youtu.be/fzB7tOwv4xk
- https://www.youtube.com/watch?v=FvHRio1yyhQI
- https://www.youtube.com/watch?v=jFCD8Q6qSTM
- https://www.youtube.com/watch?v=mMIRBNUuX6I
- https://www.youtube.com/watch?v=LmdH9u_WTqI
- https://www.youtube.com/watch?v=1S0x3aRCviM
- https://www.youtube.com/watch?v=avM1Yg5oEu0
- https://youtu.be/8cYvyYOjzOc
- https://youtu.be/tcPgdR9_t64

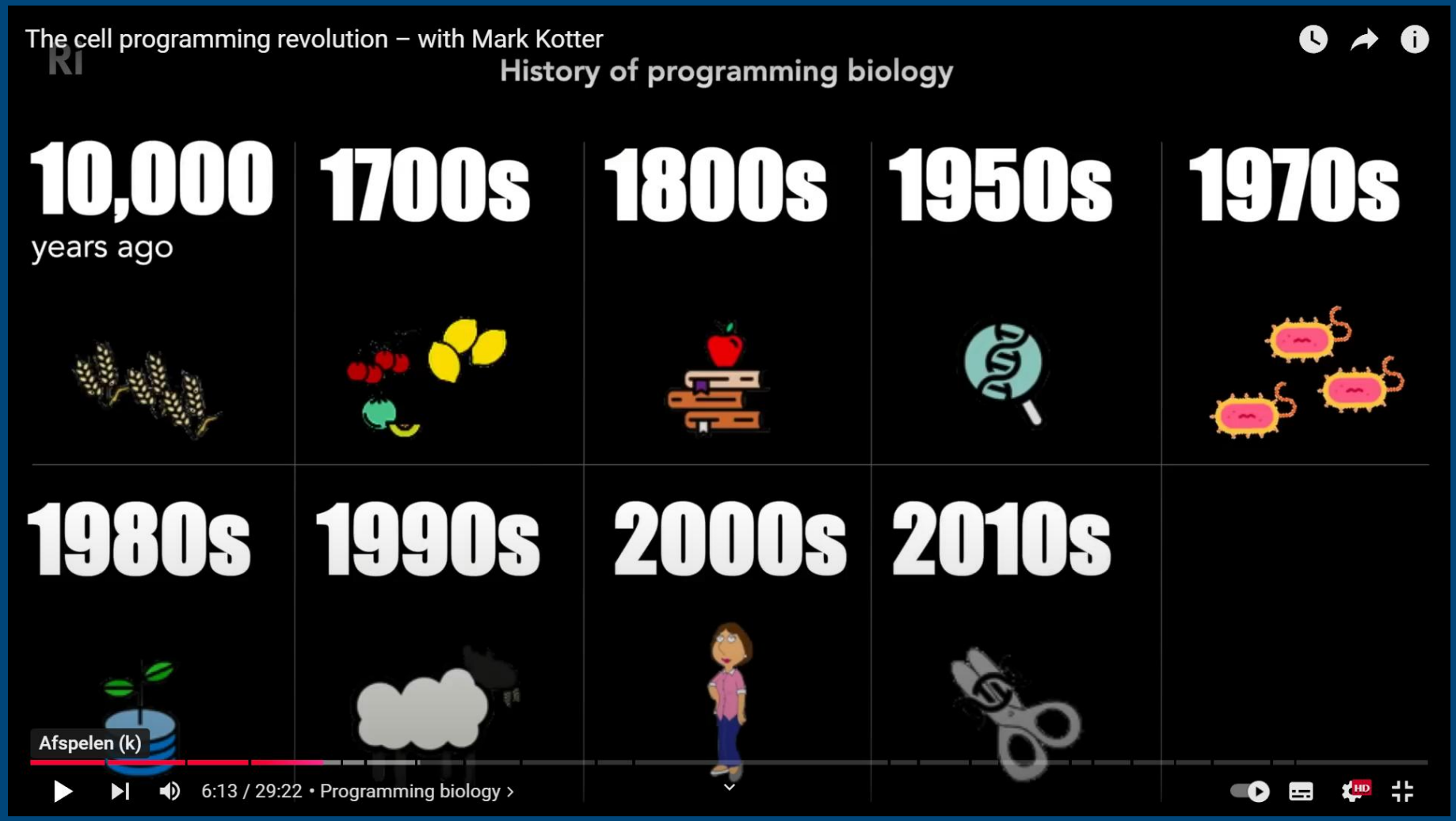
DNA synthese (schrijven)

https://youtu.be/Dwrte-CBomw

=> synthetische biologie

https://youtu.be/DxoLoOtyllU

Biotech doen we al heel lang



Genome recombination on demand

- ***SCIENCE,*** 30 Jan 2025
- Large genome rearrangements in mammalian cells can be generated at scale
- The human genome consists of more than 3 billion base pairs, among which only 1% encode proteins. These coding regions are small islands within a sea of noncoding and repetitive sequences. It remains unclear which DNA has a function or regulatory role and what the functional relevance of such genome architecture is. Advances in genome editing and functional genomics have facilitated the systematic interrogation of gene sequence and function. Yet there is little understanding of how gene order, orientation, and spacing affect gene expression and encode biological functions. On pages 487 and 488 of this issue, Koeppel *et al.* (*1*) and Pinglay *et al.* (*2*), respectively, present approaches for generating large genome rearrangements in mammalian cells at unprecedented scale. These technologies pave the way for largescale functional analyses of genome organization, structural variants, noncoding DNA, and the design of mammalian cell lines with evolved properties.

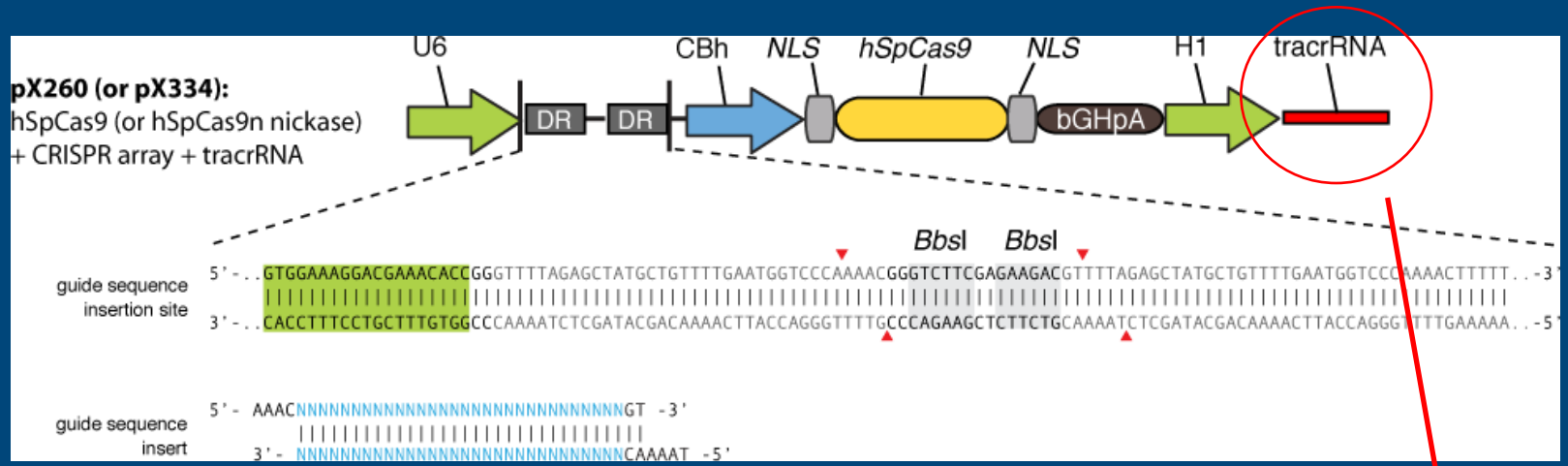
DNA is een code = informatie
=> biologie wordt informatie technologie

• A/T/C/G	DNA
• 20 aminozuren	eiwit
• 26 letters	Nederlands
• 0/1	binair (computer)

=> uitwisselbaar!

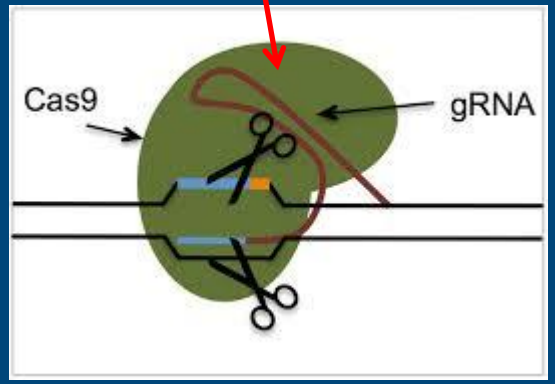
Vector

CRISPR GENOME ENGINEERING TOOLBOX



CRISPR (**C**lustered **R**egularly **I**nterspaced **S**hort **P**alindromic **R**epeats) is a microbial nuclease system involved in **defense against invading phages and plasmids**. CRISPR loci in microbial hosts contain a combination of CRISPR-associated (Cas) genes as well as **non-coding RNA elements** capable of programming the specificity of the CRISPR-mediated nucleic acid cleavage. We have recently harnessed the type II CRISPR nuclease system to facilitate genome editing in mammalian cells

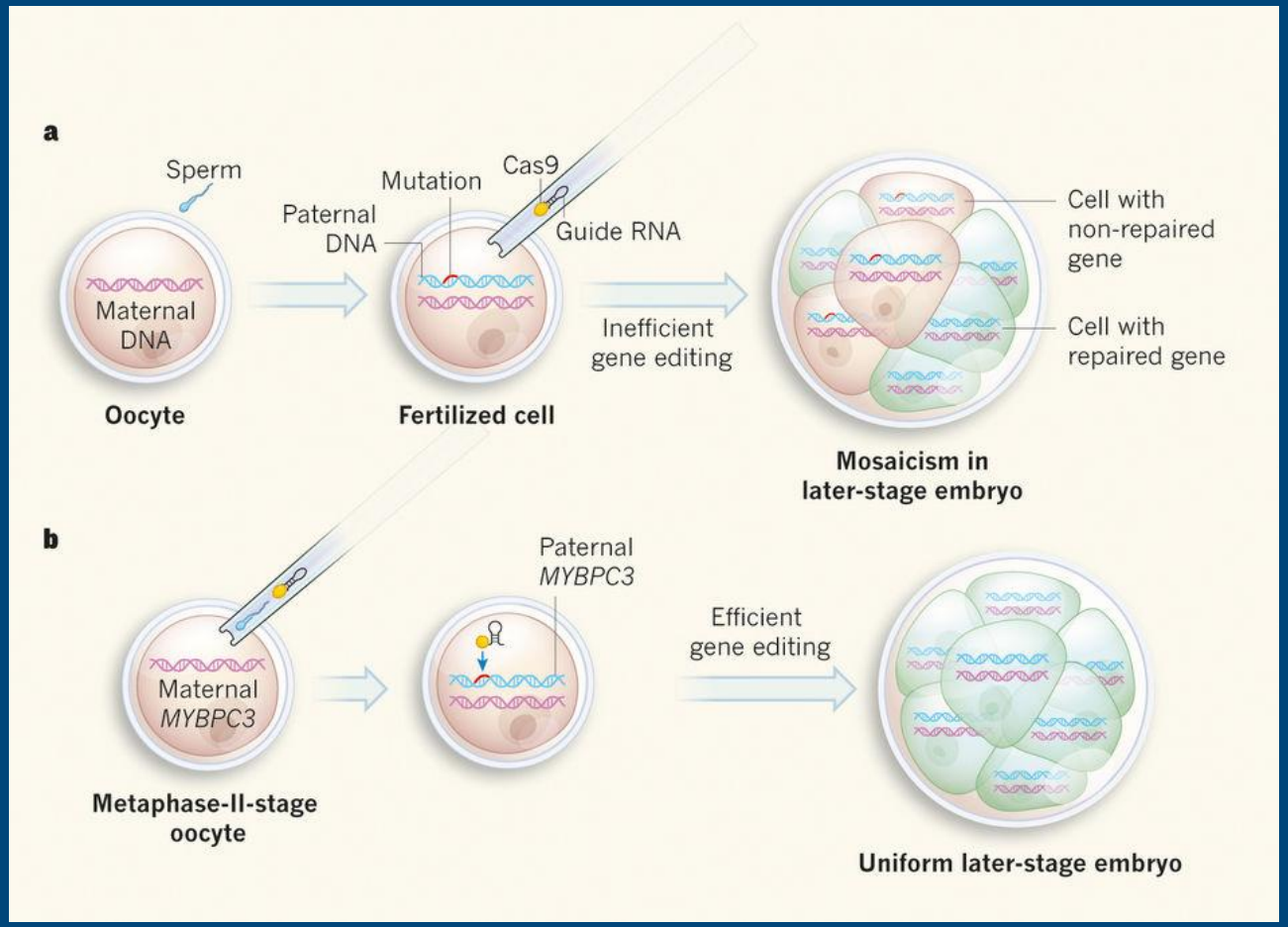
The CRISPR/Cas system can be implemented in mammalian cells by co-expressing the bacterial Cas9 nuclease along with **the guide RNA**. Two forms of guide RNAs can be used to facilitate Cas9-mediated genome cleavage, using a CRISPR RNA array and tracrRNA or a **synthetic guide RNA** fusing the CRISPR RNA with the tracrRNA. These two systems are described below.



Bacteriofagen

https://youtu.be/MnYppmstxIs
https://youtu.be/4YKFw2KZA5o

Correction of a pathogenic gene mutation in human embryos using CRISPR



Ipv heel mens behandelen, kun je beter beginnen bij het embryo.
=> transfectie van een enkele cel

http://www.nature.com/nature/journal/v548/n7668/fig_tab/nature23533_F1.html

CRISPR
muscle-dogs

Bedoeld voor slechter => normaal

Opstapje voor normaal => beter

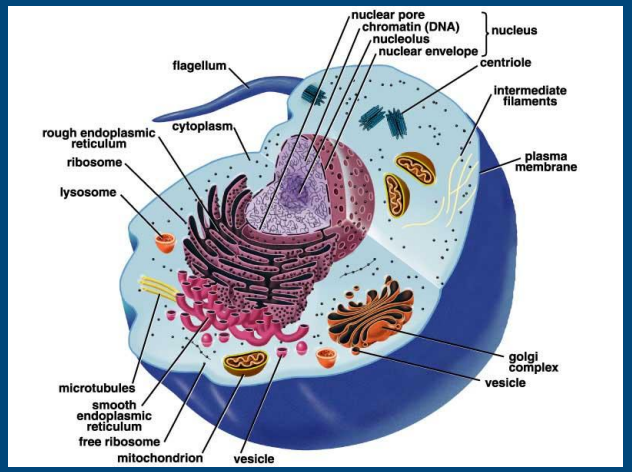
- scientists in China say they have created dogs that are twice as strong as they would be naturally, through genetic engineering.
- The process we have been developing could help prevent muscular dystrophy and Parkinson's disease," Professor Xiang Gao told CNN.
- "The mutant dogs look much stronger than the others. They are overgrown in the thighs," Gao said. "We have not observed any negative side effects. The dogs are not in pain."
- Their larger size and strength is expected to allow them to be better and stronger runners.
- "Their extra strength means that they may have uses in hunting, even the military," said Professor Gao.

How CRISPR could yield the next blockbuster crop

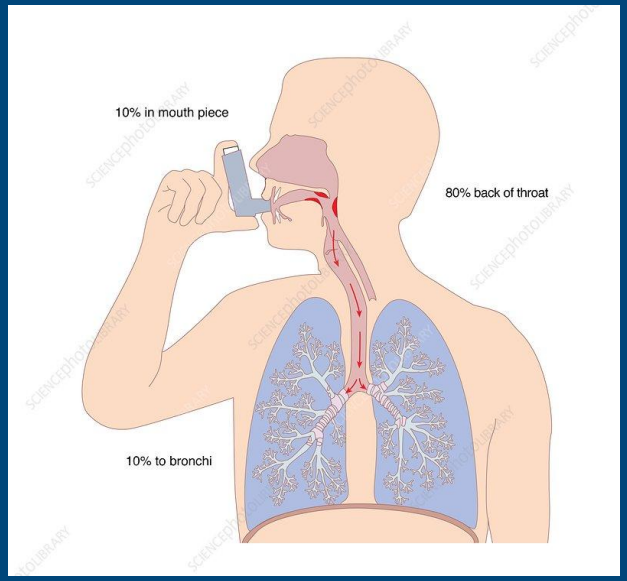
- 09 January 2024
- **Scientists are attempting to rapidly domesticate wild plant species by editing specific genes,**

The delivery problem

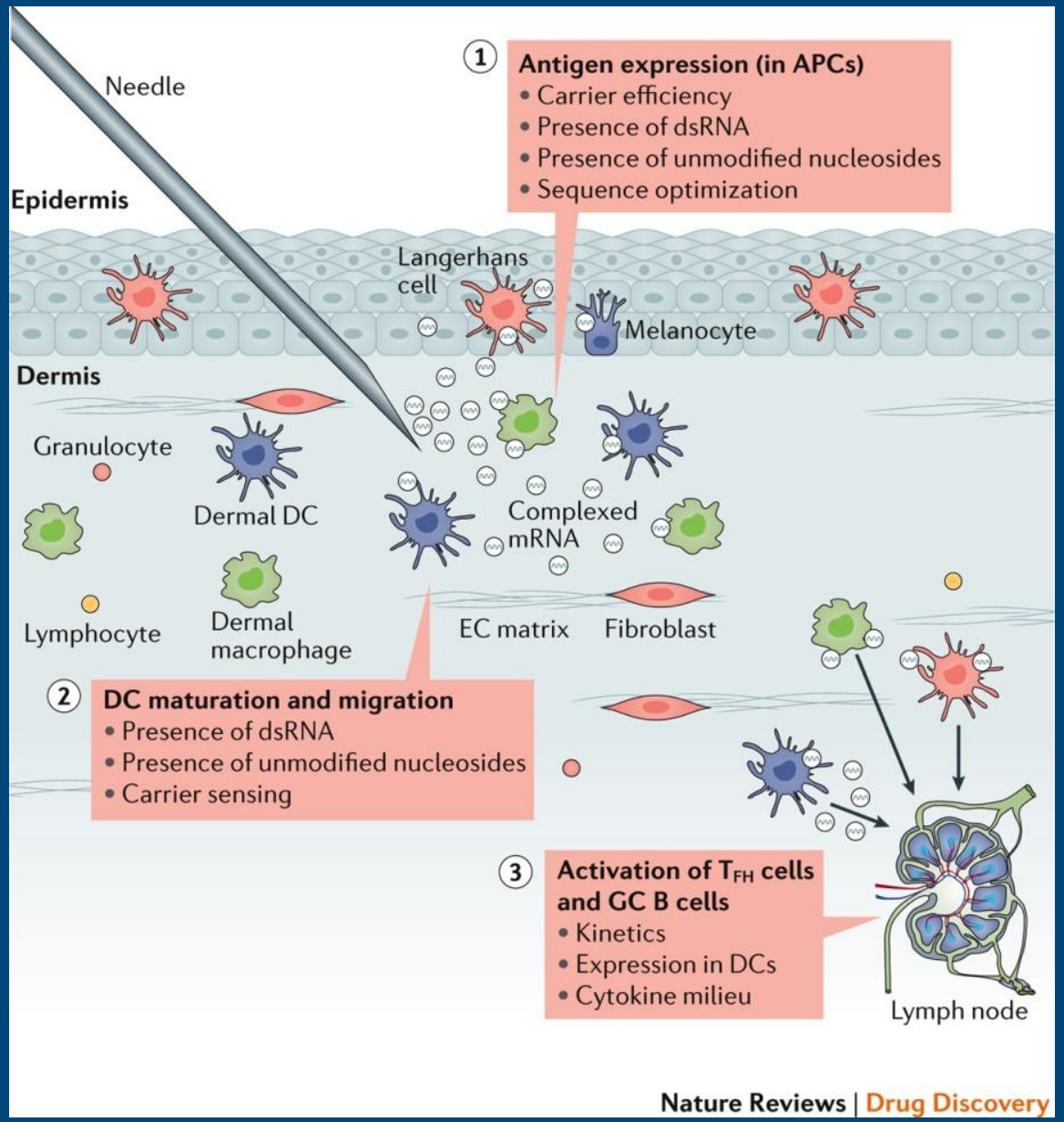
- 1 cel => OK
- Elke cel in kweekbak => al lastig



- Taaislijmziekte => heel lastig
- Heel mens => onmogelijk?



The delivery problem, solved



mRNA vaccins
(Moderna, BioNtech)

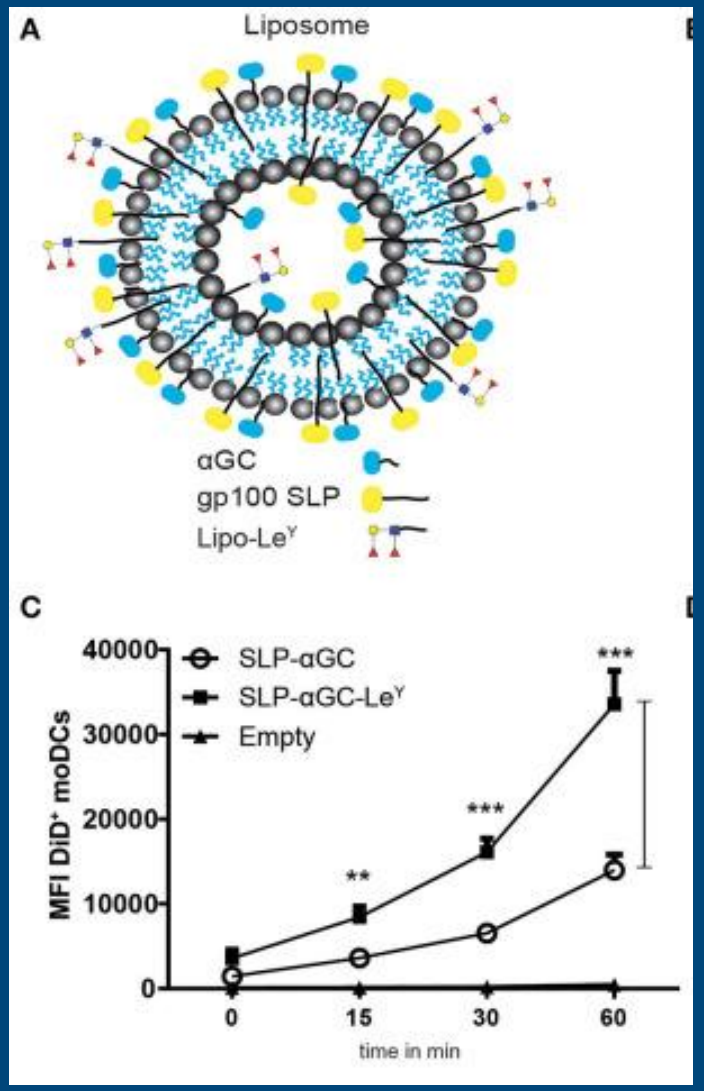
Zijn verpakt in liposomen die specifiek worden opgenomen door DC's, die ze ziet als ziekmaker
=> presentatie in lymfeklier

mRNA zijn zo aangepast (modified nucleosides) dat ze heel efficient worden afgelezen (translatie)
⇒ Expressie van corona eiwit (alleen spike, dus geen volledig virus

Targeting DC's with liposomes => delivery

Dendritic cells (DC) are an attractive target for the initiation of strong immune responses as they possess the capability of capturing antigens and presenting them to specific T-cells for their activation. The skin harbors different types of antigen presenting cells, such as dermal DC (dDC) and Langerhans cells (LC) and is therefore an attractive site for delivery of vaccines. Delivery of vaccines to DC and LC can be addressed by targeting e.g., C-type lectin receptors such as Dendritic Cell-Specific Intercellular adhesion molecule-3-Grabbing Non-integrin (DC-SIGN) and Langerin. This can be easily done using their natural glycan ligands, including Lewis Y (Le^Y)

=> MHC-II loading?



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7267035/

https://www.frontiersin.org/articles/10.3389/fimmu.2018.00590/full

- **In-human CRISPR trial for blood disease**
- A small Chinese biotech, YolTech Therapeutics, has launched the first clinical trial testing whether the CRISPR DNA-editing system can modify genes directly inside a person's bone marrow. The therapy, YOLT-204, activates an alternative haemoglobin gene in people with sickle-cell disease or beta-thalassemia. While prior gene-editing approaches involve removing, editing and reinfusing cells, YOLT-204 consists of lipid nanoparticles containing genetic instructions for the entire editing system. Molecules on the nanoparticles' surfaces direct them specifically to bone marrow cells. YolTech plans to enrol fewer than 10 people in its initial study.

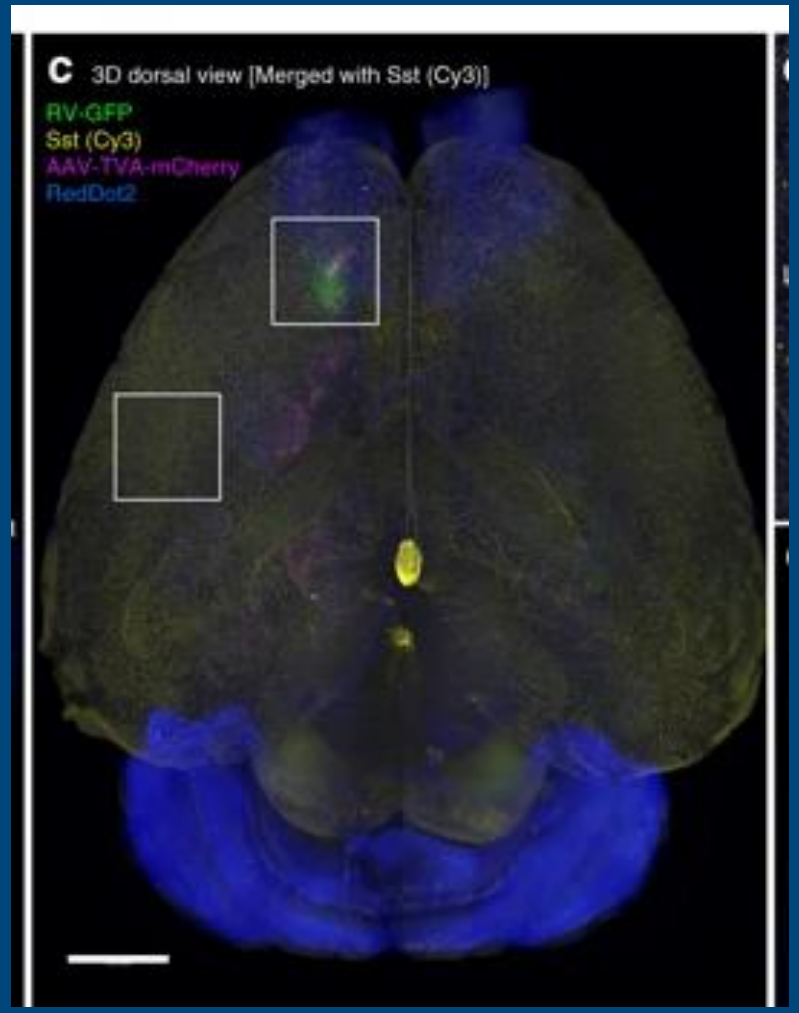
Cancer-fighting CAR T cells could be made inside body with viral injection => delivery

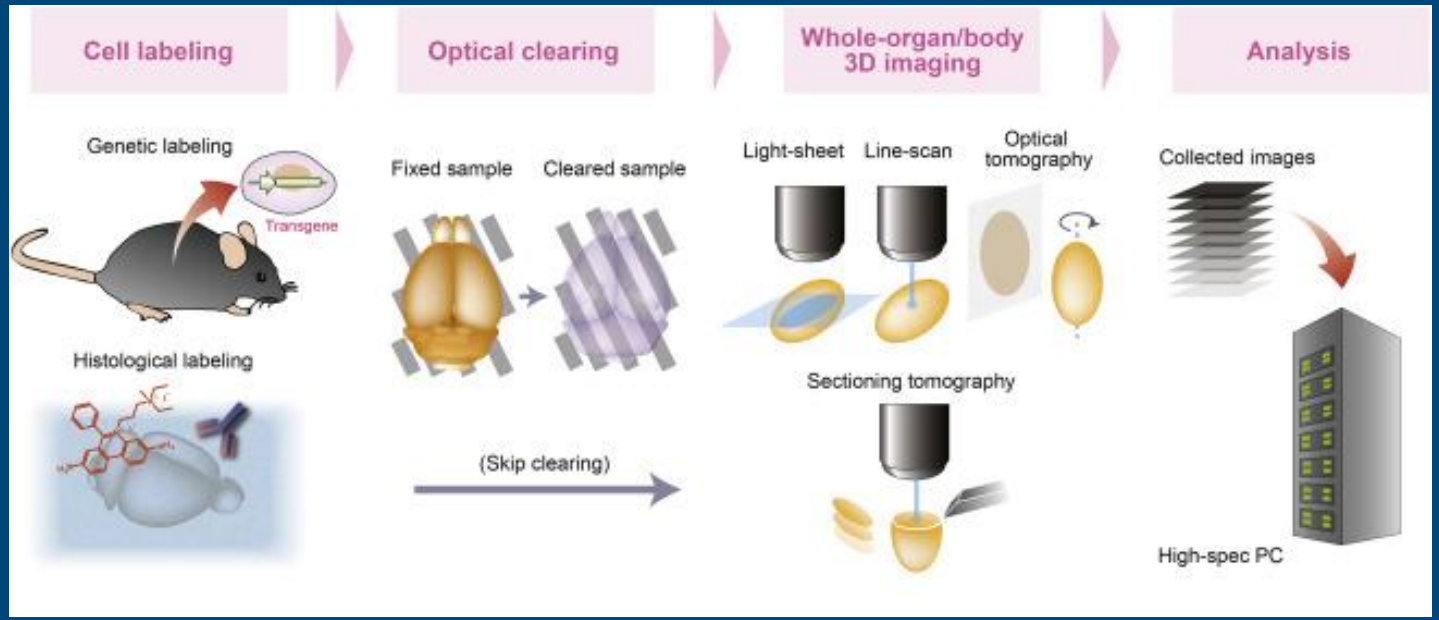
- **Scientists are devising ways to edit the genomes of immune cells without having to extract them from the people being treated.**
- https://www.nature.com/articles/d41586-023-03969-5

MRI => 3D => Augmented Reality

https://medium.com/@riyamehta9001/how-i-used-ar-to-build-3d-mri-scans-5e0df497c594

Versatile whole-organ/body staining and imaging based on electrolyte-gel properties of biological tissues



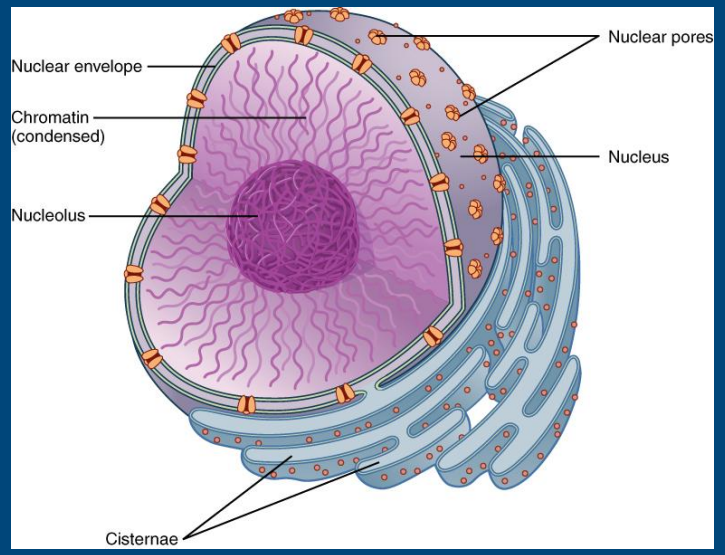


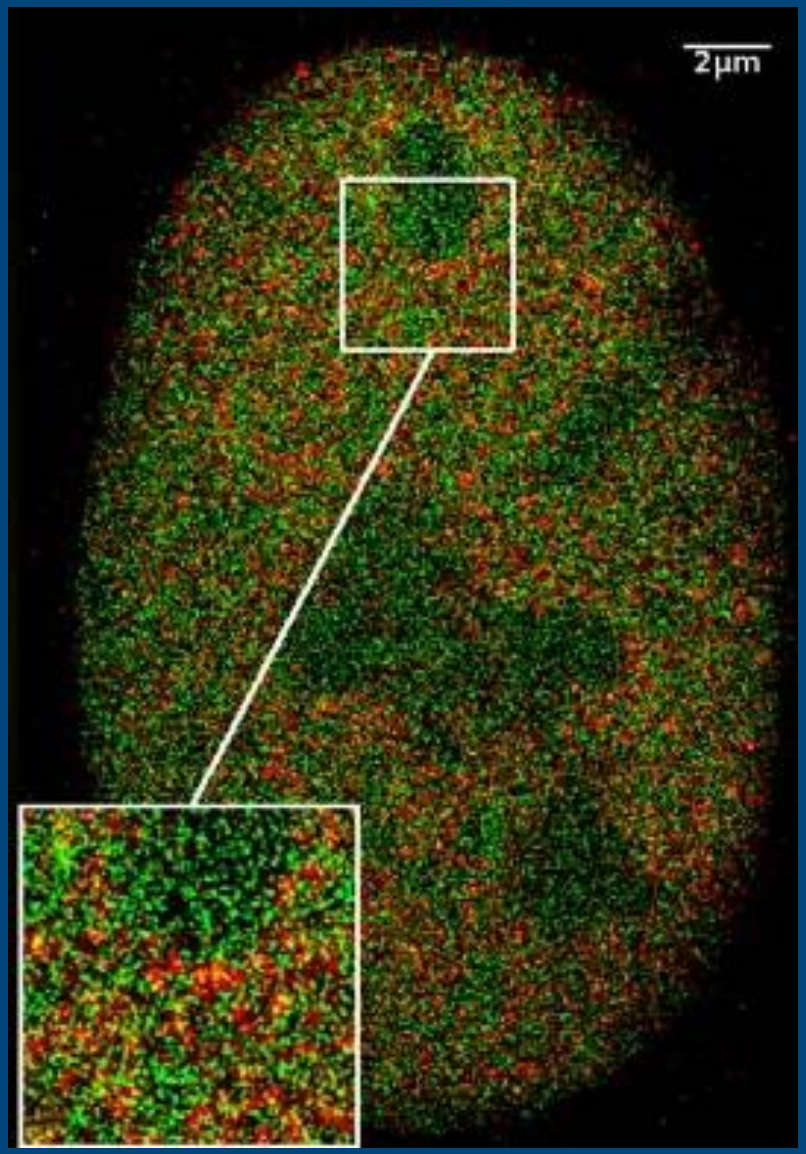
The 3D histology realized by CUBIC-HV offers an ever-increasing opportunity for systemwide whole-organ and whole-body analysis with single-cell resolution in life science and medicine.

https://www.nature.com/articles/s41467-020-15906-5

https://www.cell.com/cell-chemical-biology/fulltext/S2451-9456(15)00468-7

Imaging:
Super-resolution light-microscopy





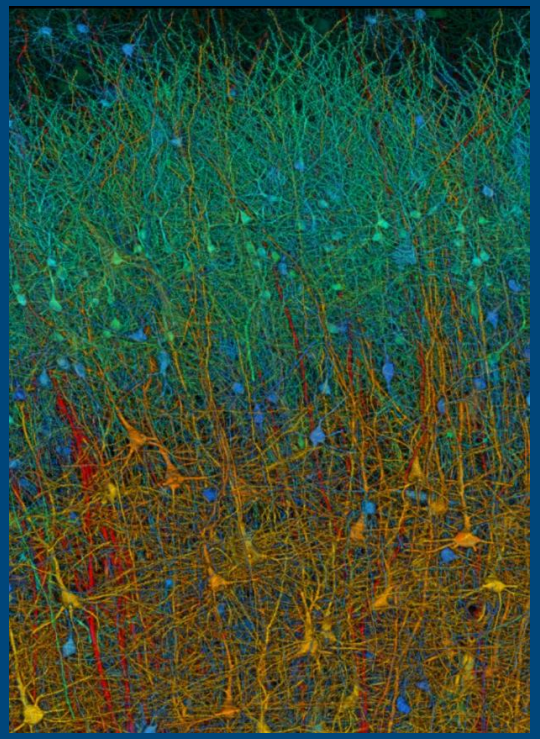
120.000 localized molecules in a wide-field area

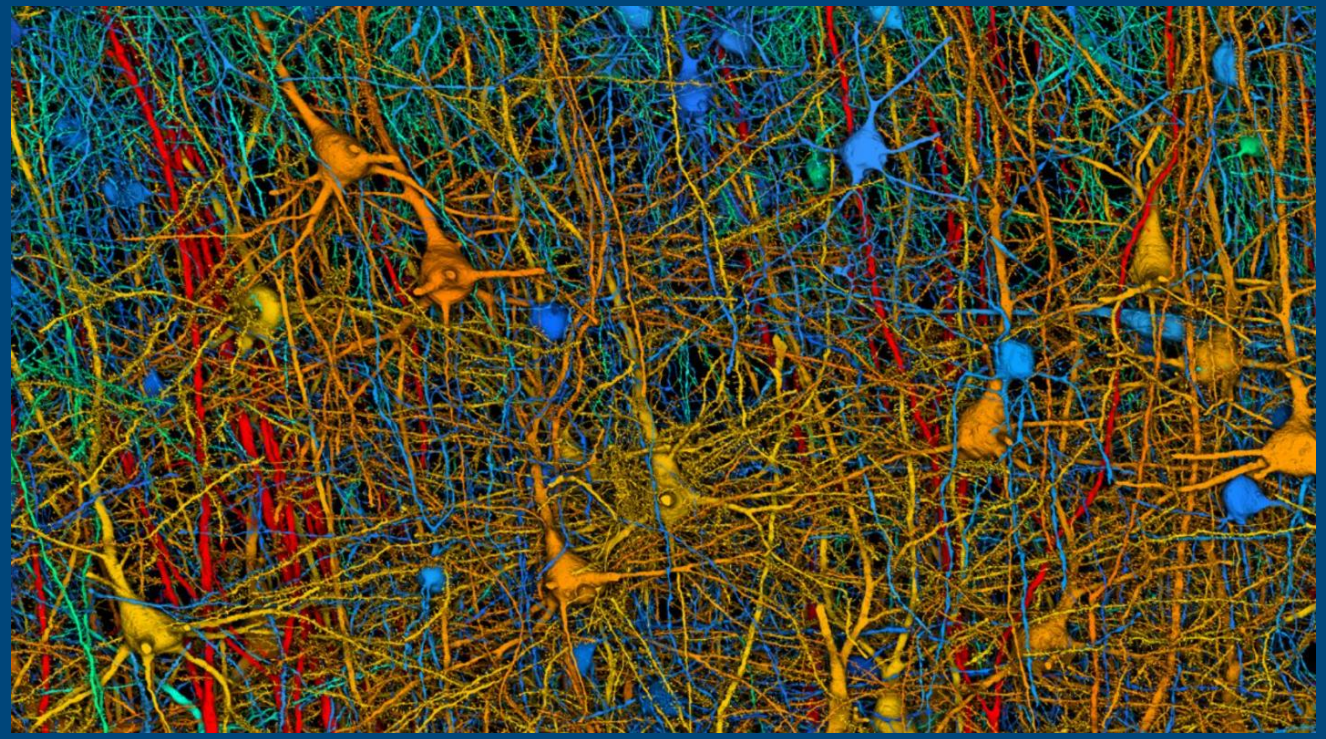
=> Nobel 2014 !

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/2014/press.html

This exquisitely detailed image charts the connections between thousands of cells in a tiny sliver of human brain.

The sample was taken from the cortex — the part of the brain responsible for complex thought — and cut into thin slices that were imaged using electron microscopes. Scientists then stitched the images back together digitally and analysed them with the help of artificial intelligence programs. Different types of neuron have been artificially colour-coded.





Atomen zichtbaar maken

STEM
https://youtu.be/88bMVbx1dzM

Imaging en modellen

Meeste dingen die we weten kunnen we niet zien
Begrip komt van modellen

Omdat onze zintuigen beperkt zijn, zijn modellen vaak beter
=> wetenschappelijke methode

Modellen worden steeds meer verfijnd, bijvoorbeeld door betere imaging technieken
=> Ook makkelijker om begrip te vergroten bij publiek
=> Maar kloof van begrip blijft

Je snapt het pas als je het ziet..

Cruijff: Je gaat het pas zien als je het door hebt.

Begrip en bewustzijn
=> college 5

https://www.youtube.com/watch?time_continue=5&v=zd2I-Yq_35Y

https://www.tudelft.nl/en/2018/tu-delft/loops-loops-and-more-loops-this-is-how-your-dna-gets-organised/

True distance between earth and the moon, and size difference

Zo zien de meeste mensen de maan

Maar nooit zo

https://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html

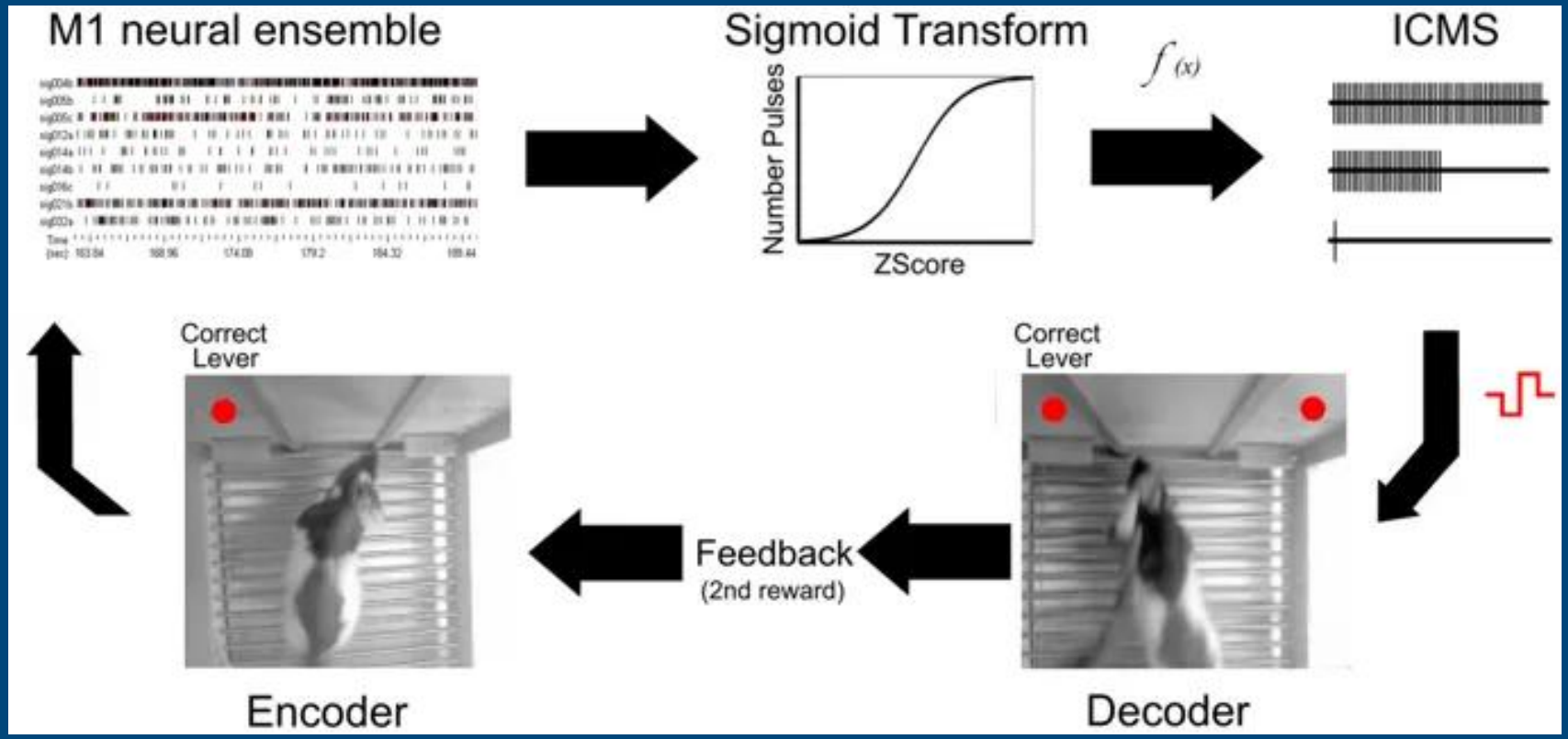
Cybernetica

=> Verbinden biologie en technologie

- Bril (al 700 jaar)
- Pacemaker (al 70 jaar)
- Kunstarm
- Telefoon
- AI ?
- Cyborg ?

=> niets nieuws?

Biotechnologie:
Gedachte transplantatie



Ook hogere hersenfuncties zijn informatie

=> A Brain-to-Brain Interface for Real-Time Sharing of Sensorimotor Information

http://www.nature.com/articles/srep01319
https://youtu.be/nNuntbrwXsM

Uploaden

- Heel veel data
- Dynamisch (tijdsdimensie => 4D)

⇒ big tech

⇒ onsterfelijkheid

⇒Kloon => nieuw individu?

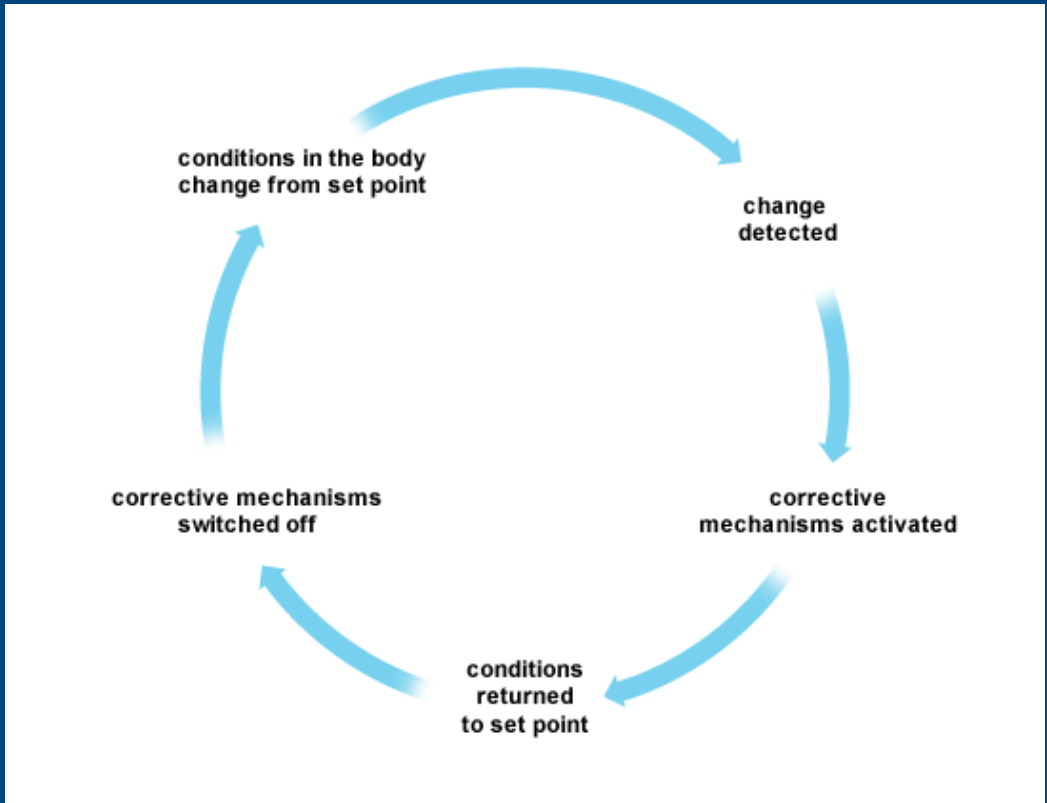
Ja, zodra die kloon zijn eigen ervaringen heeft

⇒ Avatar!

⇒Plutarchus. Ben jij nog dezelfde persoon

⇒ Dezelfde Input => andere output => dus ander persoon

Celbio 4: Feedback is continuous



For example: Biological clock, or Nerve cell firing, where input generates output, which generates input, which generates output…

Analogie is een stad:
Beetje centrale aansturing maar eigenlijk gevolg van activiteit van individuele onderdelen.
Bottom-up ipv top-down (vgl spons)

En, er is altijd iets dat het evenwicht verstoord (al is het maar entropie), dus er is continue correctie

Behoud van ordening mbv feedback (kost energie).
Proces is metastabiel, maar bestaat al 4 miljard jaar

https://www.youtube.com/watch?v=AZUeKoD_3y0

Normaal is variabel

- Beter

=> nieuwe normaal

- Normaal
- Slechter

NB Slechter dan normaal repareren is OK. Van normaal naar beter is vaak niet OK

Toch streven we allemaal naar beter (Instragram)?

The consciousness wars:
can scientists ever agree on how the mind works?

- Nature 17 January 2024
- **There are dozens of theories of how the brain produces conscious experience, and a new type of study is testing some of them head-to-head.**

Nadelen van bewustzijn

- Behoefte aan zingeving

- Besef van de dood

=> Evolutie doet niet aan moraal, dood gaan is essentieel.

- Illusie van sturing van bovenaf (vrije wil), terwijl vrijwel alles autonoom is. En bewustzijn is meestal juist achteraf.

- Wat we doen komt door genen, hormonen, ervaring die in onze informatieverwerkingsunit wordt verwerkt tot output.

⇒Swaab: Wij zijn ons brein https://nl.wikipedia.org/wiki/Dick_Swaab

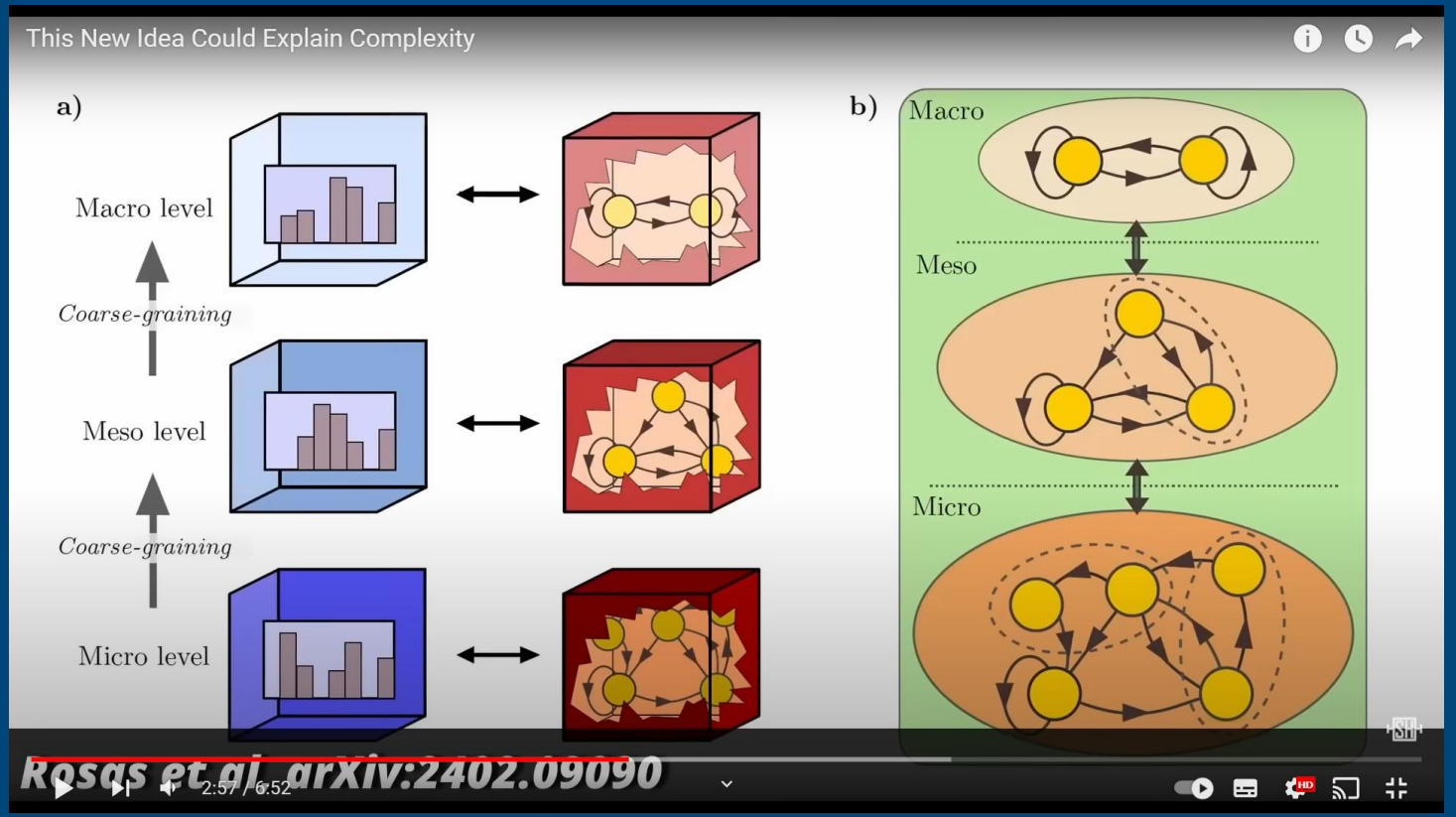
⇒Scheppend en vernietigend

Emerging properties
Voorbij reductionisme

- http://www.npo.nl/de-volmaakte-mens/10-06-2015/VPWON_1231937

Software in the natural world:
A computational approach to hierarchical emergence

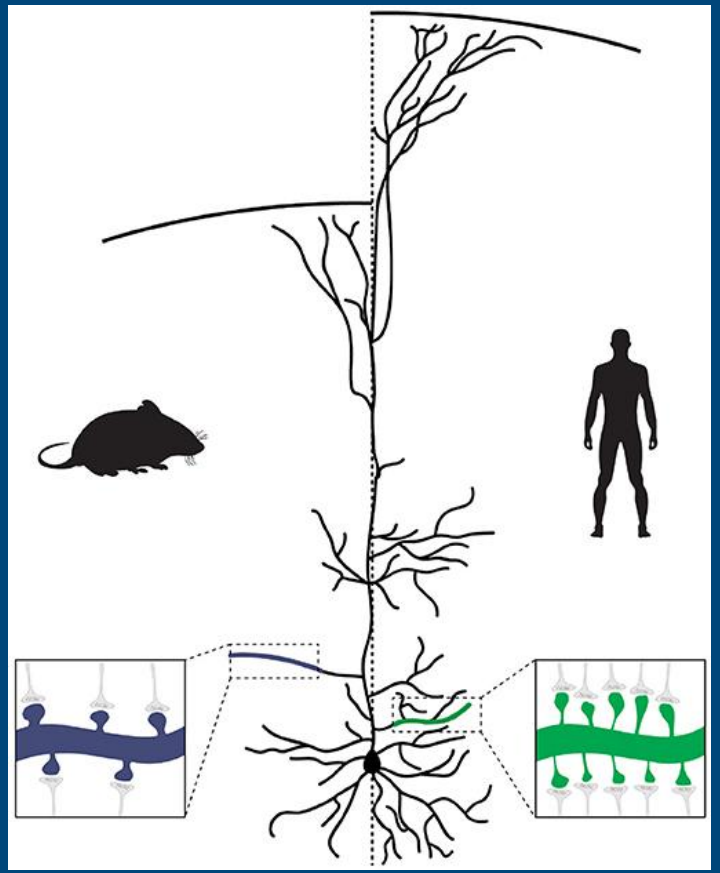
- A rigorous framework that not only identifies *when* emergence takes place, but explains *how* this happens computationally
- https://arxiv.org/abs/2402.09090
- https://youtu.be/Tw9sr05Vtso

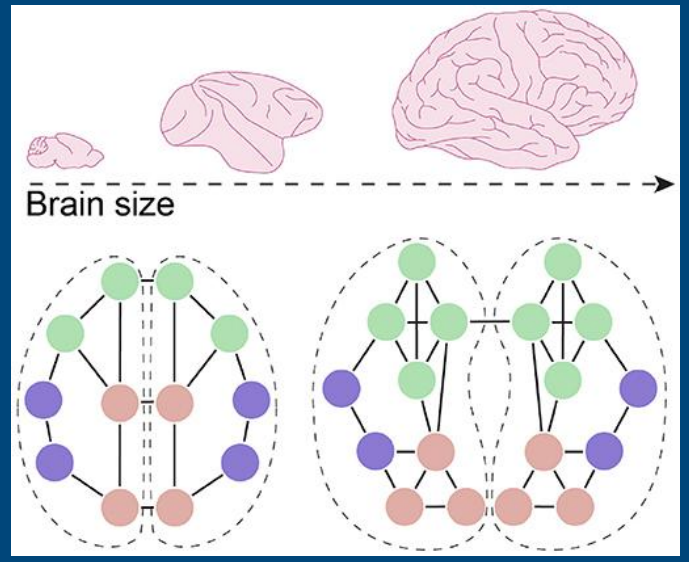


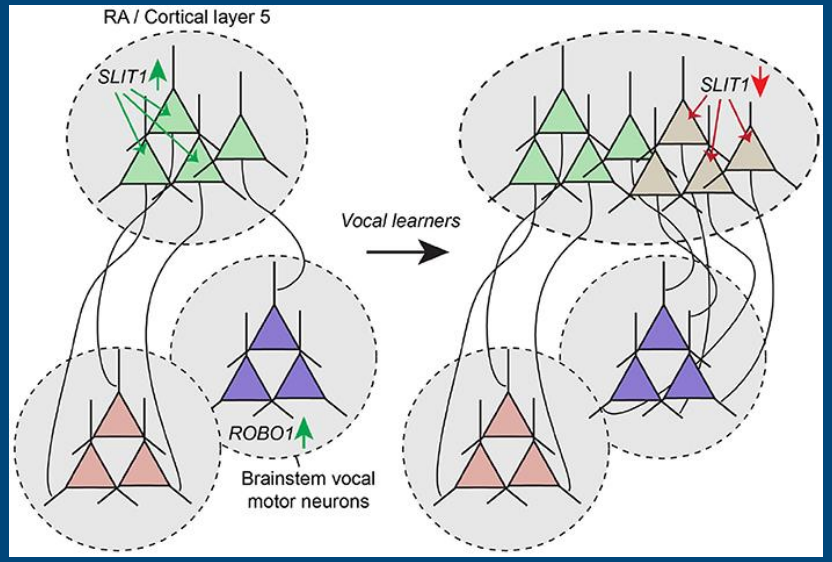
The human brain:

More connections

More flexible connections







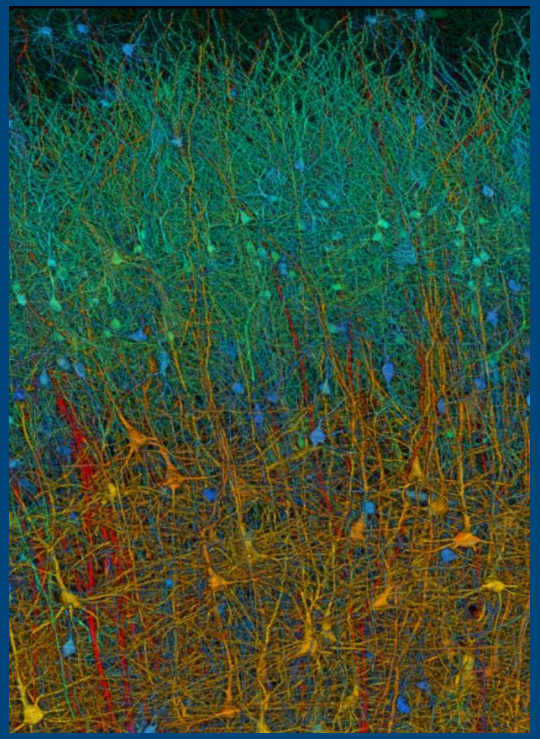
In human pyramidal neurons (PNs), a larger number of branch points leads to a more extensive and complex dendritic tree. Each branch also contains a larger number of synapses, resulting in an overall increase in the number of synapses made onto human PNs. In addition, because of the increased cortical thickness of the human brain, the apical dendrites of human PNs extend over a longer distance to reach layer I.

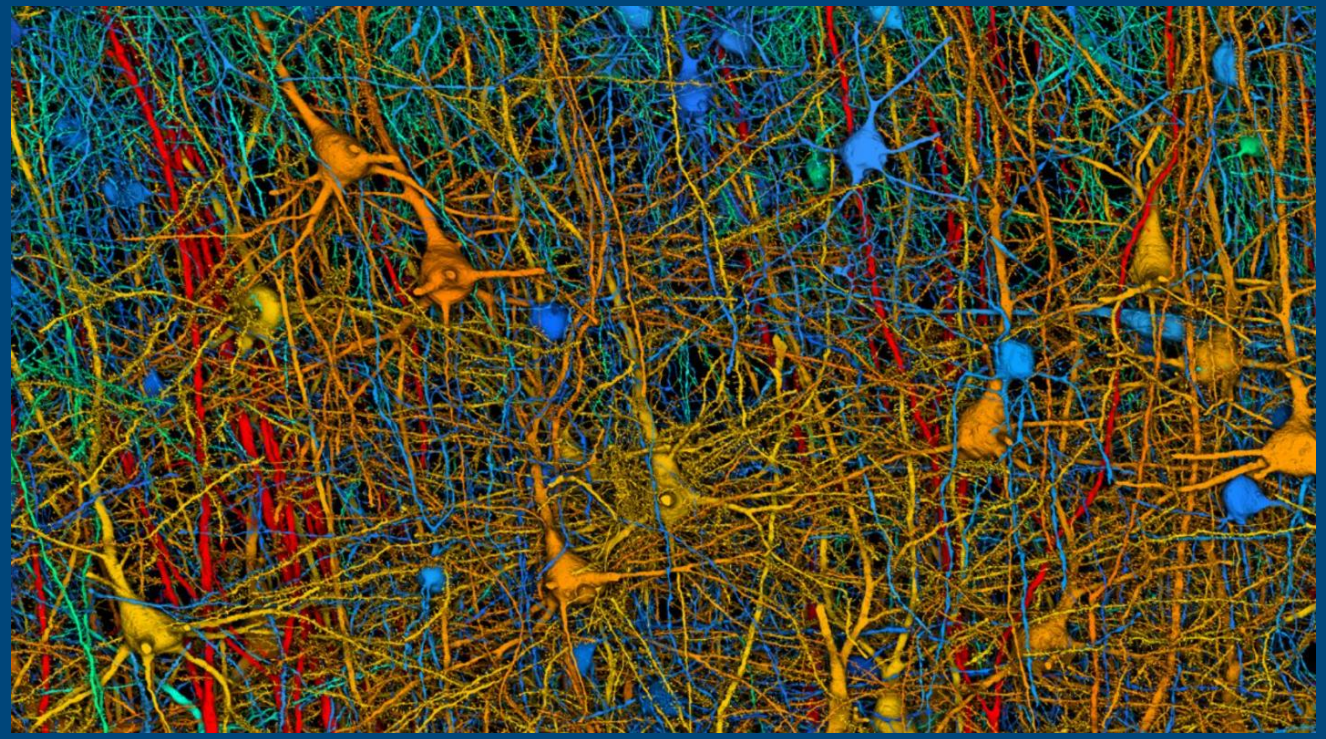
https://www.frontiersin.org/articles/10.3389/fncir.2021.787164/full

New genes, Synaptic pruning

This exquisitely detailed image charts the connections between thousands of cells in a tiny sliver of human brain.

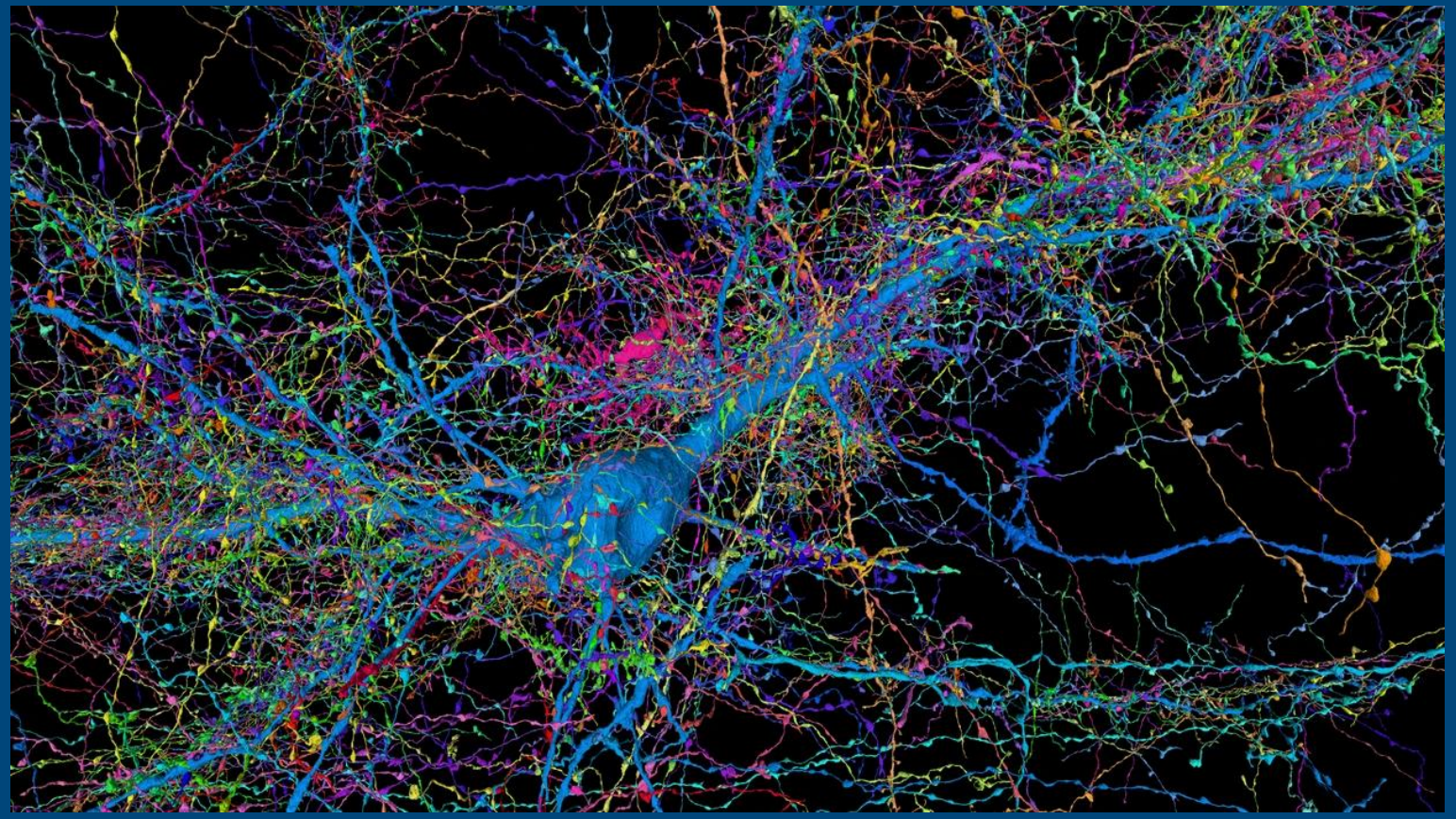
The sample was taken from the cortex — the part of the brain responsible for complex thought — and cut into thin slices that were imaged using electron microscopes. Scientists then stitched the images back together digitally and analysed them with the help of artificial intelligence programs. Different types of neuron have been artificially colour-coded.





How AI could lead to a better understanding of the brain

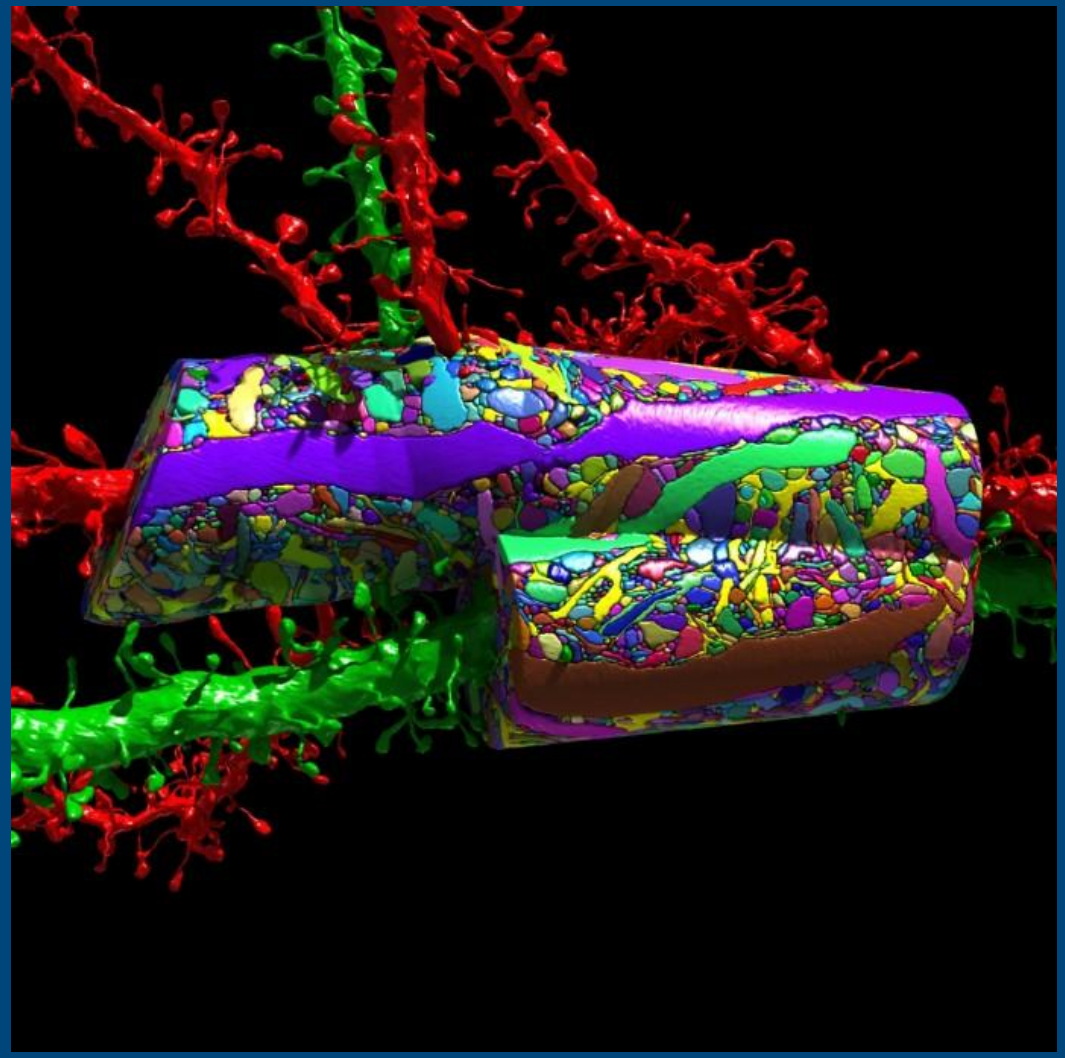
- **Early machine-learning systems were inspired by neural networks — now AI might allow neuroscientists to get to grips with the brain's unique complexities.**



incoming connections to a single human pyramidal cell

https://www.nature.com/articles/d41586-023-03426-3

Hersencellen zitten compact samen



3D model
Elke kleur is een andere cel
Elk uitsteeksel een verbinding
(1mm^3 van een muis)

~86 miljard zenuwcellen waarvan elk in verbinding staat met een groot aantal andere neuronen

⇒ Meer verbindingen dan het internet
⇒ (when will the internet become aware?)

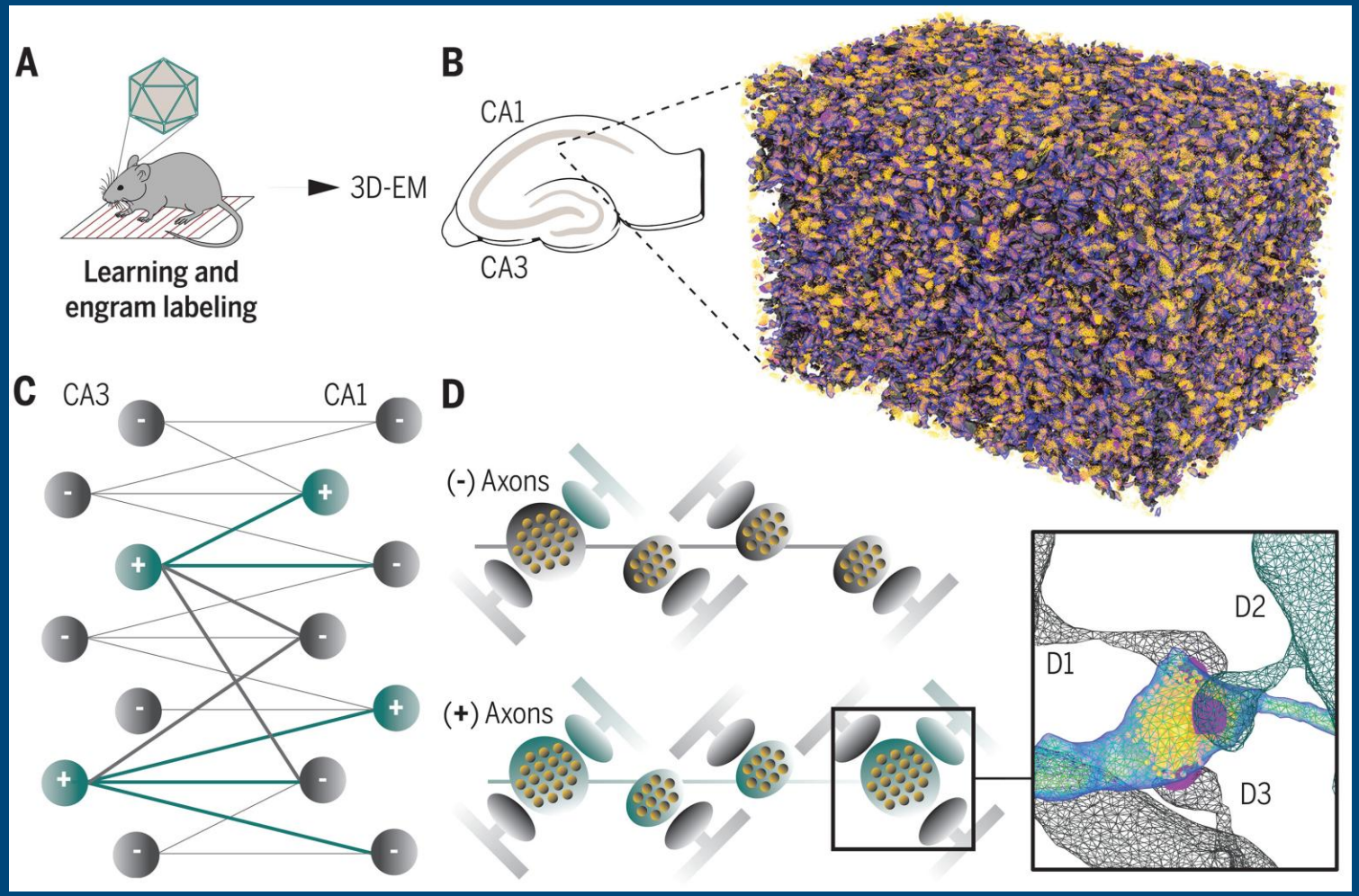
https://youtu.be/nvXuq9jRWKE?t=72

Synaptic architecture of a memory engram in the mouse hippocampus

- Hoe werkt geheugen?

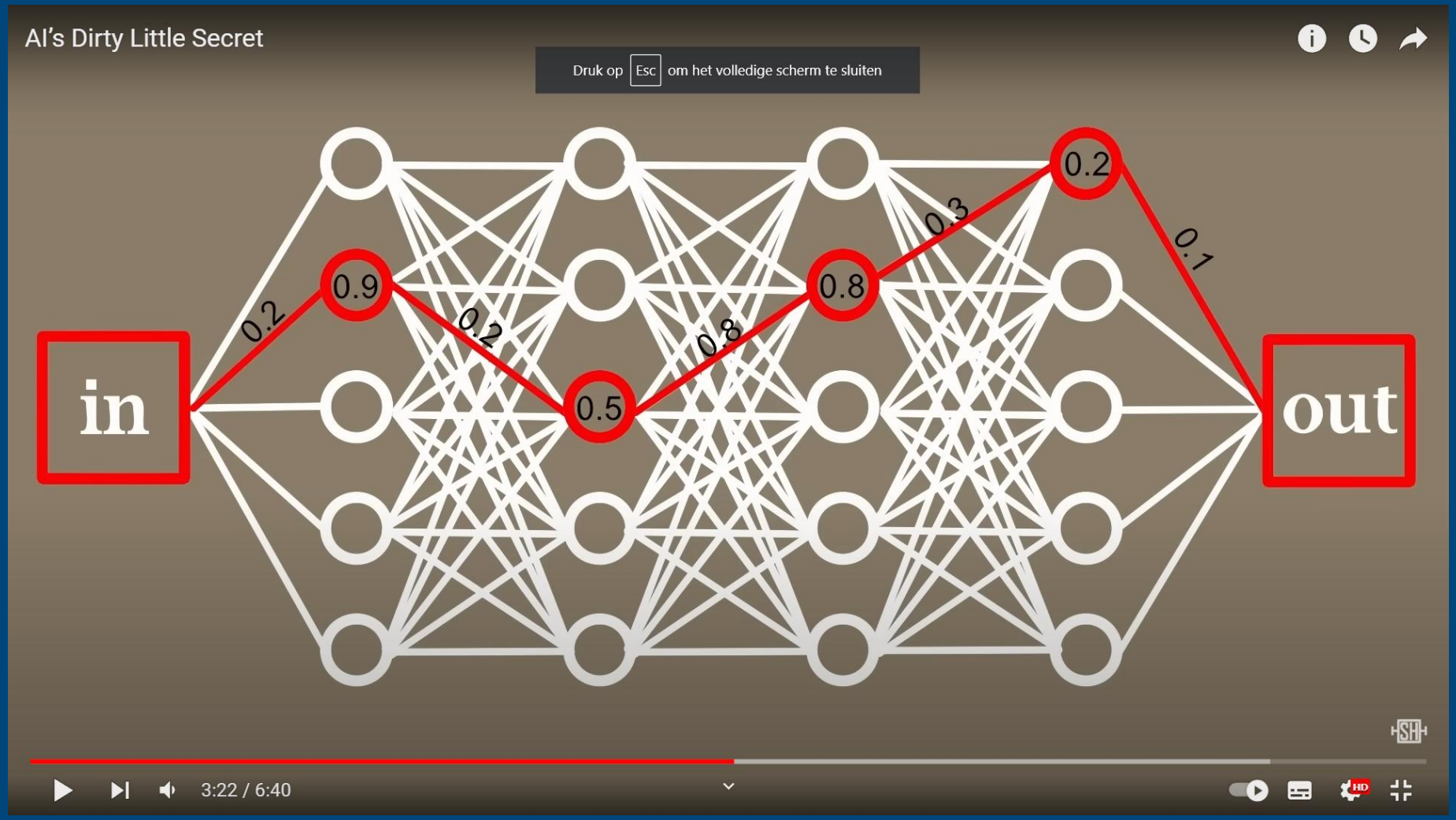
⇒aanpassingen netwerk

https://www.science.org/doi/10.1126/science.ado8316



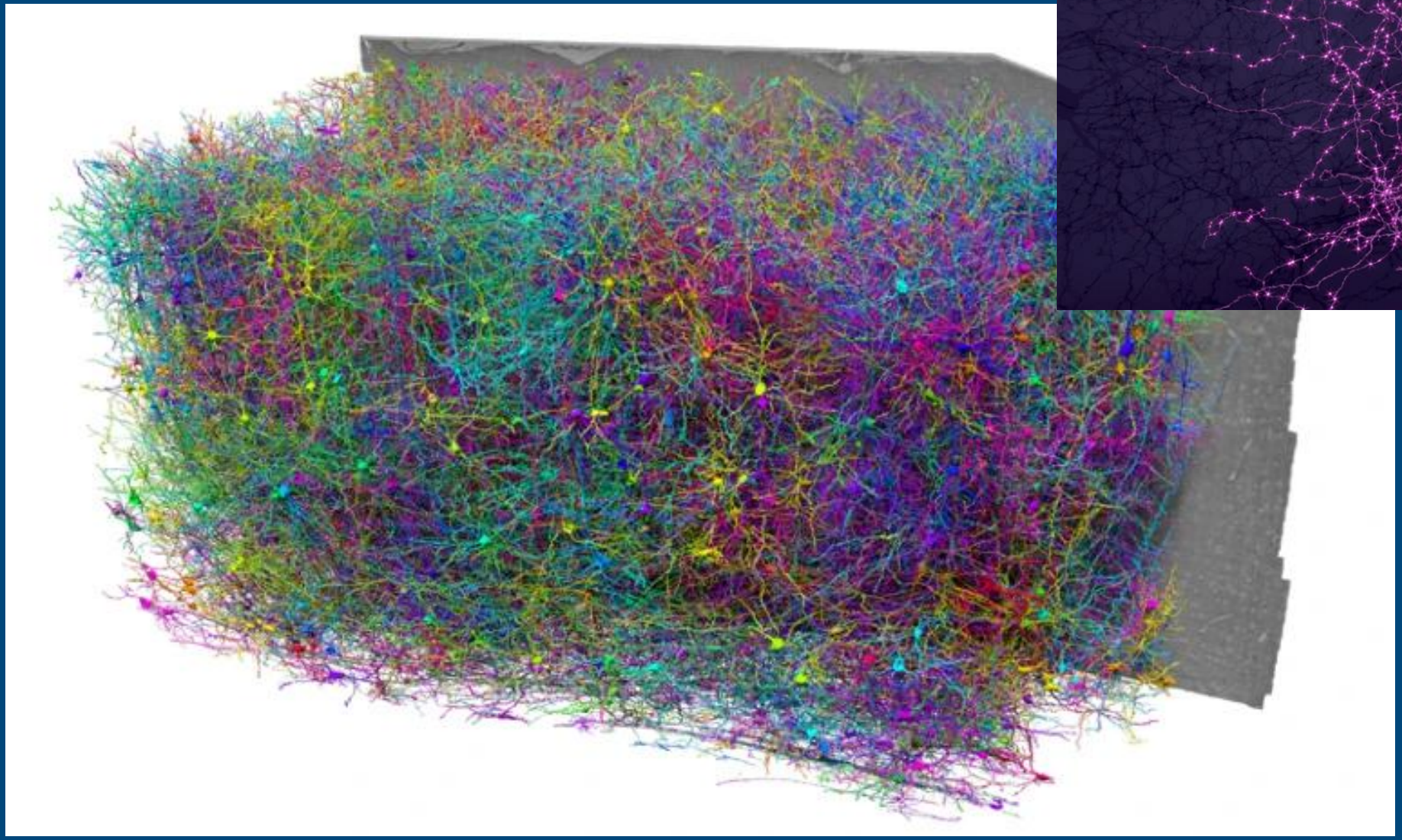
AI and neural nets

- https://www.youtube.com/watch?v=QO5plxqu_Yw



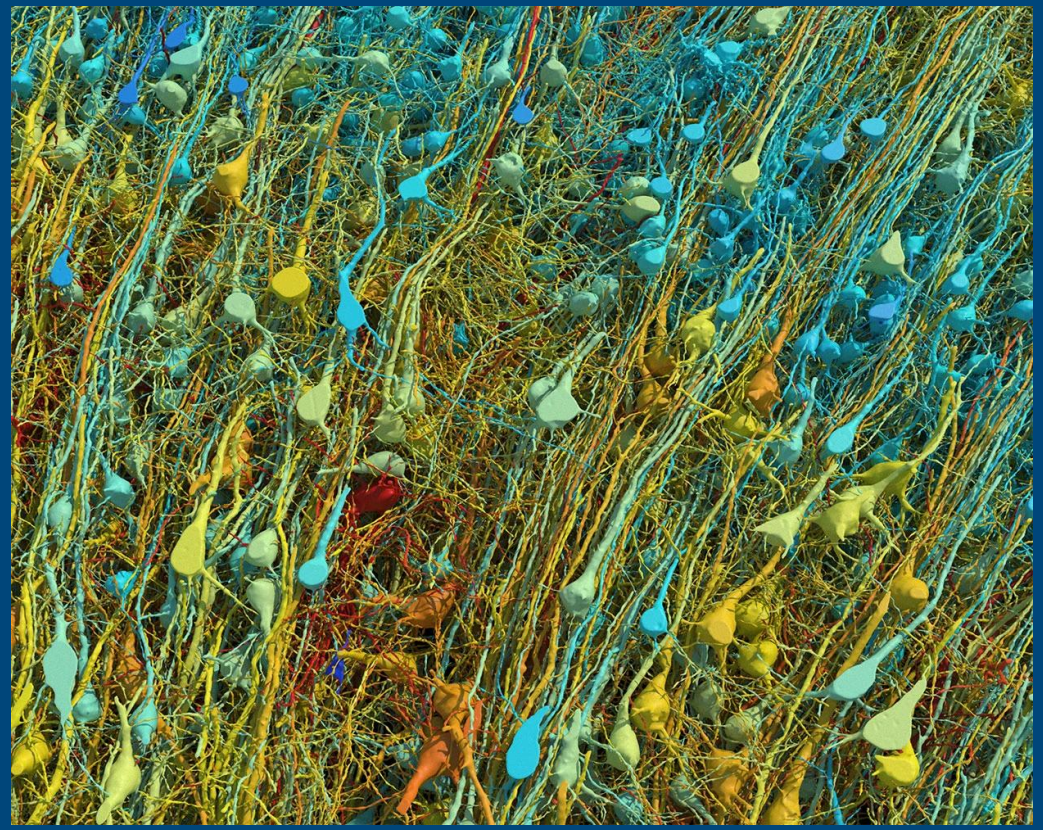
1 muis neuron

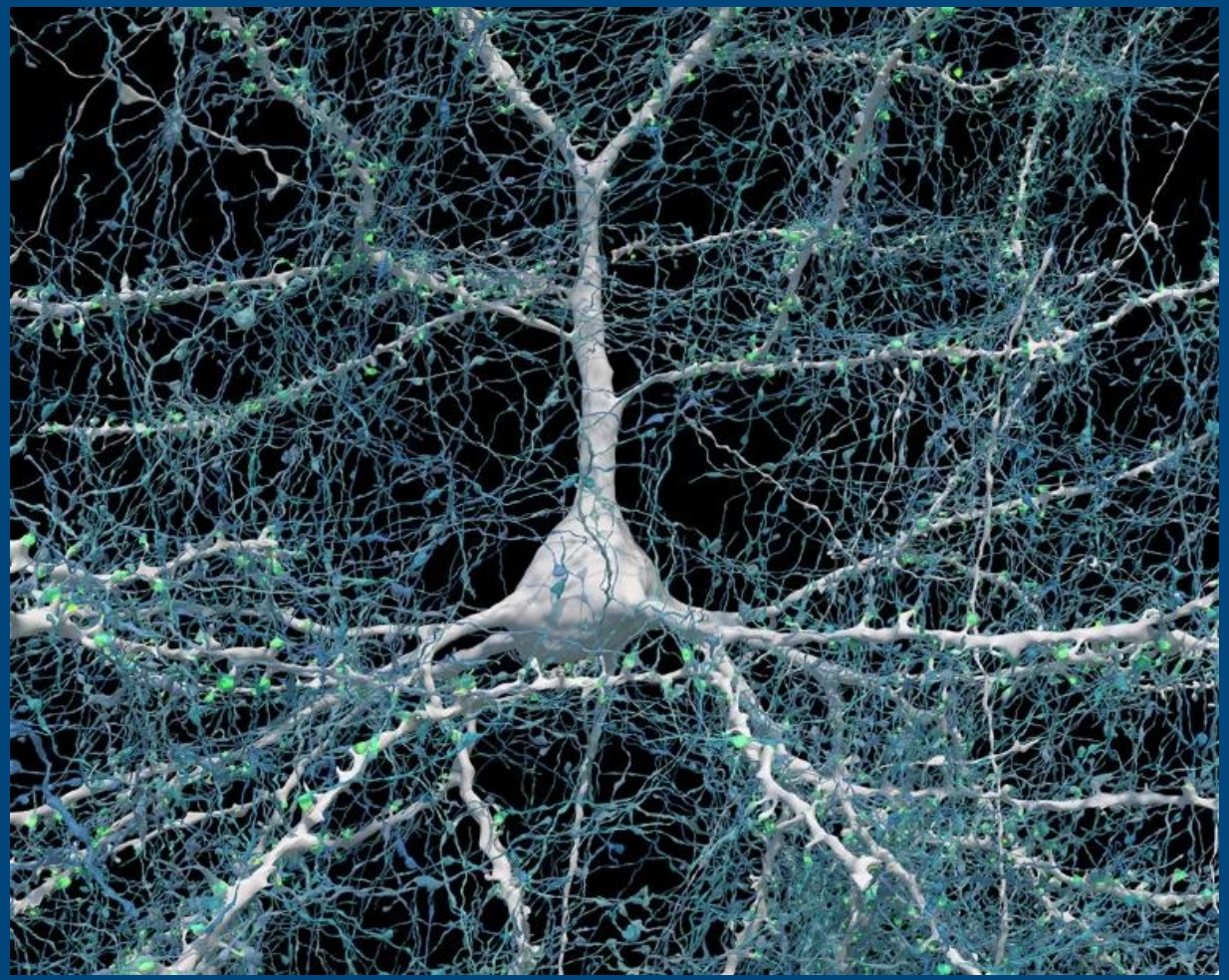
1mm3 muis cortex



Cubic millimetre of brain mapped in spectacular detail

- https://www.nature.com/articles/d41586-024-01387-9





- https://www.technologyreview.com/2024/03/08/1089612/the-many-uses-of-mini-organs

Are cells sentient

- https://www.science.org/doi/10.1126/science.ado0065

- Is a quantum system sentient? Or at least does it have a will?

Wat maakt de mens bijzonder?
Is nog volop debat over, maar..

Complexe taken => kunnen dieren ook
Zelfbewustzijn => hebben kraaien al
Planning => kunnen chimpansees ook

Vooral veel meer dan andere dieren (grotere hersenen)
Hierarchical thinking and abstractie (=> kurzweil)

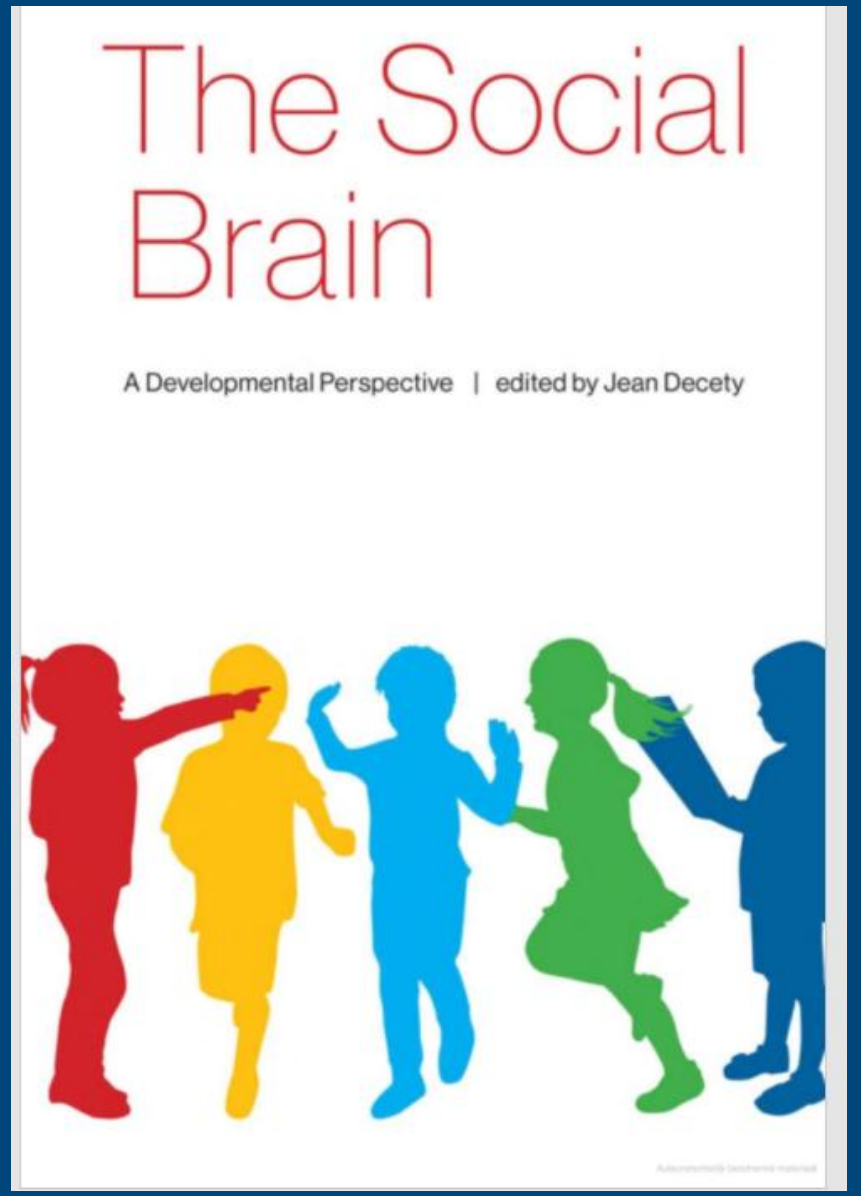
En flexibeler (leren = nieuwsgierigheid),
Misschien wel de helft van ons gedrag is aangeleerd (nurture)

En taal (strottenhoofd !)
Geheugen begint ook bij taalontwikkeling

⇒ Informatieoverdracht (the social brain)

Social cognition encompasses all the information-processing mechanisms that underlie how people capture, process, store, and apply information about others to navigate social situations. It focuses on the importance of cognitive and emotional processes in our social interactions. The way we think about others plays a major role in how we think, feel, and interact with the world around us.

Strong covariation in size and developmental duration coupled with flexible brains allow organisms to adapt in variable social and ecological environments across the life span and in evolution.



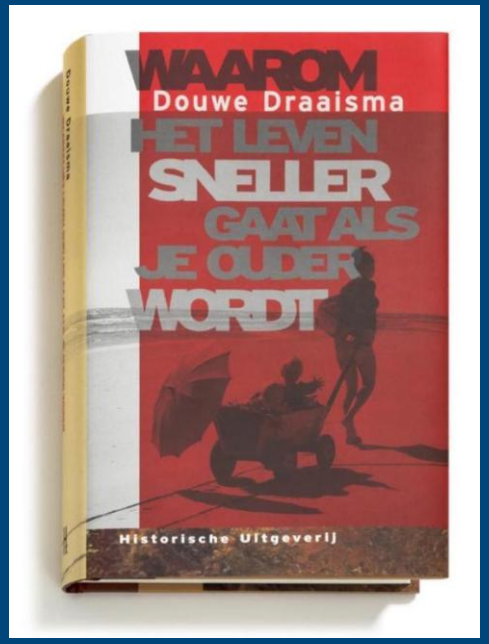
https://books.google.nl/books/about/The_Social_Brain.html

https://www.sciencedirect.com/science/article/abs/pii/B9780444538604000040

Visuo-frontal interactions during social learning in freely moving macaques

- Nature: 14 February 2024
- Social interactions represent a ubiquitous aspect of our everyday life that we acquire by interpreting and responding to visual cues from conspecifics[1]. However, despite the general acceptance of this view, how visual information is used to guide the decision to cooperate is unknown. Here, we wirelessly recorded the spiking activity of populations of neurons in the visual and prefrontal cortex in conjunction with wireless recordings of oculomotor events while freely moving macaques engaged in social cooperation. As animals learned to cooperate, visual and executive areas refined the representation of social variables, such as the conspecific or reward, by distributing socially relevant information among neurons in each area. Decoding population activity showed that viewing social cues influences the decision to cooperate. Learning social events increased coordinated spiking between visual and prefrontal cortical neurons, which was associated with improved accuracy of neural populations to encode social cues and the decision to cooperate. These results indicate that the visual-frontal cortical network prioritizes relevant sensory information to facilitate learning social interactions while freely moving macaques interact in a naturalistic environment.

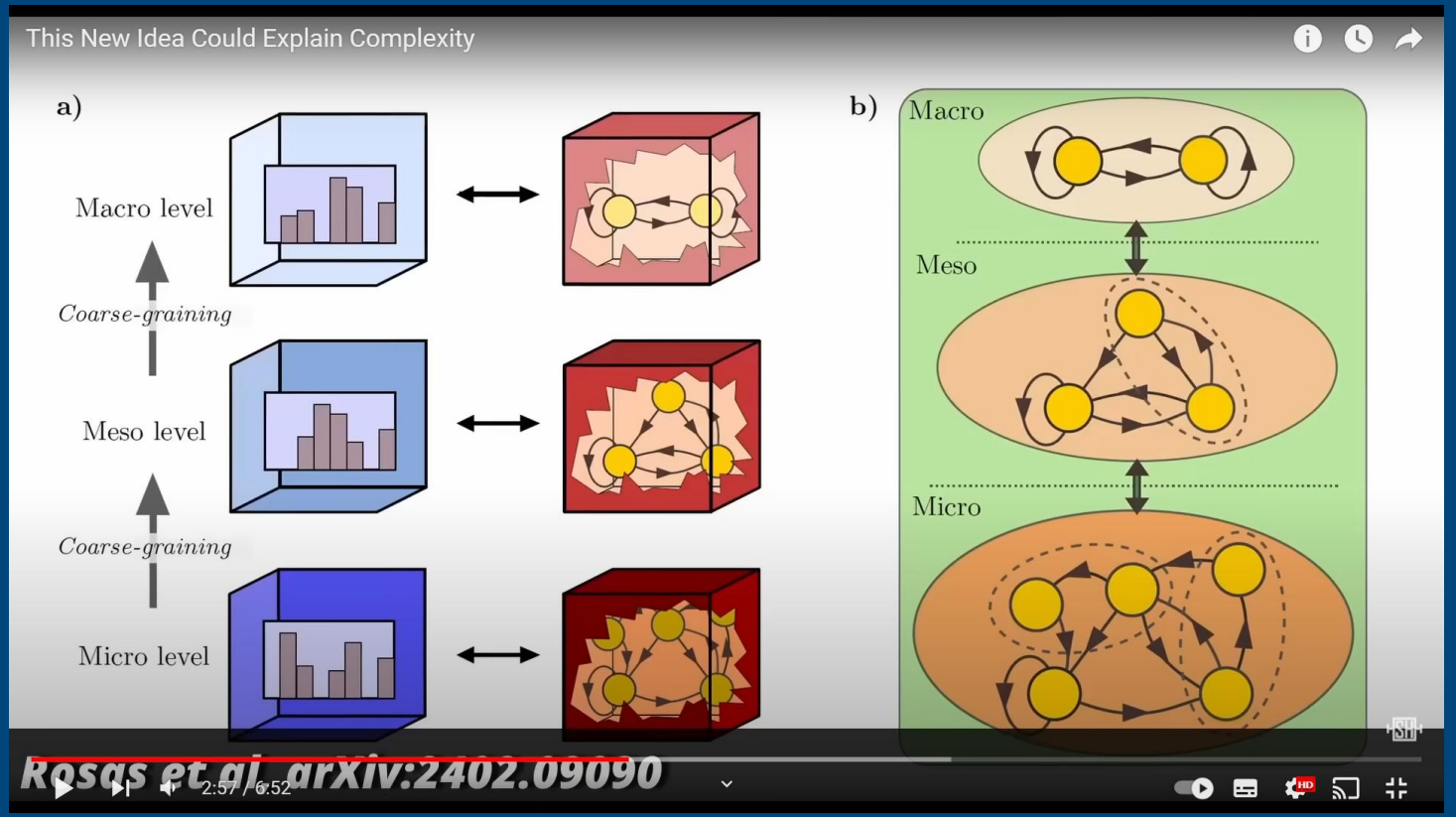
Douwe Draaisma, Rutger Kopland



- https://douwedraaisma.nl/nl/books
- https://nl.wikipedia.org/wiki/Rutger_Kopland

Software in the natural world:
A computational approach to hierarchical emergence

- A rigorous framework that not only identifies *when* emergence takes place, but explains *how* this happens computationally
- https://arxiv.org/abs/2402.09090
- https://youtu.be/Tw9sr05Vtso



Celbio 6.
Het zenuwstelsel

Hogere feedback-loops

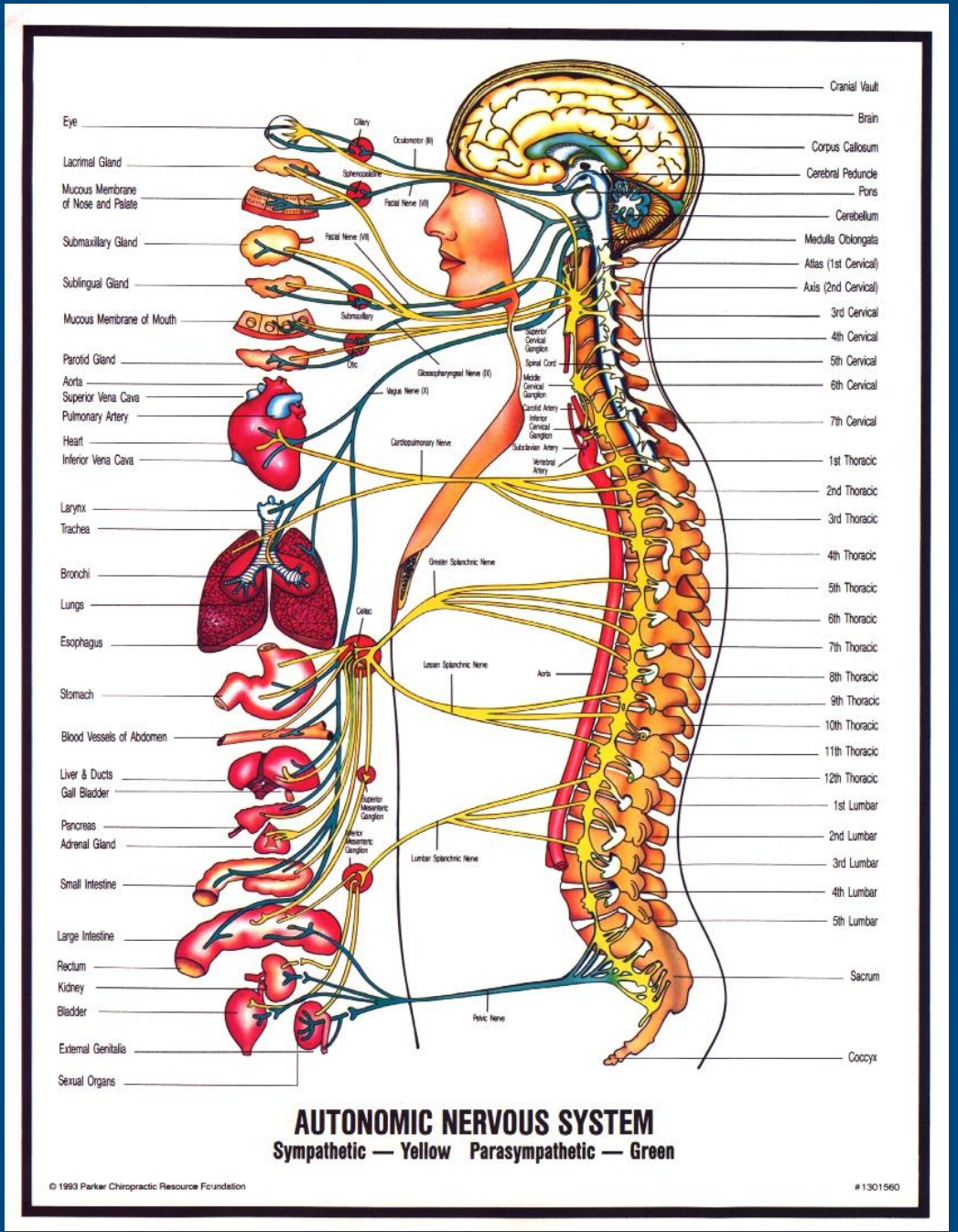
Regelcentra

Hersenen

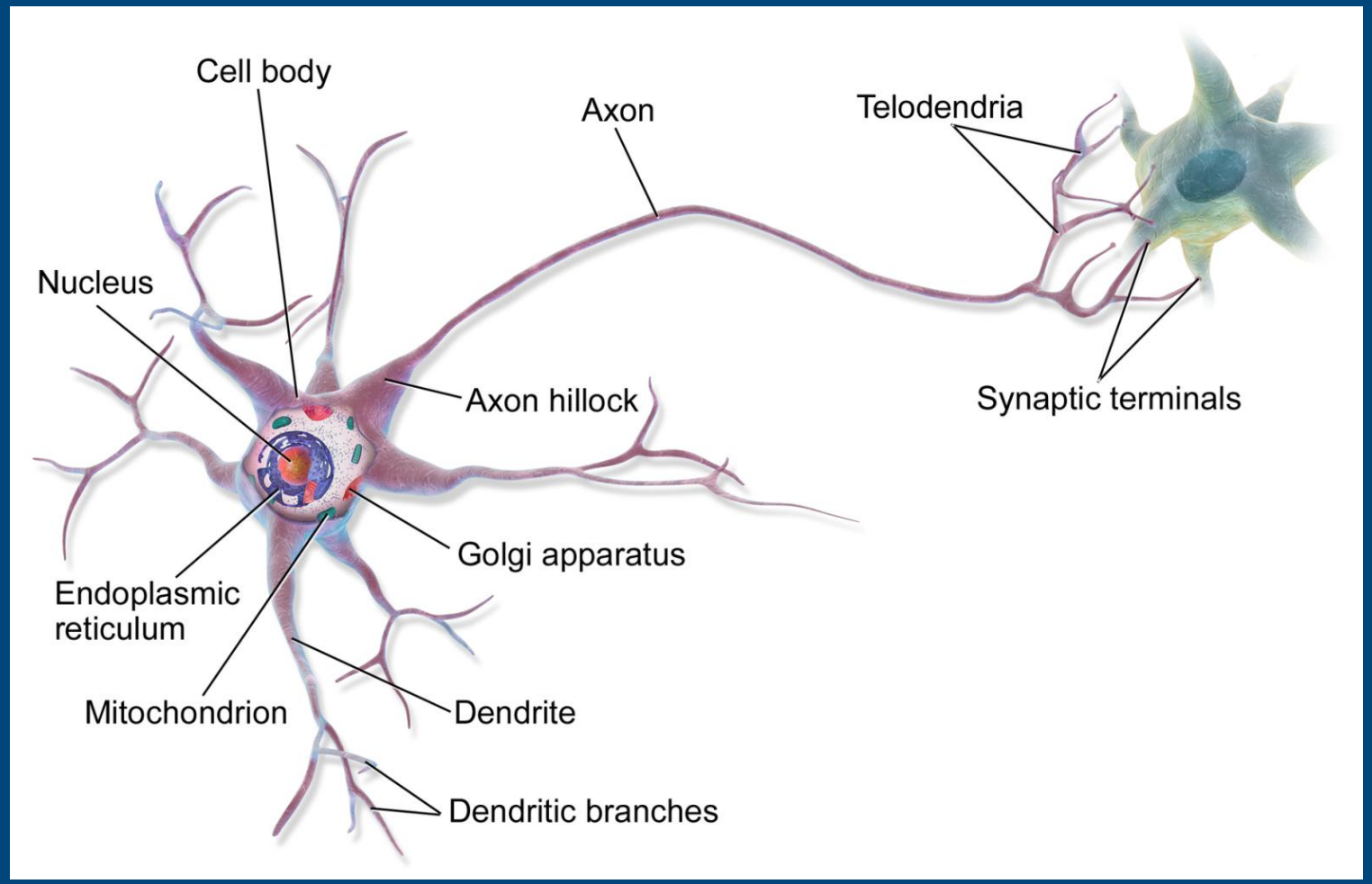
Bewustzijn

99% Onbewust !

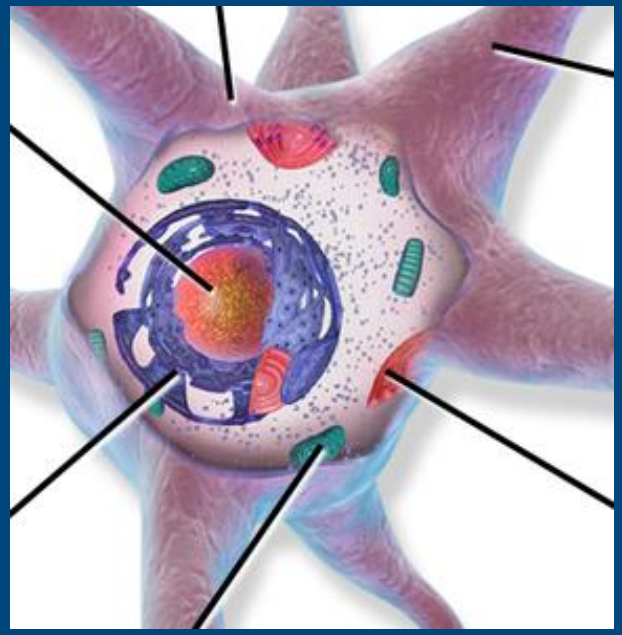
(ademhaling)



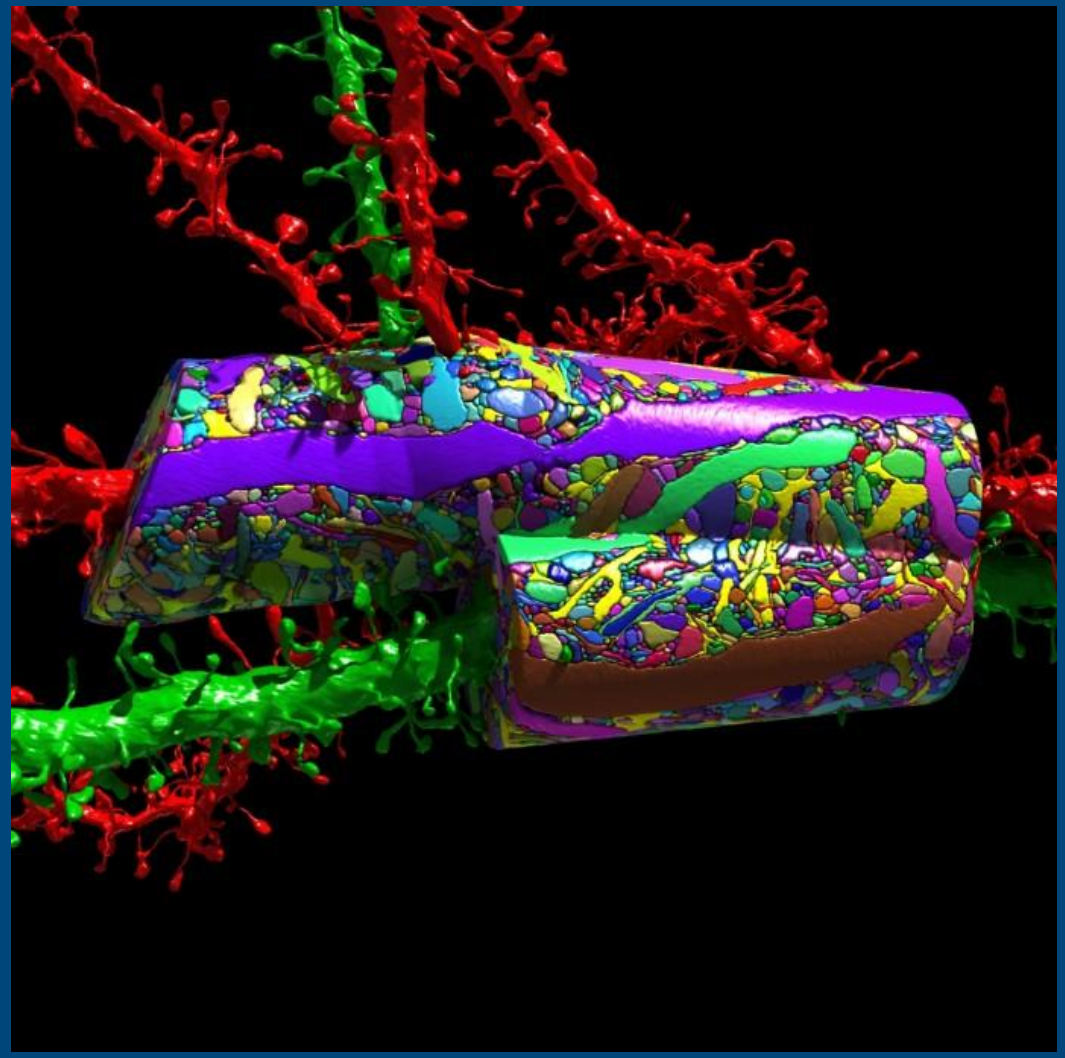
De zenuwcel



- Ook klein (~86 miljard in een hoofd)
- Axon kan tot 1 m lang zijn (superdun)
- Dendriet: ingaand
- Axon: uitgaand



Hersencellen zitten compact samen



3D model
Elke kleur is een andere cel
Elk uitsteeksel een verbinding
(1mm^3 van een muis)

~86 miljard zenuwcellen waarvan elk in verbinding staat met een groot aantal andere neuronen

⇒ Meer verbindingen dan het internet
⇒ (when will the internet become aware?)

https://youtu.be/nvXuq9jRWKE?t=72

Informatie

“All that we are, comes from how the neurons are connected”:
Tim Berners Lee (uitvinder http => www)

“We are our memories”

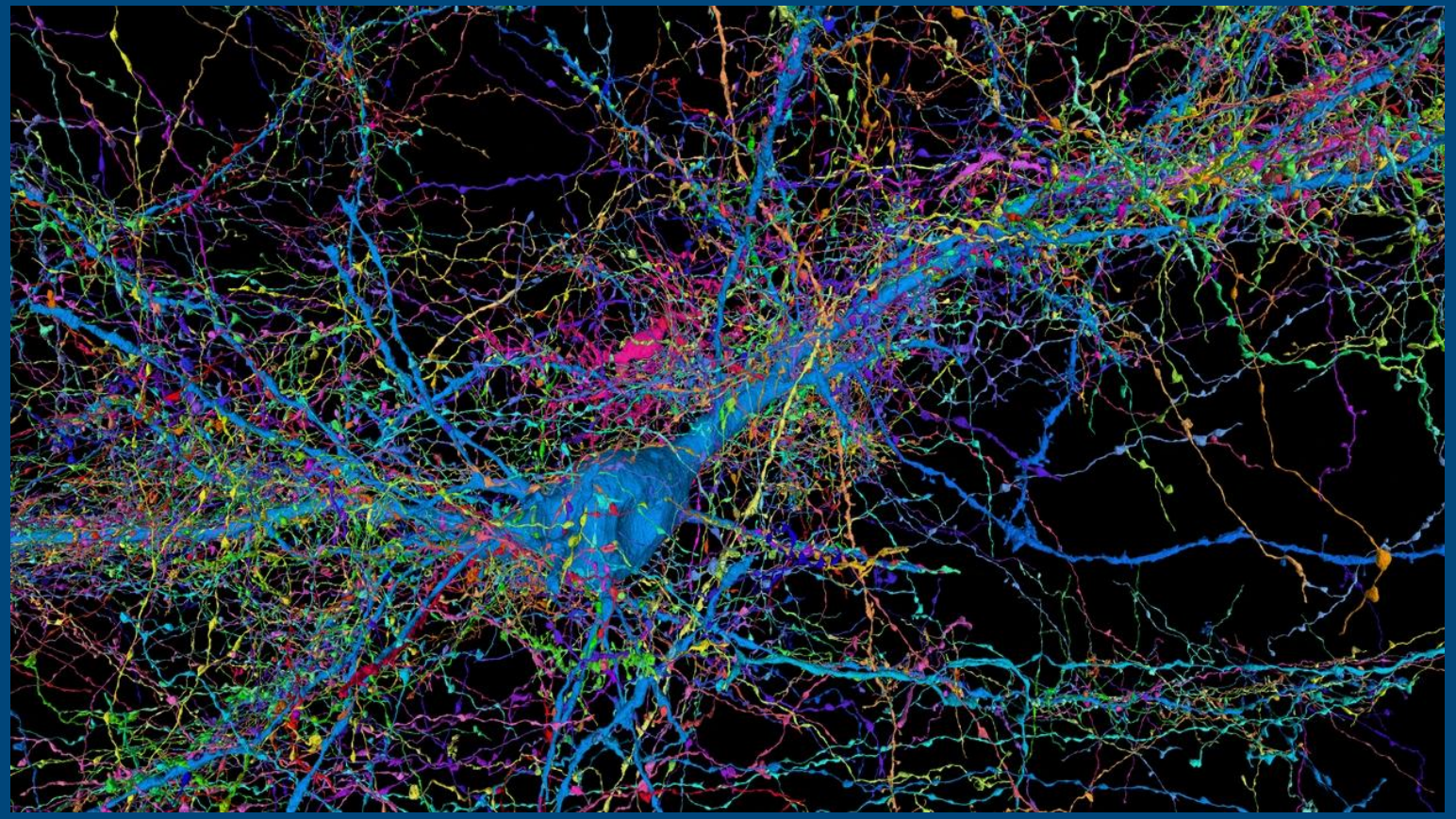
Alle stoffelijke zaken (cellen, atomen) worden vervangen (celbio 7).
Na 10 jaar ben je letterlijk iemand anders. Het enige dat blijft is informatie.

(Neuro)biologie os vooral informatietechnologie

=> Artifical Intelligence

How AI could lead to a better understanding of the brain

- **Early machine-learning systems were inspired by neural networks — now AI might allow neuroscientists to get to grips with the brain's unique complexities.**



incoming connections to a single human pyramidal cell

https://www.nature.com/articles/d41586-023-03426-3

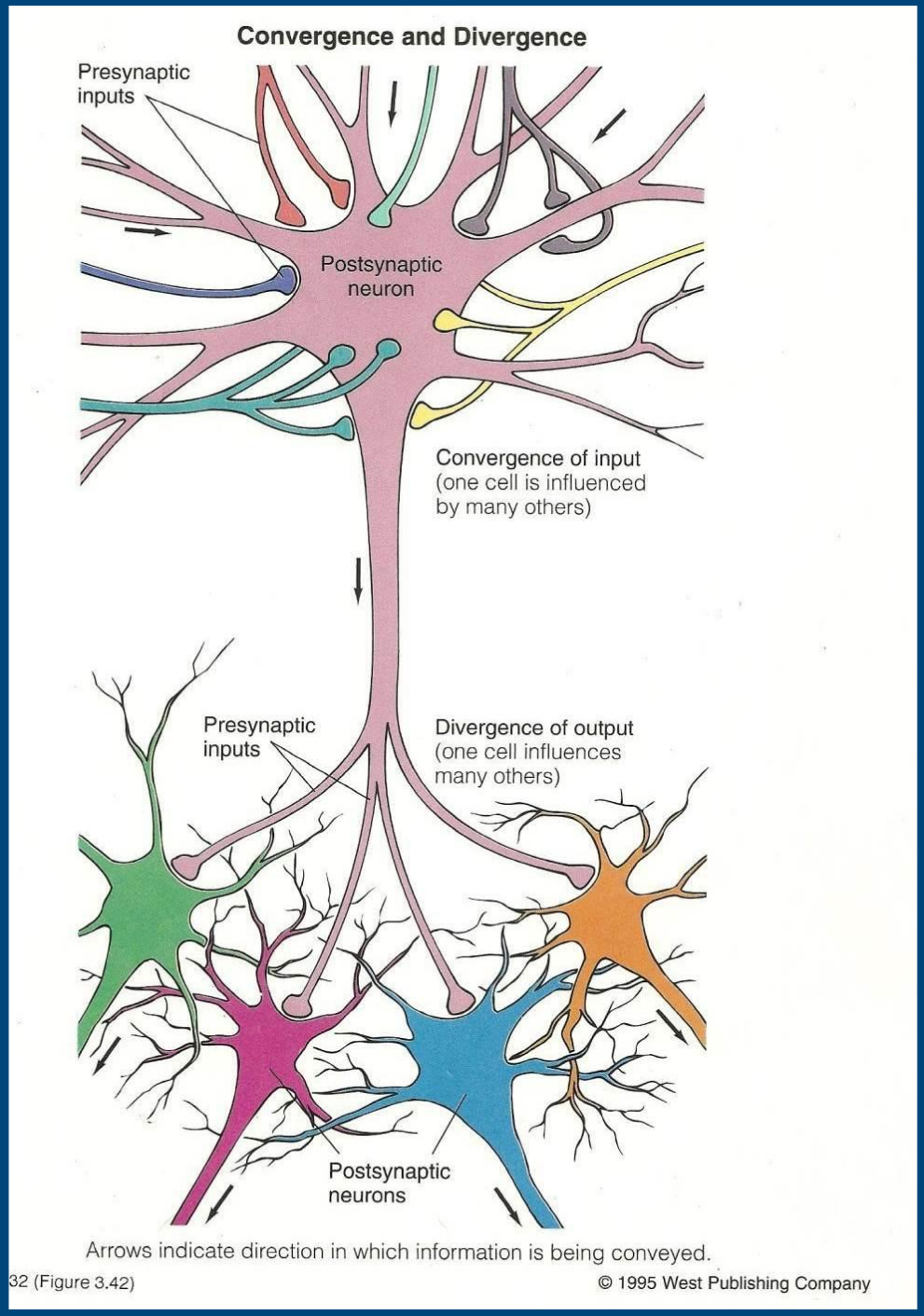
Neuronen en netwerken

- Er zijn ~86 miljard neuronen
- Een gemiddeld neuron heeft ~1000 verbindingen

=> ~10^{14} verbindingen

NB Vgl met celmembraan: integratie van signalen, alleen dan nog veel veel veel complexer

NB Internet heeft nu 10^{10} verbindingen (and counting..)



Vervolgcursus Biotechnologie.

DNA/RNA-technologie

Stamcellen en Tissue-Engineering

Proefdieren en Imaging

Cybernetica (*Integratie biologie en technologie)*

Synthetic biology en Wat is leven?

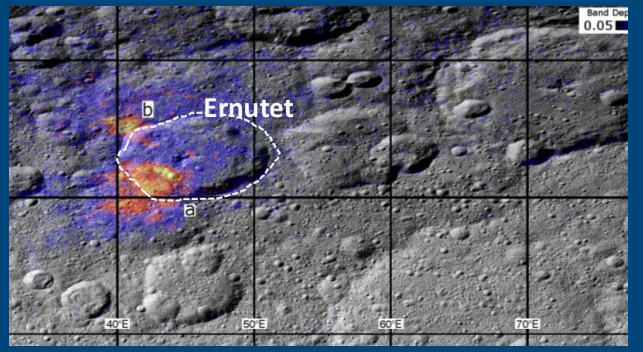
Genomics, proteomics en individuele gezondheidszorg

Lezen wetenschappelijke literatuur, hoe werkt wetenschap?

Excursie?

Dwarf planet Ceres and the ingredients of life

A fundamental question in the evolution of the early Earth is the origin of the oceans and of some of the organic molecules that were required for the formation of life. Earth formed in the protoplanetary disk, a mixture of gas and dust. At the location of Earth, temperatures were too high for water vapor and some more volatile organic components to condense. This led to the idea that those materials may have been delivered to Earth by asteroids and/or comets from the outer solar system. Recent spacecraft studies of Comet 67P/Churyumov-Gerasimenko with Rosetta, and of Ceres with the Dawn space probe, provide evidence that complex organic molecules and even amino acids are ubiquitous on small bodies in the solar system and that water ice is abundant in the asteroid belt.

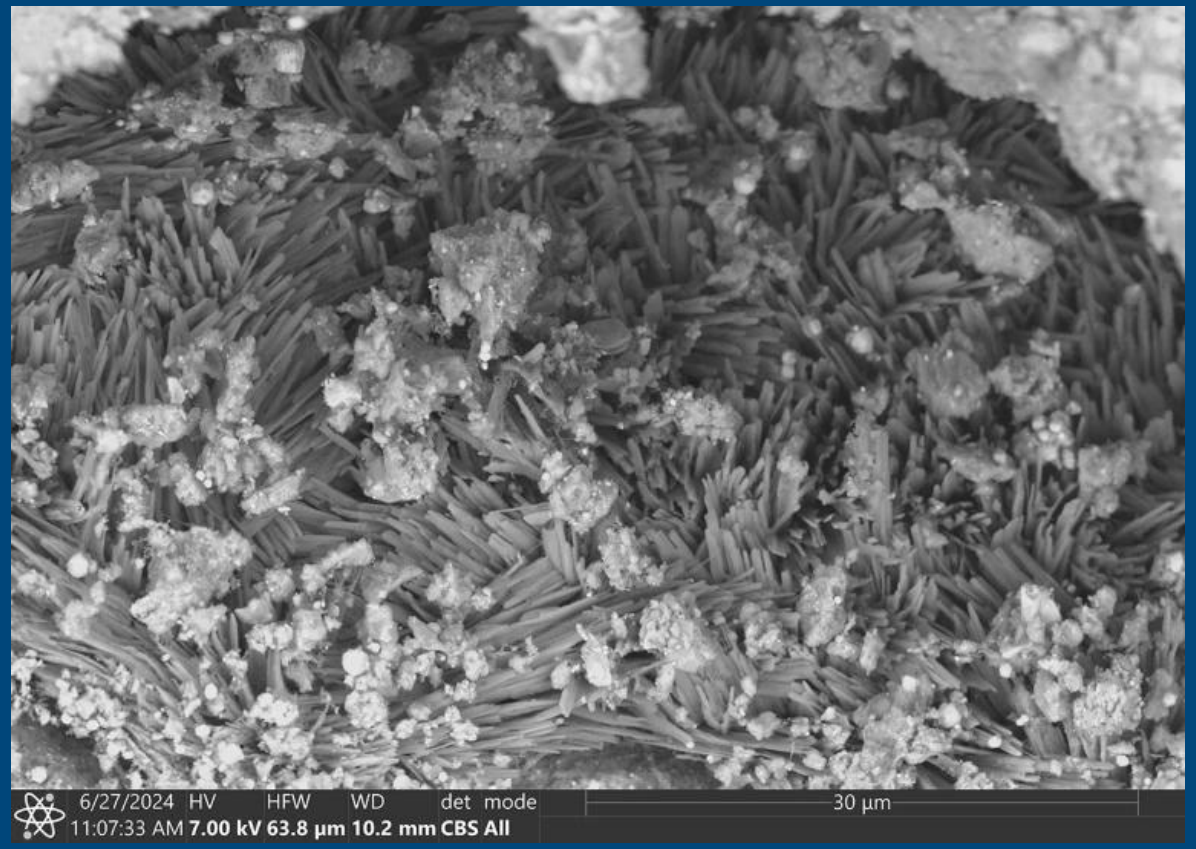


Maan is 1/5e van de aarde
Ceres 1/20ste

=> protoplanets

Samples from Bennu contain the chemical building blocks of life but with a twist.

- Not only does Bennu contain all 5 of the nucleobases that form DNA and RNA on Earth and 14 of the 20 amino acids found in known proteins, the asteroid's amino acids hold a surprise. On Earth, amino acids in living organisms predominantly have a 'left-handed' chemical structure. Bennu, however, contains nearly equal amounts of these structures and their 'right-handed', mirror-image forms
- material from Bennu is also rich in salts created billions of years ago. "Having these brines there, along with simple organic stuff, may have kick-started [the process of] making much more complicated and interesting organics like the nucleobases,"

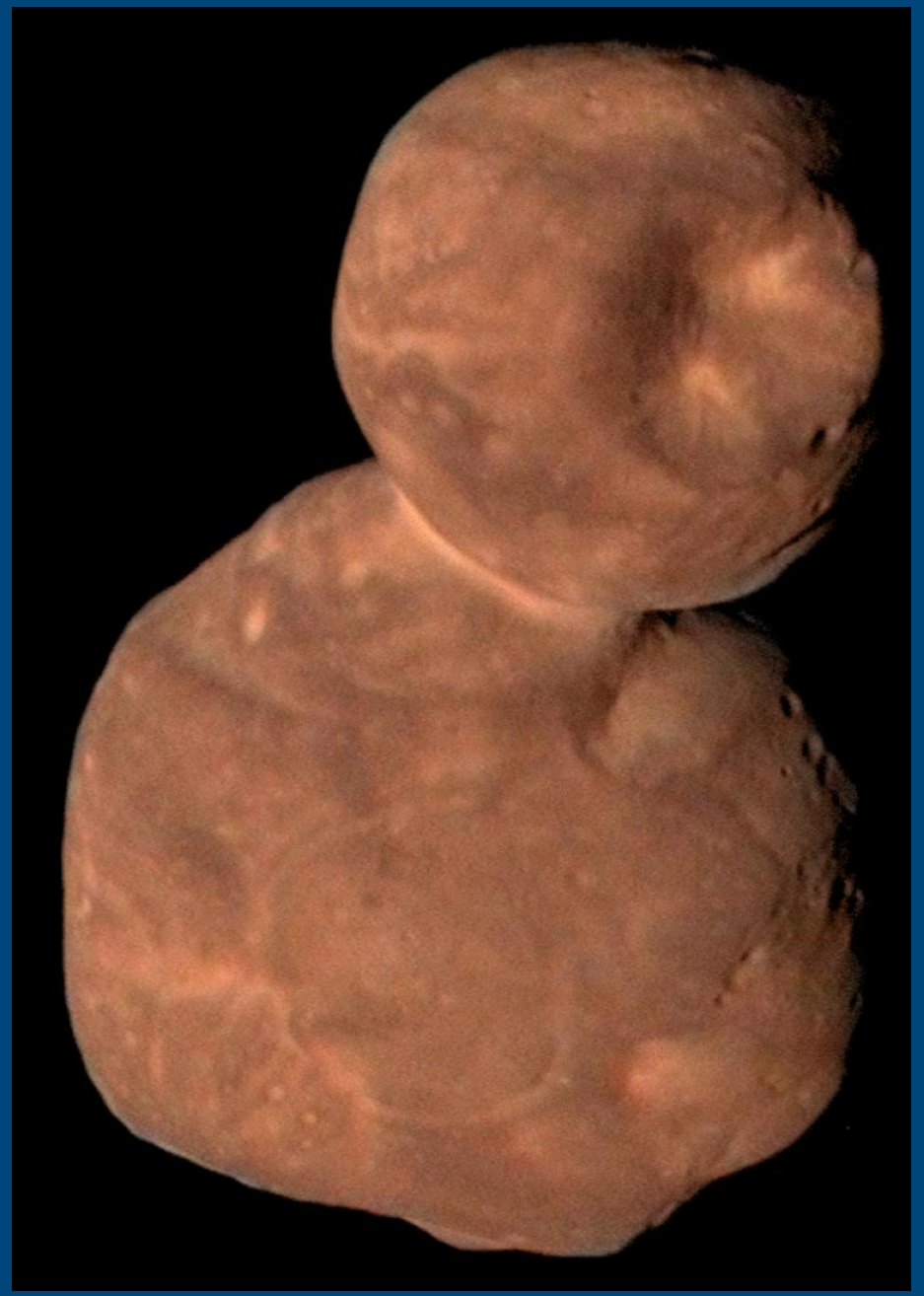


A scanning electron microscope image of the sodium carbonate crystalline needles found in samples of the asteroid Bennu.

Ultima Thule

- Ultima Thule is the first unquestionably primordial contact binary ever explored. Approach pictures hinted at a strange, snowman-like shape, but further analysis of images, taken near closest approach, uncovered just how unusual the KBO's shape really is. At 22 miles (35 kilometers) long, the binary consists of a large, flat lobe (nicknamed "Ultima") connected to a smaller, rounder lobe (nicknamed "Thule").
- This strange shape was the biggest surprise of the flyby. Nothing like it has been anywhere in the solar system -- sending the planetary science community back to the drawing board to understand how planetesimals (the building blocks of the planets) form. New Horizons scientists have also seen evidence for methanol, water ice and organic molecules on the surface -- a spectrum similar to some of the most extreme objects we've seen in the outer solar system.

=> het ontstaan van leven



Bouwstenen voor leven in de ruimte

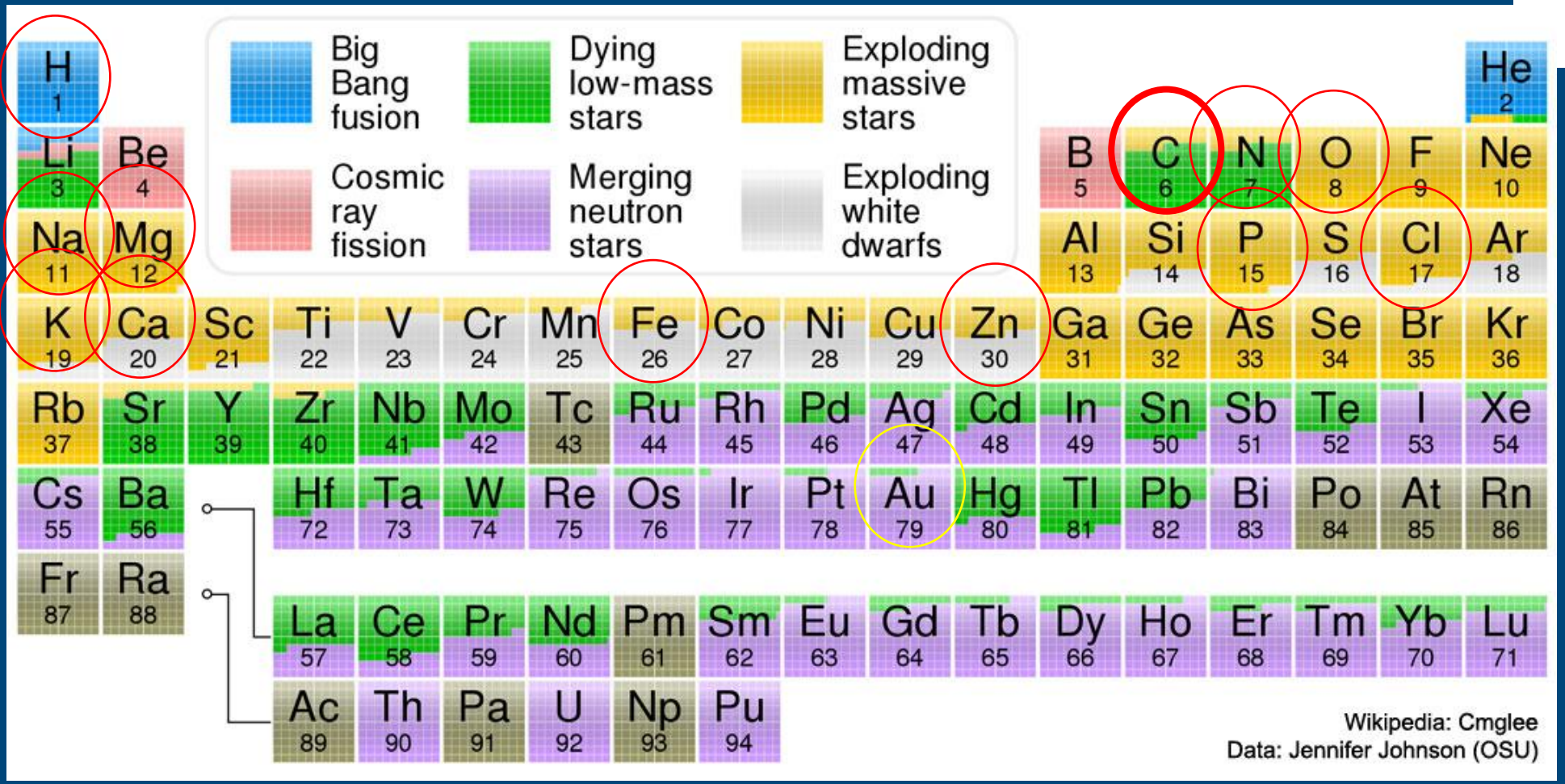
- H, C, N, O
- Fe, Zn (=> katalysatoren)

- CO, NH (eenvoudige verbindingen)

- Aminozuren (eiwitten)
- Ribose (suiker, DNA)

=> zelfs al ingewikkelde verbindingen kunnen in de ruimte ontstaan (UV-straling op oppervlak van stofdeeltjes)

We are made of star stuff



Ashes to Ashes, Dust to Dust

- **Early supernovae may have filled the universe with planet-forming dust**
- JWST space telescope images provide direct evidence for a long-unobservable theory
- In four interacting supernovae that combusted around a few hundred million years ago, they saw light wavelengths characteristic of aluminum, silicate, and carbon dust
- Dust is the building block of the universe," says Melissa Shahbandeh, an astrophysicist at the Space Telescope Science Institute (STScI). Over millions of years, specks of cosmic dust and gas clump together to form large, dense clouds from which planets and stars are born. But the dust's own origins have been mysterious. Now, in data from NASA's JWST space observatory, Shahbandeh and her colleagues have found a source for the dust that filled the early universe: giant stellar explosions called interacting supernovae, whose intense shockwaves can blast out dusty plumes that accumulated in the supernovae's surroundings.
- The team proposes that in the last stages of a giant star's life, it sheds heavier elements that coalesce into dust particles, which form into a cold, dense shell around the stellar core. When the star's core ultimately collapses and then explodes, the shock wave blasts through the dust.
- https://www.science.org/content/article/early-supernovae-may-have-filled-universe-planet-forming-dust

Wat is leven: RNA hypothese

- DNA en Eiwit systemen kunnen moeilijk tegelijk zijn ontstaan

(niet alleen wetenschappelijke vraag maar ook kritiek van creationisten)

- RNA in ribosoom heeft functie van enzym (ribozyme)
- mRNA kan zelf splicen (verwijderen introns)

=> RNA kan zowel informatie bevatten, als iets doen

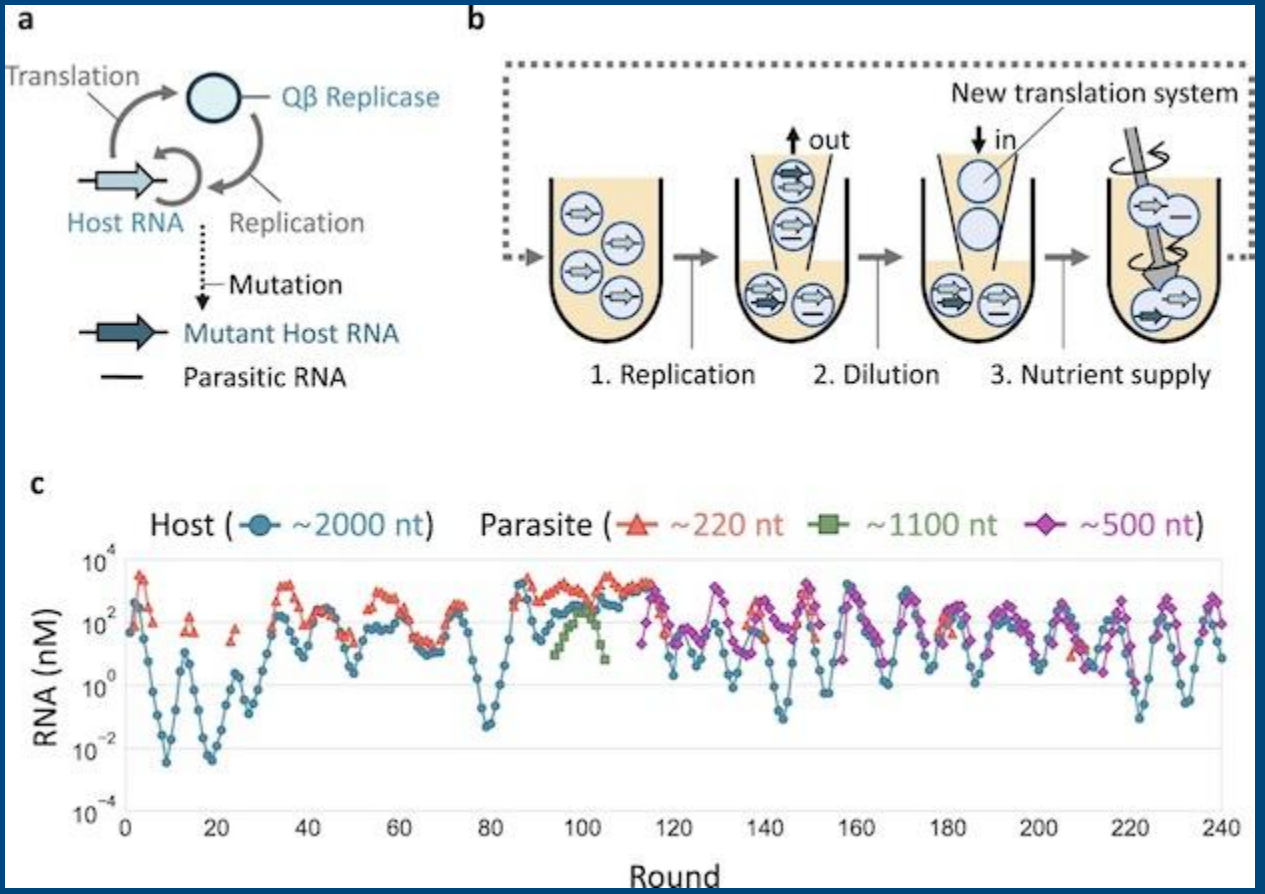
- Veel virussen (Corona) hebben alleen RNA
- RNA is soms ook dubbelstrengs (tussenvorm voor DNA)

=> Eerste leven kon van start met alleen iets van RNA.

=> Later is daar het stabielere DNA, en een complex eiwitsysteem bij gekomen.

NB Al evolutie (selectie) voor er echt leven was: abiotische evolutie

RNA hypothese



Researchers at the University of Tokyo have for the first time been able to create an RNA molecule that replicates, diversifies and develops complexity, following Darwinian evolution. This has provided the first empirical evidence that simple biological molecules can lead to the emergence of complex lifelike systems.

Astrobiology magazine, March 19, 2022

http://astrobiology.com/2022/03/new-insight-into-the-possible-origins-of-life.html

To unravel the origin of life, treat findings as pieces of a bigger puzzle

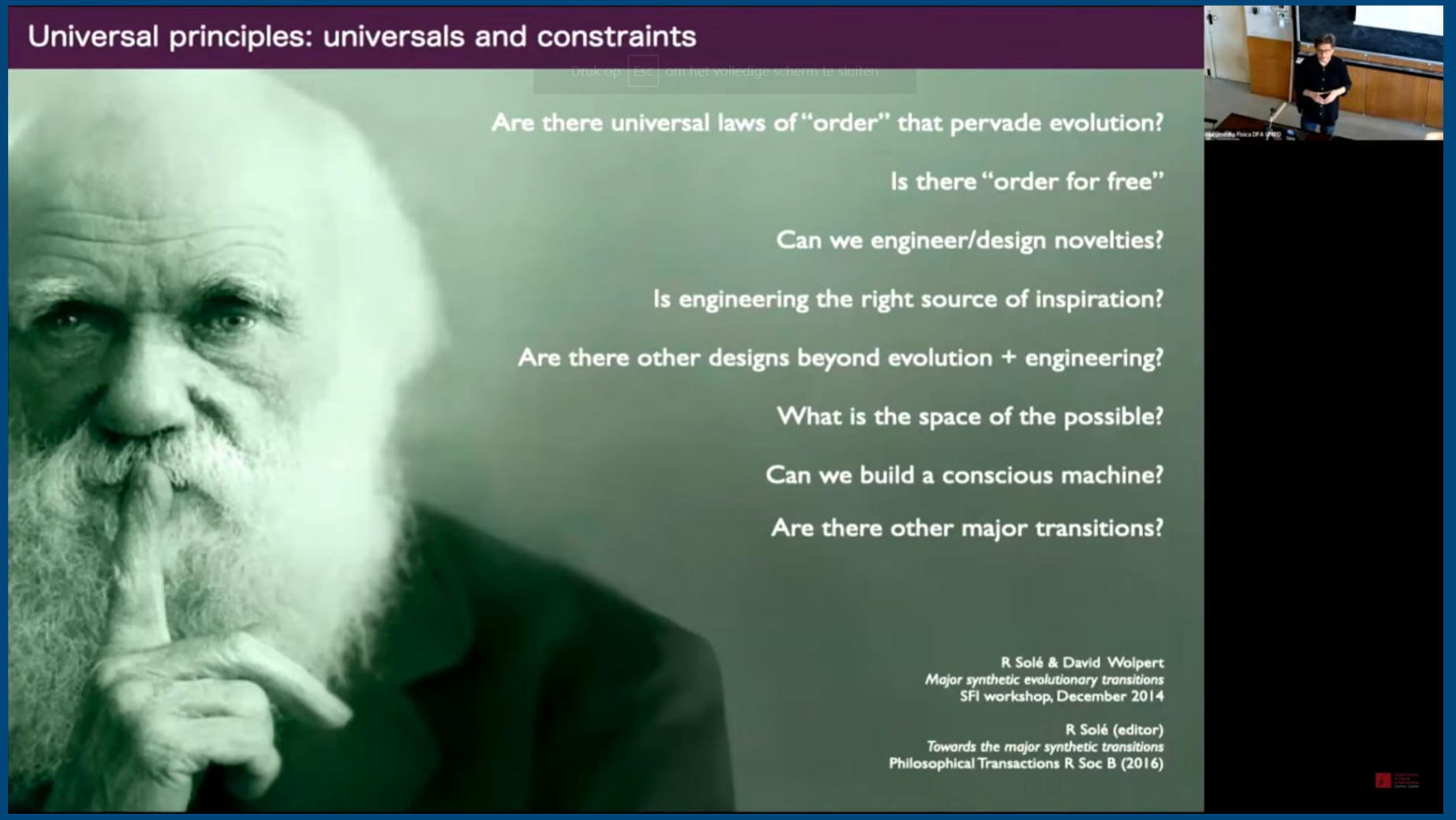
- Nature 2024, Nick Lane & Joana C. Xavier
- Explaining isolated steps on the road from simple chemicals to complex living organisms is not enough. Looking at the big picture could help to bridge rifts in this fractured research field.

Defining Life
=> astrobiology

- Life is a popular term, not a scientific term.
- Nasa: life is a “self-sustaining chemical system capable of Darwinian evolution.”

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3005285/

Fundamental constraints to the logic of living systems



- https://youtu.be/TAfd-NjUbmY

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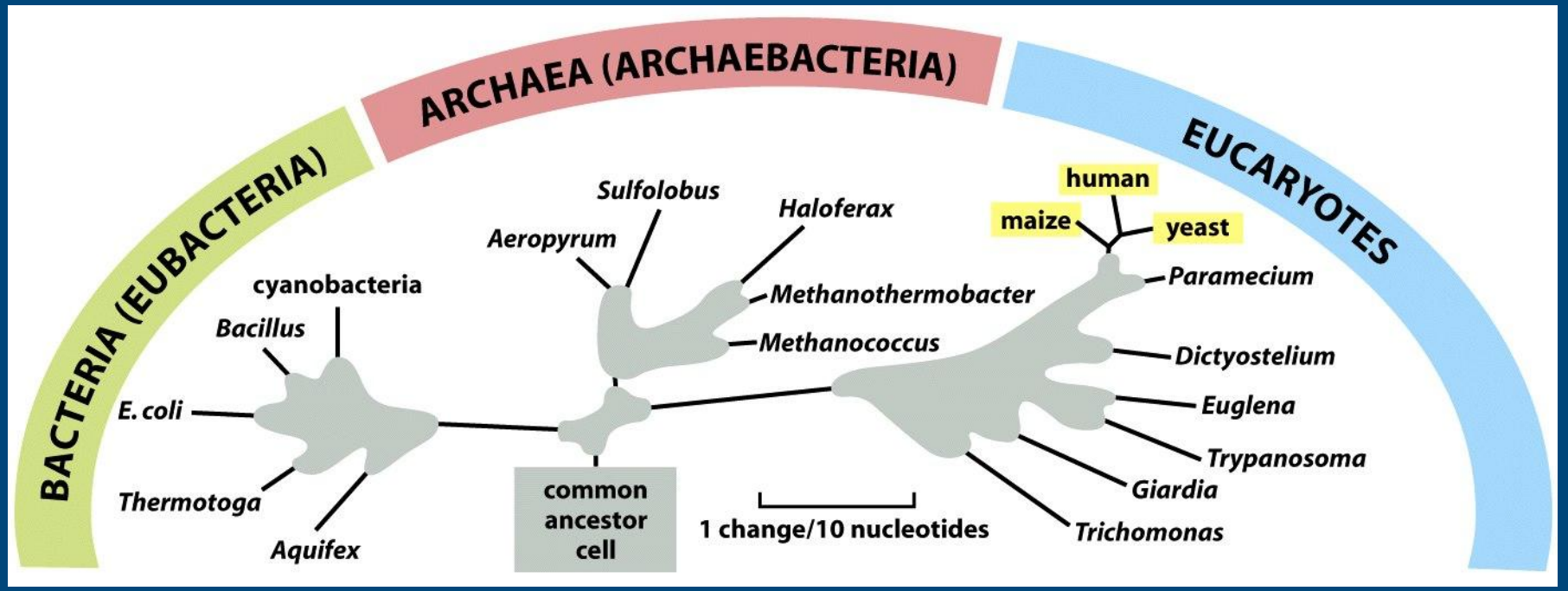
Excursie?

Life is older than most rocks

- https://youtu.be/-Gq-5qNekdo

- De schapen (en mijn dochter) zijn de echt oude voorwerpen!

Tree of life, is big



Reconstructie van de stamboom van het leven, op basis van genetische archeologie.

4000 miljoen jaar

Leven is oud (deep time) => is een bijzonder systeem.

Prebiotically plausible chemoselective pantetheine synthesis in water

- ***SCIENCE***
- 22 Feb 2024
- Pantetheine is an essential chemical moiety within enzymes and coenzyme A that serves as a handle for reactions involving thioesters, a key species in many biochemical transformations. Because it is strictly conserved and has such a central role in metabolism, pantetheine may have originated alongside other prebiotic components from simple organic and inorganic precursors. Fairchild *et al*. identified a set of reactions that selectively yield pantetheine in water under dilute conditions that may be reasonable for an early Earth setting. The route uses nitrile chemistry common to other prebiotic syntheses and thus fits into a broader picture for prebiotic cyanosulfidic reactions that are likely candidates for the chemistry that gave rise to life on early Earth
- https://www.science.org/doi/10.1126/science.adk4432

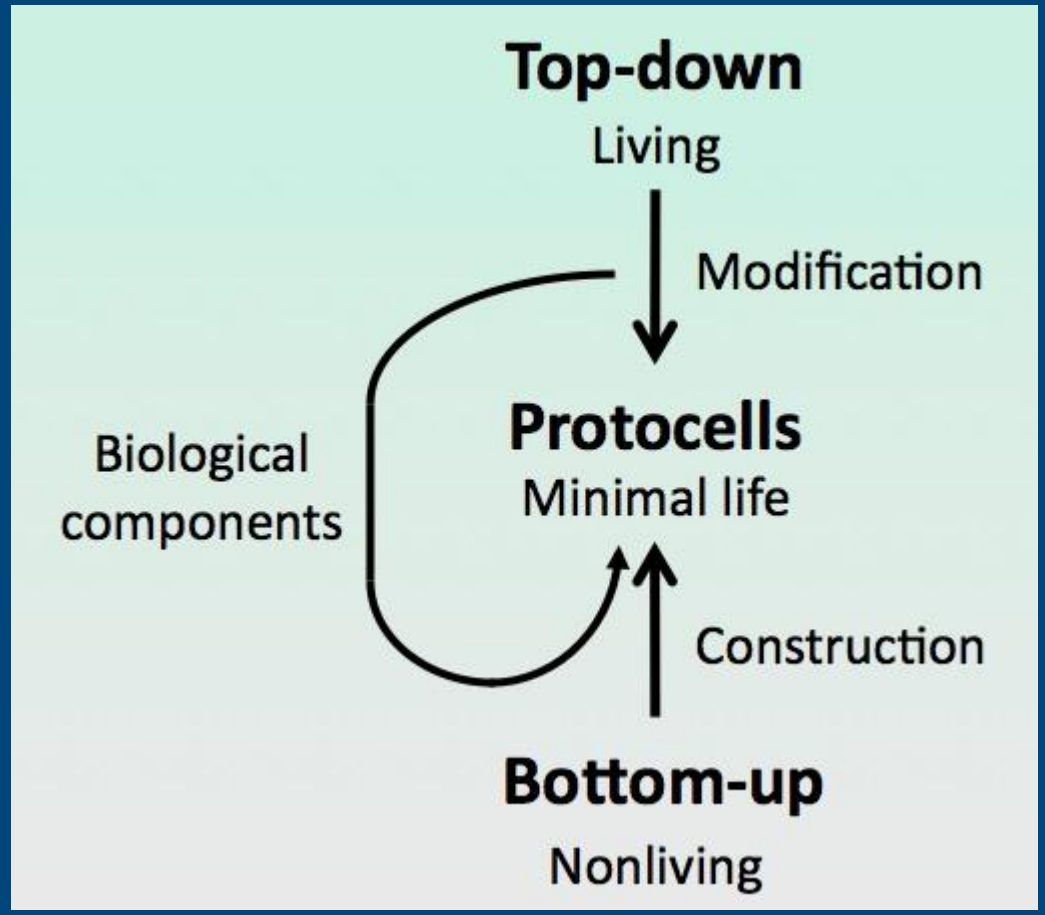
Synthetic biology
Minimal Life

What is life?

Take away genes until cells are no longer living

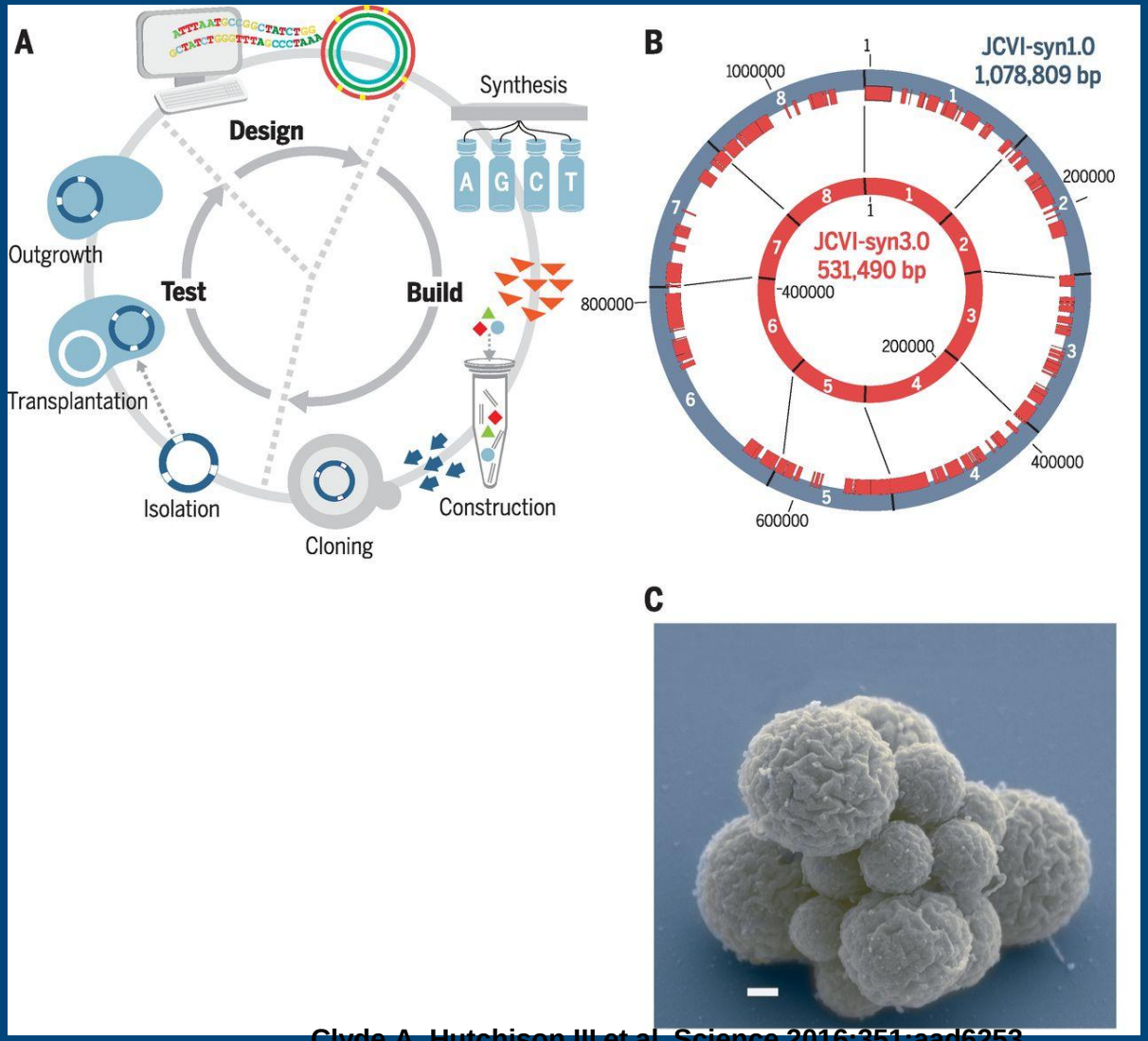
Or, plugging in various sets of genes until a cell is alive

Mycoplasma "laboratorium"



- http://flint.sdu.dk/index.php?page=overall-protocell-design
- http://www.synbioproject.org/topics/synbio101/definition/

Design and synthesis of a minimal bacterial genome => G. Venter



473 genes!

A conserved core of about 250 essential genes, +149 genes with unknown biological functions, suggesting the presence of undiscovered functions that are essential for life.

=> Not one pure essential gene

http://science.sciencemag.org/content/351/6280/aad6253

Clyde A. Hutchison III et al. Science 2016;351:aad6253

Published by AAAS

Science AAAS

A New Physics Theory of Life

- according to the physicist proposing the idea, the origin and subsequent evolution of life follow from the fundamental laws of nature and “should be as unsurprising as rocks rolling downhill.”

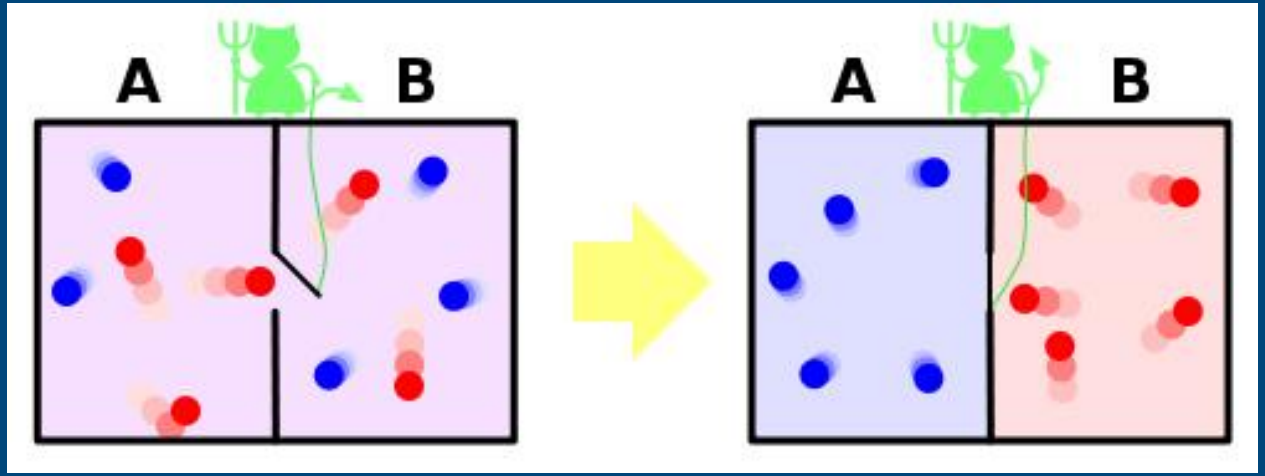
- From the standpoint of physics, there is one essential difference between living things and inanimate clumps of carbon atoms: The former tend to be much better at capturing energy from their environment and dissipating that energy as heat. Jeremy England, a 31-year-old assistant professor at the Massachusetts Institute of Technology, has derived a mathematical formula that he believes explains this capacity. The formula, based on established physics, indicates that when a group of atoms is driven by an external source of energy (like the sun or chemical fuel) and surrounded by a heat bath (like the ocean or atmosphere), it will often gradually restructure itself in order to dissipate increasingly more energy. This could mean that under certain conditions, matter inexorably acquires the key physical attribute associated with life.

=> entropy as the driving force

We do not fight entropy, we use entropy to exist

- https://youtu.be/tdv7r2JSokI

Ordening door informatie
Maxwells demon
https://nl.wikipedia.org/wiki/Maxwells_demon



Informatie en energie zijn gelinkt
En Informatie heeft een fysieke drager nodig

Verlinde,
Gravity as an emerging property of entropy

Unlike the traditional view of gravity as a fundamental force of nature, Verlinde sees it as an *emergent property* of space. Emergence is a process where nature builds something large using small, simple pieces such that the final creation exhibits properties that the smaller bits don't.
The sensation of temperature is an emergent phenomenon, arising from the motion of molecules and atoms.
So too with gravity, which according to Verlinde, emerges from entropy

https://youtu.be/ynRVnIh6wq4

http://www.quantumuniverse.nl/emergent-gravity-and-dark-universe

The multiverse

- Ons universum heeft heel strak bepaalde basiswaarden.
- Dat kan geen toeval zijn?
- Wel als er heel veel universa zijn..
- Quantummechanica ondersteund dit concept

- In Dublin in 1952, Erwin Schrödinger gave a lecture in which he jocularly warned his audience that what he was about to say might "seem lunatic". He said that when his equations seemed to describe several different histories, these were "not alternatives, but all really happen simultaneously".[3] This sort of duality is called "superposition".

Why is there something instead of nothing?

- Informatie is er altijd?

- Although Heidegger described this as the fundamental question of metaphysics, the answer is quite straightforward at its base, if we are strictly examining a comparison between something and nothing. There is something because there is literally no such thing as nothing (at all), and there possibly never was.

- Energy generation and conciousness
- https://youtu.be/vBiIDwBOqQA

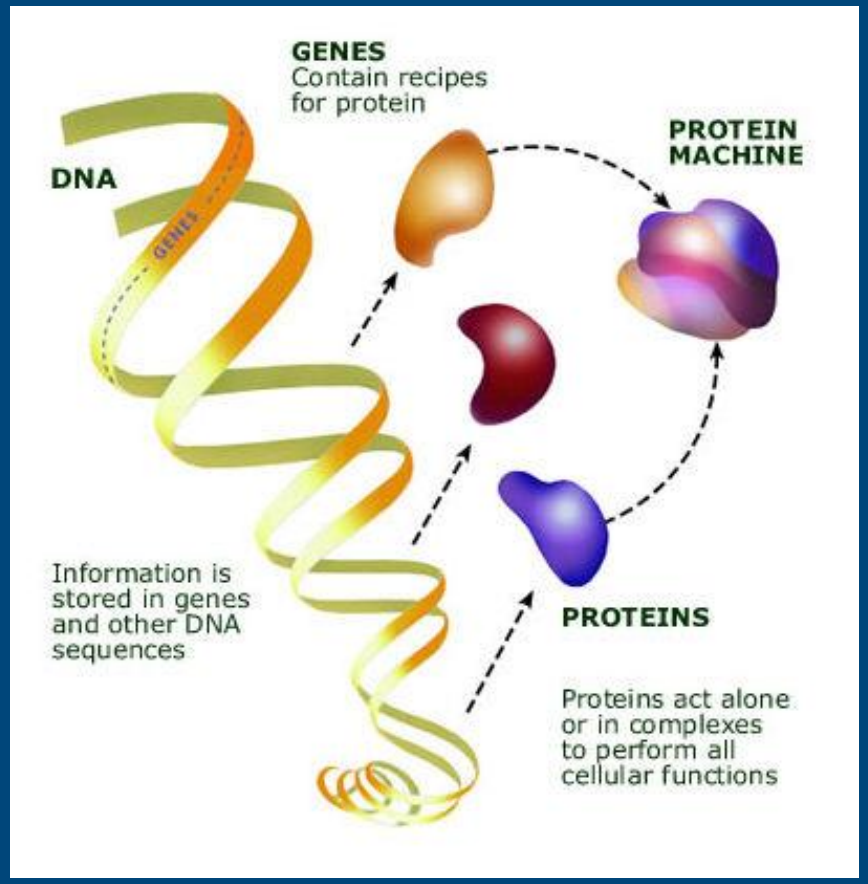
Rolls Takes Another Step Toward Complete Predictive Maintenance

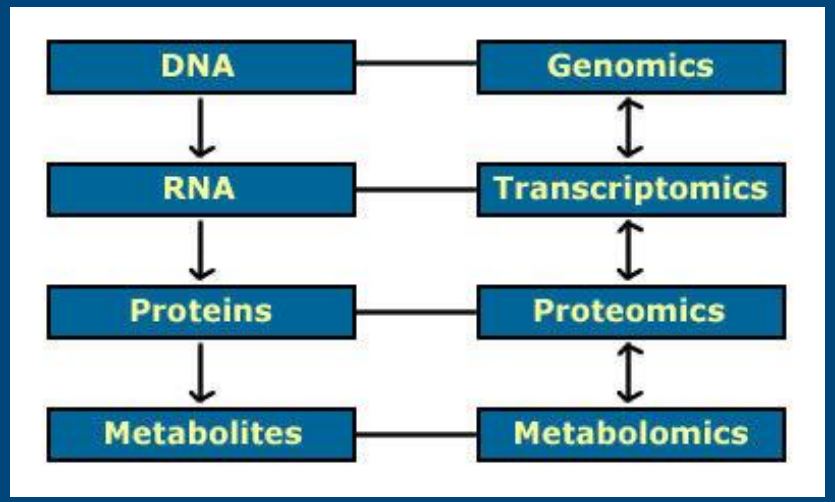
Continuous performance data and engineering data, including maintenance data.

=> In combinatie met kunstmatige intelligentie

Gen, eiwit
Genome, proteome => 'omics

Epigenomics





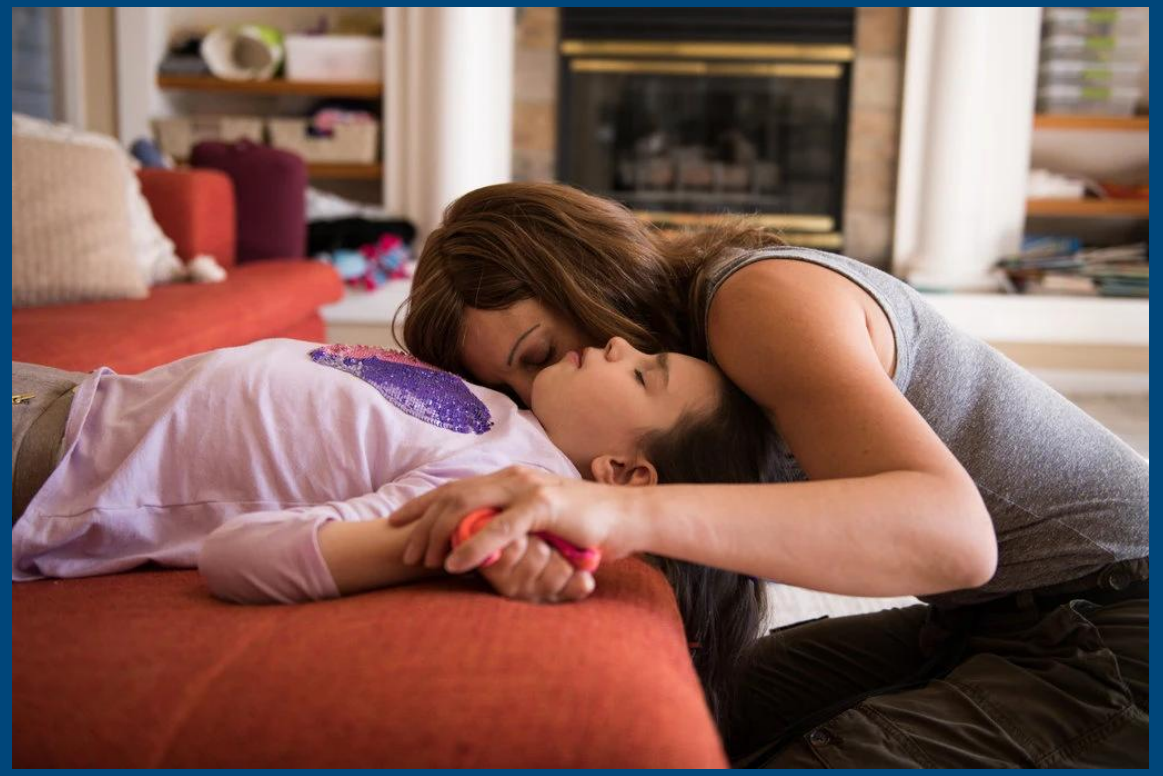
Microbiomics

=> personalized medicine

=> Betere therapie met minder bijwerkingen

Individuele Geneeskunde:
Milasen

Scientists Designed a Drug for Just One Patient.
Her Name Is Mila.
An achievement in ultra-personalized medicine also raises questions about fairness and regulation.



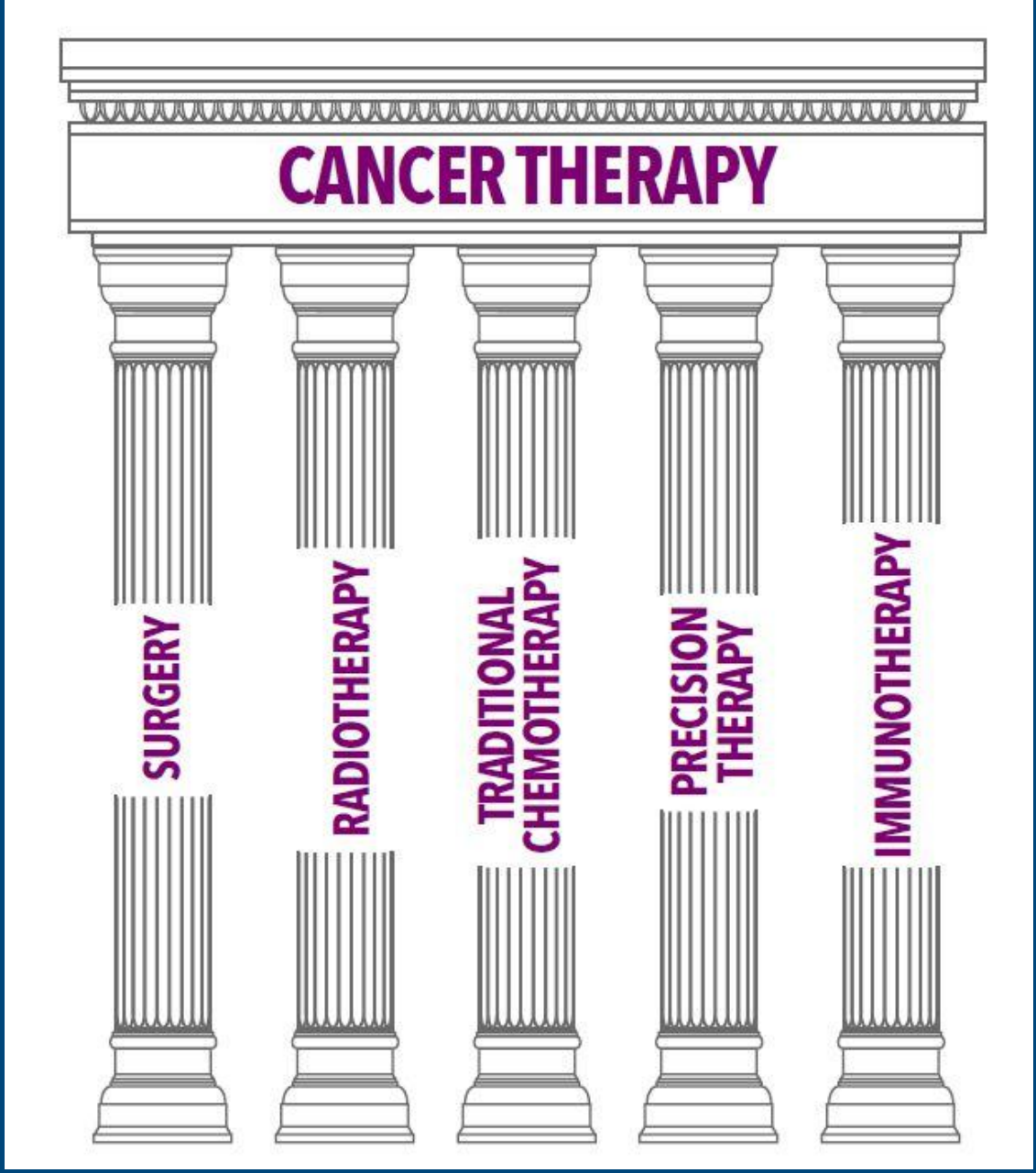
Julia Vitarello with her daughter, Mila, 8, who has a rare neurological disorder. Scientists were able to create a drug to treat only the form of the illness she has.

=> Personalized Medicine

Cycling training
=>personalised medicine

- https://youtu.be/wXBKjqVPJpY
- Data and more data

Immunotherapy: A New way of treating cancer



Surgery: wegsnijden

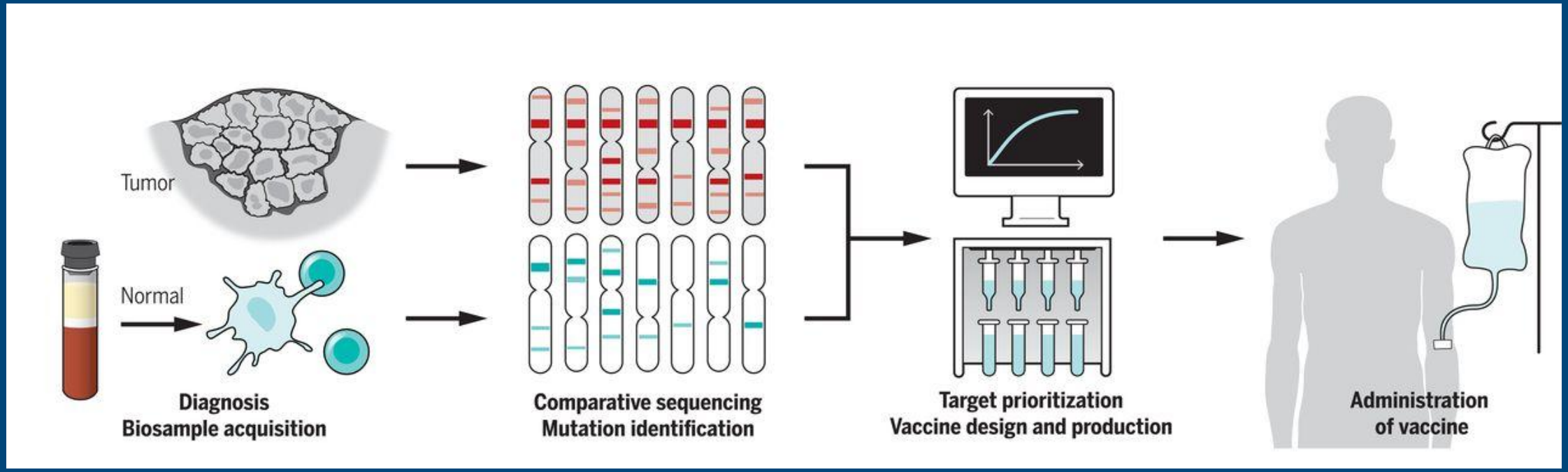
Radio: bestraling

Chemo: doden (alle) snel delende cellen

Precision: doden specifieke cellen (antilichamen)

Immuno: T/B en NK cellen opleiden/aanpassen tot tumor bestrijders of verminderen suppressie
=> Personalised medicine

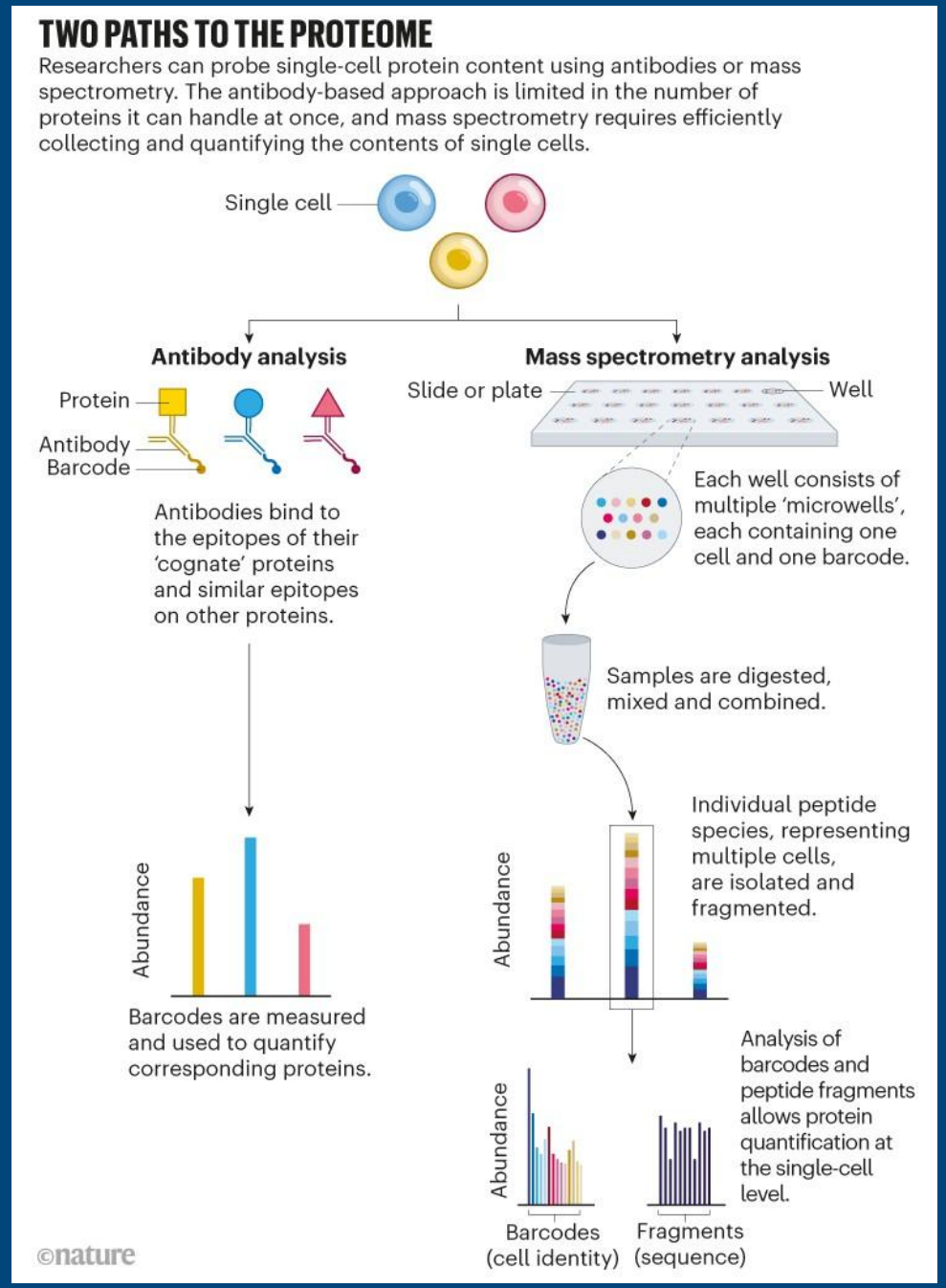
Immunotherapy: It's personal



- https://en.wikipedia.org/wiki/Cancer_immunotherapy
- https://science.sciencemag.org/content/359/6382/1355

Single-cell proteomics takes centre stage

- Deducing the full protein complement of individual cells has long played second fiddle to transcriptomics. That's about to change.
- According to one study[2], the median mammalian protein is present at 18,000 copies per cell.



https://www.nature.com/articles/d41586-021-02530-6

technologies to watch in 2025

- Self-driving laboratories, advanced immunotherapies and five more
- Sustainability and artificial intelligence dominate our seventh annual round-up of exciting innovations.
- https://www.nature.com/articles/d41586-025-00075-6

Big data

https://www.ted.com/talks/kenneth_cukier_big_data_is_better_data?language=nl

- Wetenschap ('omics)
- Gezondheidszorg
- Health (sport)
- Internet / apps
- Zelfrijdende auto

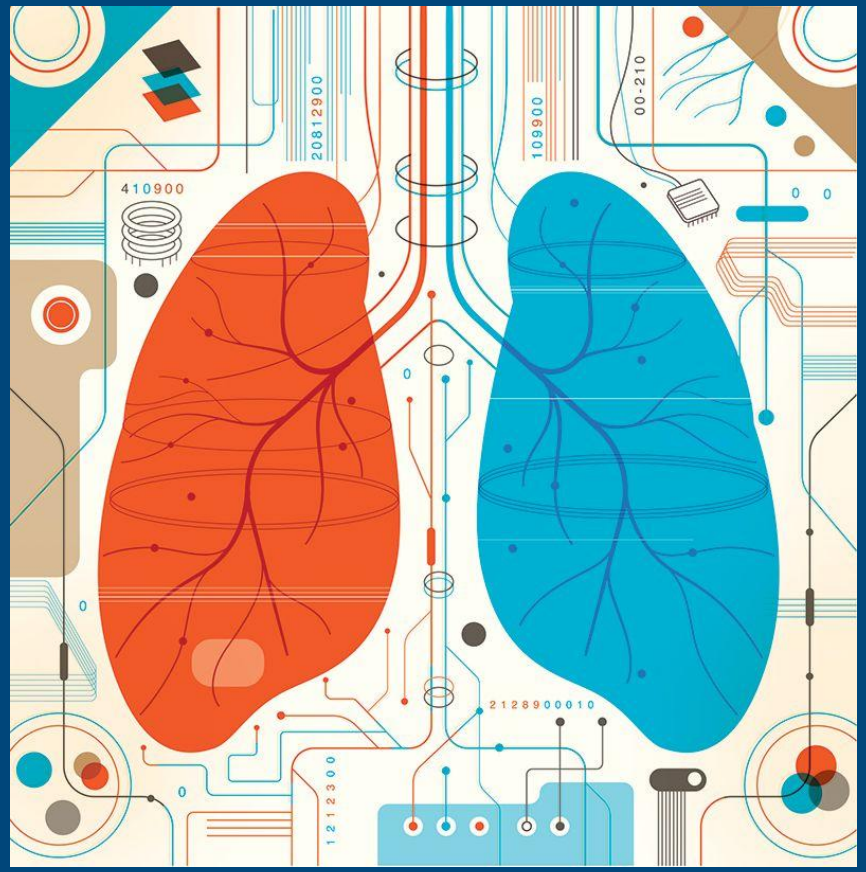
- Internet of things

- Facebook
- Google

=> Kunstmatige intelligentie (Artificial Intelligence)

How Artificial Intelligence Will Change Medicine

The biomedical world is awash in data. We have terabytes of genomic information from mouse to human, troves of health metrics from clinical trials, and reams of so-called real-world data from insurance companies and pharmacies. Using powerful computers, scientists have scrutinized this bounty with some fine results, but it has become clear that we can learn much more with an assist from artificial intelligence. Over the next decade deep-learning neural networks will likely transform how we look for patterns in data and how research is conducted and applied to human health.



https://www.nature.com/articles/d41586-019-03845-1

Gratis grootschalig onderzoek

- Covid
- Ozempic

=> En geen ethische bezwaren

NatSci

Onderzoek en uitgeverij

Publicatie is voor onderzoek essentieel, anders geen verspreiding van feiten/ideeen. En geen geld (funding)

Betalen voor onderzoek
Betalen voor publicatie
Betalen om het te lezen

Maatschappij betaald 3x
Burger kan niet zomaar overal bij

⇒ Open source
⇒ PLOS http://www.plosone.org/#news
⇒ http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1002300

Nature (van Elsevier) => ook gewoon geld verdienen

Wetenschappelijke informatie: Betrouwbaarheid

Paper (Article):	”Peer review”
Summary	door auteurs
Review	door andere wetenschapper
Opinion editorial (Op-ed)	door blad (journal)
Nieuws (krant)	door redacteur
Pop.wet. Bladen	redactie
Wikipedia	crowd (selectie)
Ziekenhuis	redactie
Bioplek	docenten
Facebook	elke halve zool

Betrouwbaarheid
(en moeilijkheidsgraad)

Wetenschap is de meest betrouwbare bron van informatie.
Maar, er moet wel vertrouwen zijn in het systeem.
=> integriteit

NB Wetenschappers maken ook fouten, en sommige facebook content is OK
Wat waar(devol) is, is subjectief

Wetenschappelijke literatuur

- Pubmed

https://www.ncbi.nlm.nih.gov/pubmed

- Google scholar

https://scholar.google.nl/

- Wetenschappelijk woordenboek

https://en.oxforddictionaries.com/

- Science

http://science.sciencemag.org/

- Nature

http://www.nature.com/nature/index.html

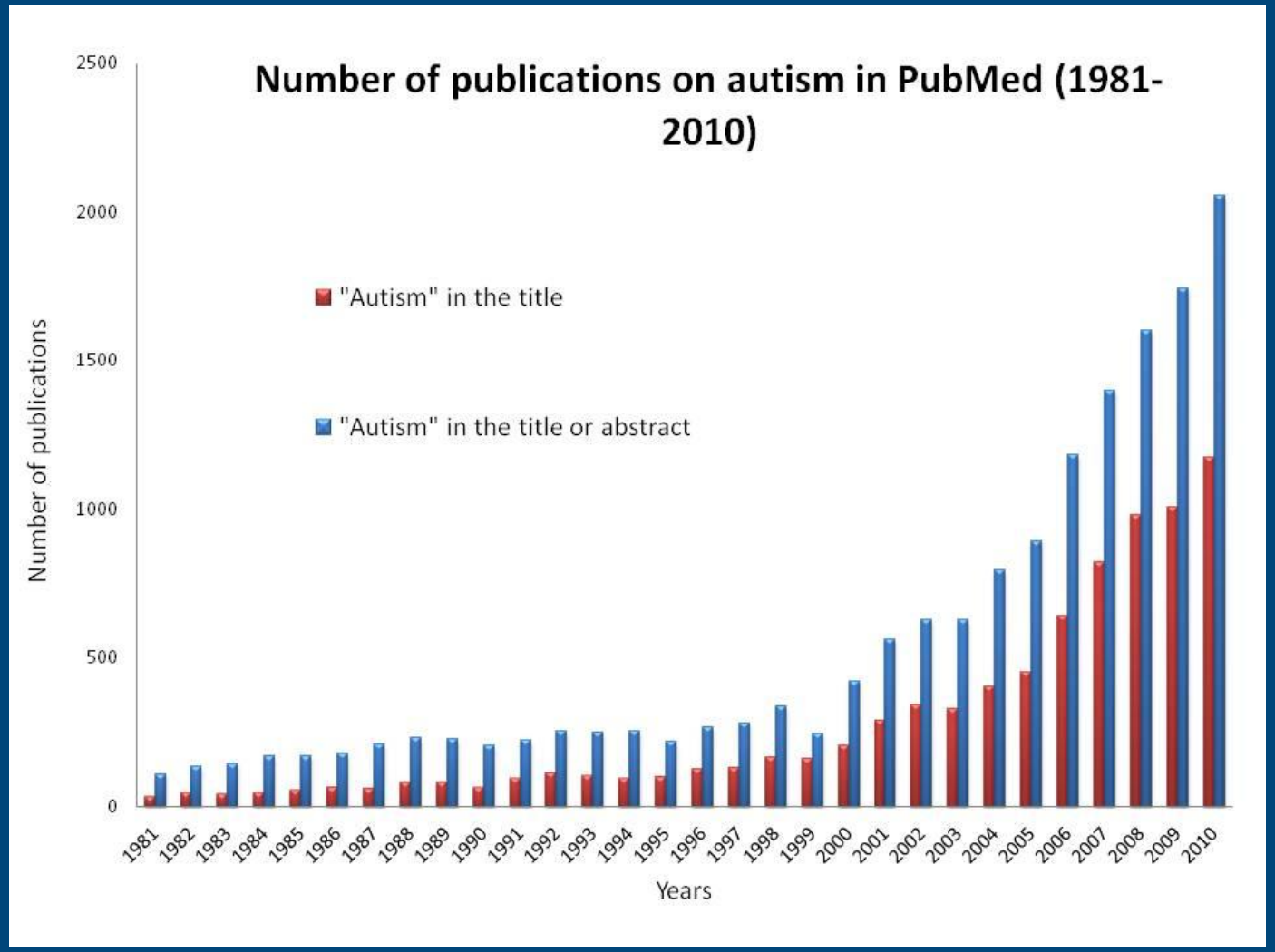
- Cell

http://www.cell.com/cell/current

Open access:

http://www.openaccessweek.org/profiles/blogs/the-top-20-countries-for-scientific-output

Literatuur
Inflatie



Geld voor vrijwel alle onderwerpen

wetenschappelijke literatuur

- **TITEL**
- **ABSTRACT / SUMMARY**
- **INTRODUCTION**
- **RESULTS / METHODS**
- **DISCUSSION**
- **REFERENCES**

Ontwikkelingen

Celbiologie (introductiecursus, najaar 2023)
=> Hoe werkt leven?

Biotechnologie (voorjaar 2024)
=> Het manipuleren van leven

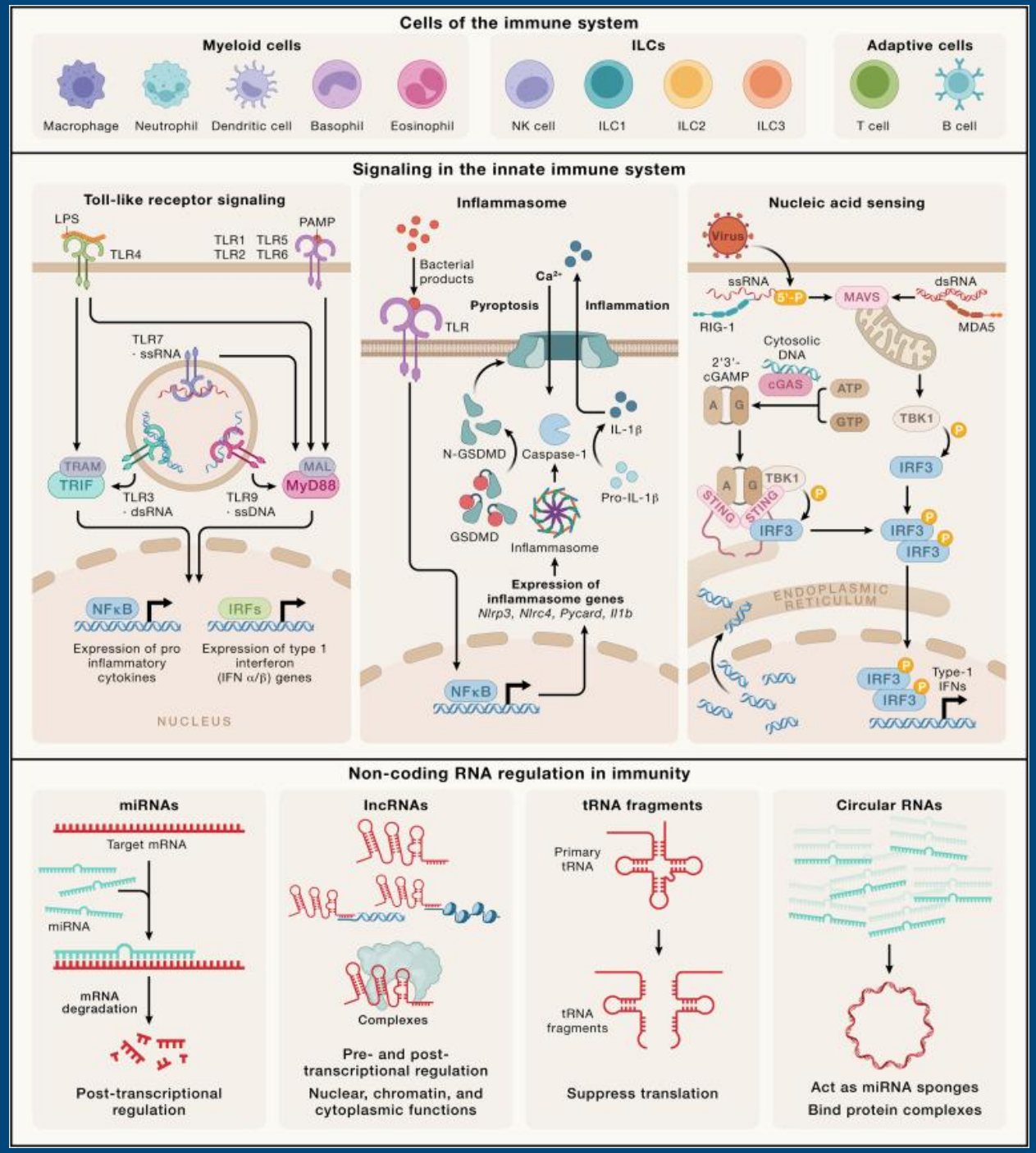
Afweer (najaar 2024)
=> hoe blijven we in leven

Ontwikkelingen in de levenswetenschappen (voorjaar 2025)
=> elke 2 jaar?

=> Wat is leven?

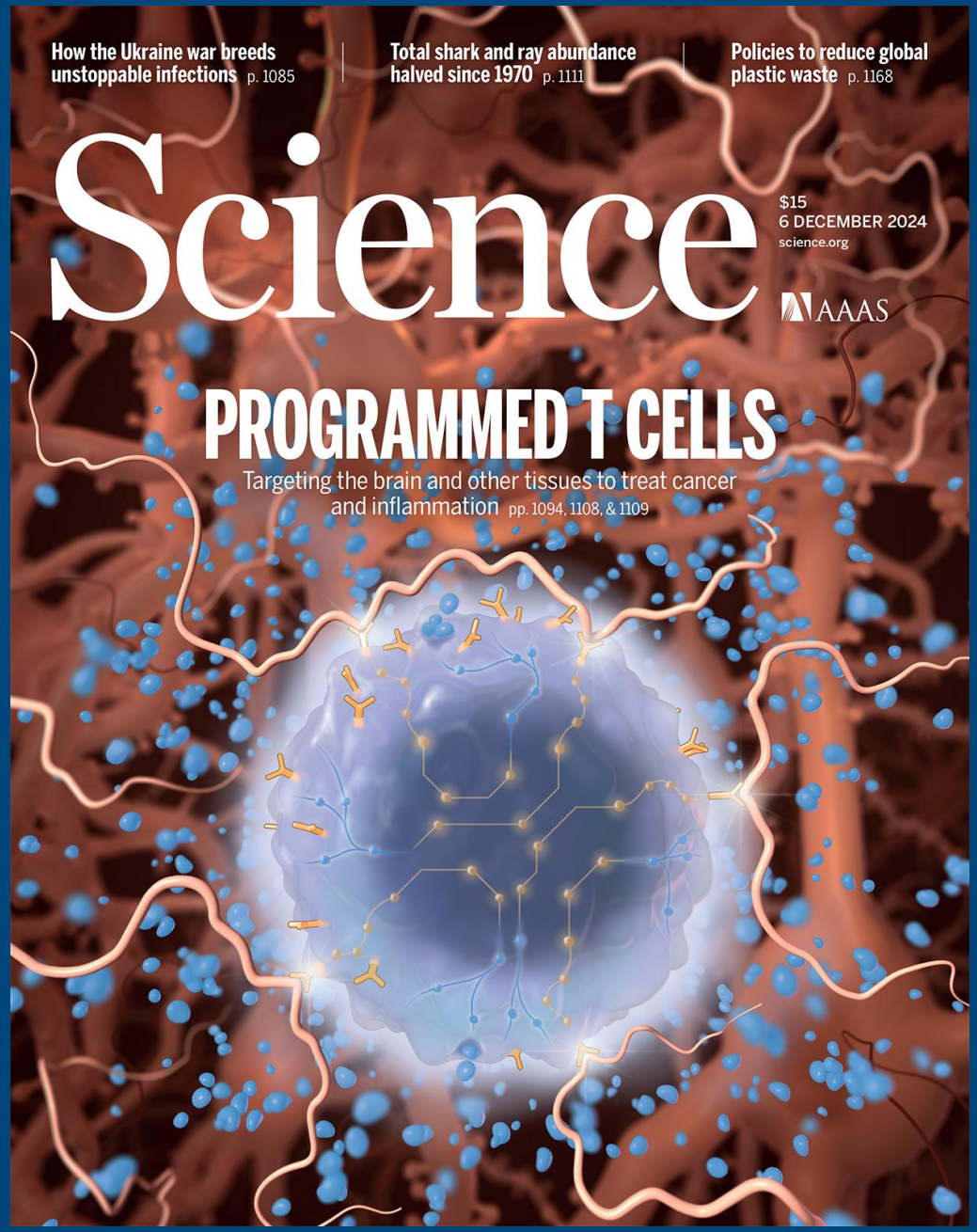
From periphery to center stage: 50 years of advancements in innate immunity

- https://www.cell.com/cell/fulltext/S0092-8674(24)00352-0



Ontwikkelingen:

- Immunotherapie 2.0
- An engineered T cell (center) is designed to deliver therapies to the brain. This T cell displays orange synthetic receptors on its surface, which recognize components of extracellular matrix fibers that are only found in the brain. Within the cell, downstream signaling pathways are programmed to initiate transcription and release a therapeutic payload—shown as light blue protein secretions
- https://www.science.org/toc/science/current
- https://www.science.org/doi/10.1126/science.adl4237



New antiviral

Small-molecule inhibition of SARS-CoV-2 NSP14 RNA cap methyltransferase

Nature **volume 637**, pages1178–1185 (2025)Cite this article

Abstract

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[1]. The rapid development of highly effective vaccines[2,3] against SARS-CoV-2 has altered the trajectory of the pandemic, and antiviral therapeutics[4] have further reduced the number of COVID-19 hospitalizations and deaths. Coronaviruses are enveloped, positive-sense, single-stranded RNA viruses that encode various structural and non-structural proteins, including those critical for viral RNA replication and evasion from innate immunity[5]. Here we report the discovery and development of a first-in-class non-covalent small-molecule inhibitor of the viral guanine-N7 methyltransferase (MTase) NSP14. High-throughput screening identified RU-0415529, which inhibited SARS-CoV-2 NSP14 by forming a unique ternary *S*-adenosylhomocysteine (SAH)-bound complex. Hit-to-lead optimization of RU-0415529 resulted in TDI-015051 with a dissociation constant (K_d) of 61 pM and a half-maximal effective concentration (EC_{50}) of 11 nM, inhibiting virus infection in a cell-based system. TDI-015051 also inhibited viral replication in primary small airway epithelial cells and in a transgenic mouse model of SARS CoV-2 infection with an efficacy comparable with the FDA-approved reversible covalent protease inhibitor nirmatrelvir[6]. **The inhibition of viral cap methylases as an antiviral strategy is also adaptable to other pandemic viruses**

A gut fungus protects mice against parasitic worms but increases allergies

- It has been hard to find fungi that normally reside in the mouse gut. The identification of one such fungus deepens our understanding of how resident fungi drive immune responses in their natural hosts.

Ontwikkelingen

- **Skin has its own immune system**

- The skin seems to be able to produce its own antibodies to keep microbes in check. “When the immune system sees a friendly bacterium, you would think that it would just give a friendly wave and walk in the other direction, but that’s not at all what happens,” says microbiologist and study co-author Michael Fischbach. In mice colonized by *Staphylococcus epidermidis*, a common and harmless bacterium found on human skin, the skin was able to generate antibodies even when other parts of the immune system were disabled. And this surprise power might be harnessed to fight pathogens: when researchers modified *S. epidermidis* to display part of the tetanus toxin, the skin response protected mice from a lethal dose.

Ontwikkelingen

- **This doctor raised the alarm about a deadly mpox outbreak that went global**
- **Placide Mbala is part of *Nature*'s 10, a list of people who shaped science in 2024.**
- **https://www.nature.com/articles/d41586-024-03900-6**
- He has been sounding the alarm about deadly mpox outbreaks. But when will the world truly listen?

Disease diagnostics using machine learning of B cell and T cell receptor sequences

Ontwikkelingen

Celbiologie (introductiecursus, najaar 2023)
=> Hoe werkt leven?

Biotechnologie (voorjaar 2024)
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=> hoe blijven we in leven

Ontwikkelingen in de levenswetenschappen (voorjaar 2025)
=> elke 2 jaar?

=> Wat is leven?

Catching carbon fixation without fixing

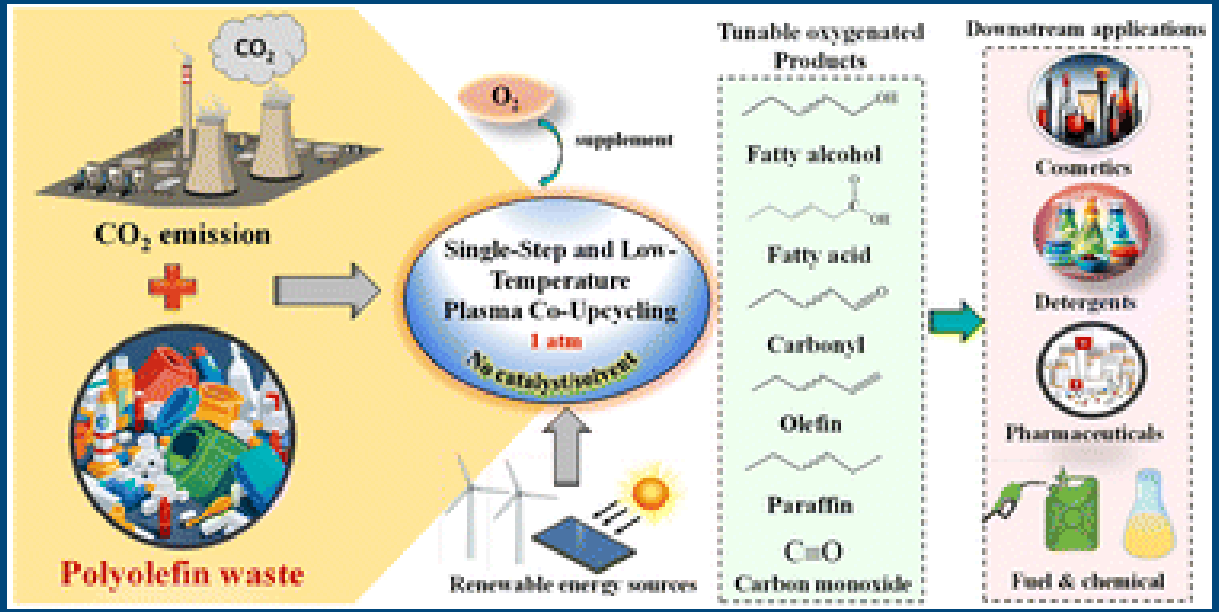
- Structural snapshots of an enzyme complex reveal missing pieces of a biological process
- Biological carbon fixation is a process in which living organisms convert atmospheric carbon dioxide (CO_2) into metabolically usable organic compounds, such as sugars or acetate. This not only forms the foundation of the food chain but is also vital for regulating the global carbon cycle. The fixation of CO_2 involves many enzymes and cofactors. Although important features of the six known biological carbon fixation pathways have been established (*1*, *2*), the sizes and transient natures of protein complexes have complicated the capture of intermediate states using structural methods such as x-ray crystallography and nuclear magnetic resonance spectroscopy. On page 498 of this issue, Yin *et al.* (*3*) report high-resolution snapshots of the Wood-Ljungdahl pathway (WLP), which is one of the most efficient carbon fixation mechanisms, using cryo–electron microscopy (cryo-EM). The results reveal the dynamics of key enzymes and could contribute to designing such pathways for carbon capture and biofuel production

Seaweed farms dish up climate benefits

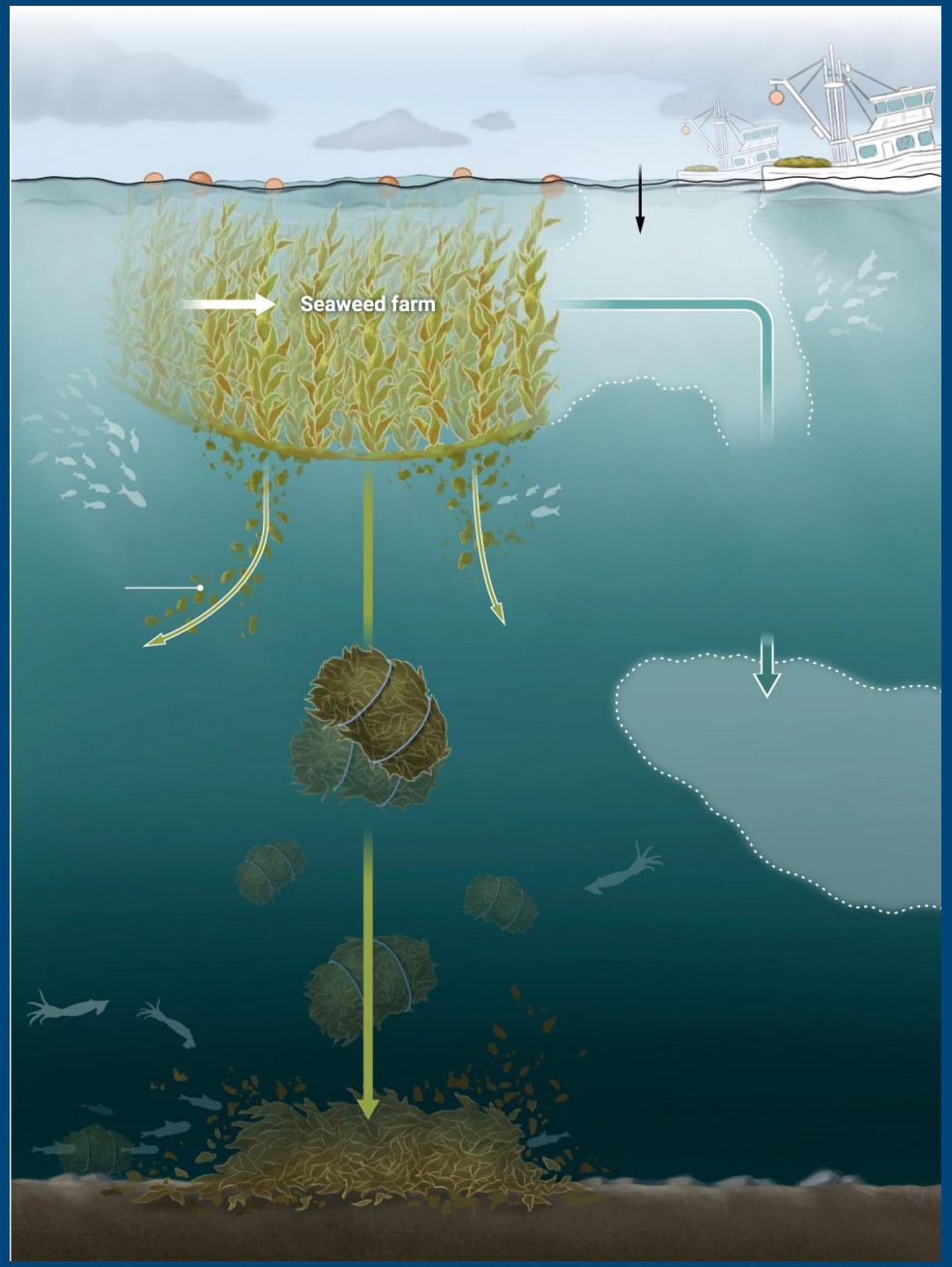
- First estimate of its type shows that cultivated seaweed beds can accumulate as much carbon as some natural ecosystems.

Using CO_2 to break down polyolefins

- Polyolefins are the most abundant plastics and, unfortunately, they are also among the hardest to break down in postconsumer waste. Radhakrishnan *et al.* report that treatment with CO_2 plasma can convert these plastics into mixtures of hydrocarbons, and the introduction of oxygen into the plasma can shift the product distribution toward more valuable long-chain alcohols. The reaction proceeds at atmospheric pressure without a catalyst and also makes productive use of the CO_2 that would otherwise contribute to the waste stream in its own right.
- *GreenChem.* (2024) 10.1039/d4gc02340d



- https://www.science.org/content/article/can-dumping-seaweed-sea-floor-cool-planet-some-scientists-are-skeptical



- [Climate Capitalism: Winning the Race to Zero Emissions and Solving the Crisis of Our Age]

A FUTURE TO LOOK FORWARD TO

Meaningful climate solutions can be achieved within existing market structures, argues journalist Akshat Rathi.

PODCAST

Climate Capitalism: Winning the Race to Zero Emissions and Solving the Crisis of Our Age

Akshat Rathi

Greystone Books, 2024. 272 pp.

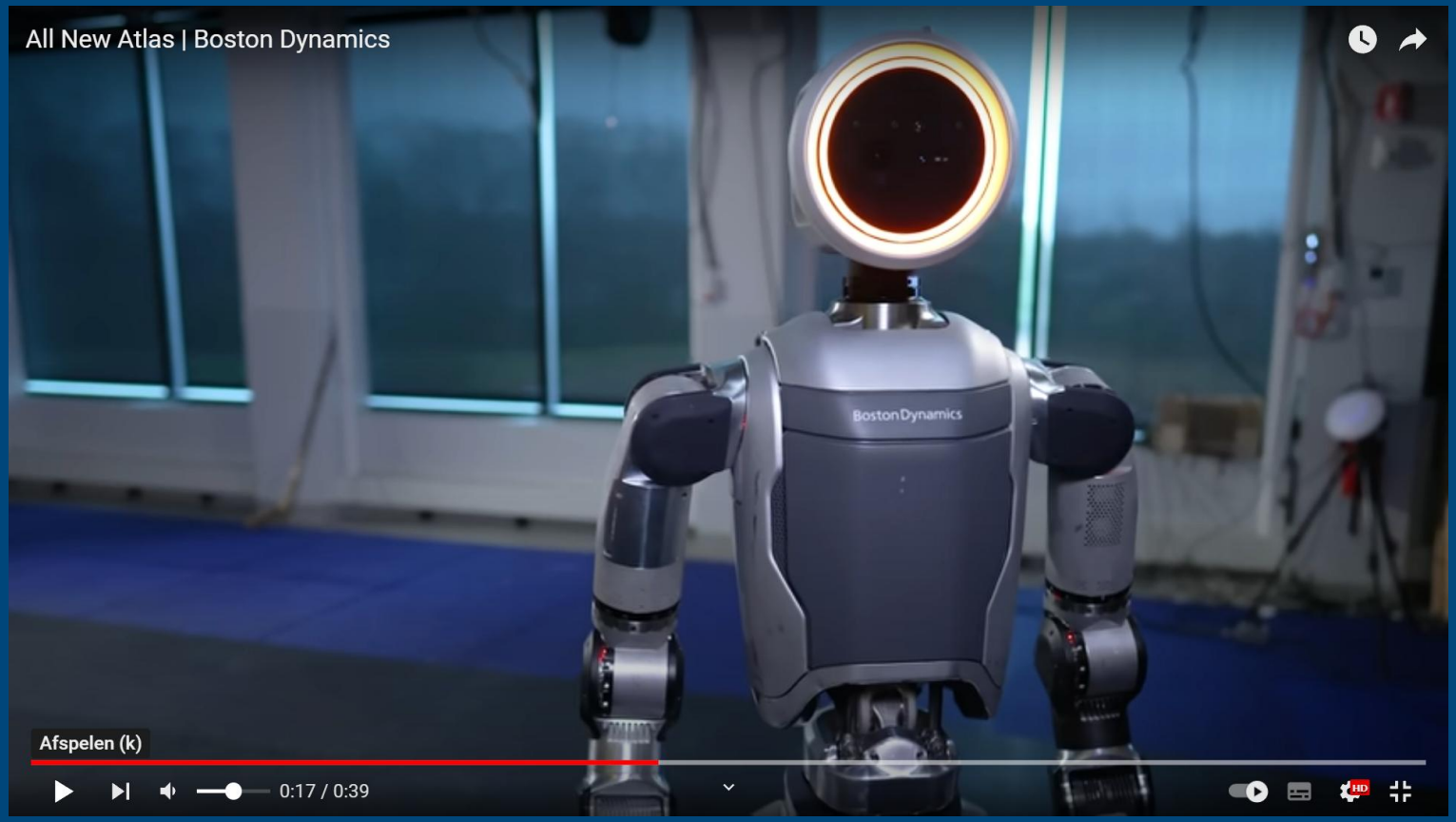
"It's now cheaper to save the world than destroy it," writes journalist Akshat Rathi in the opening pages of *Climate Capitalism*, which explores market-based solutions to climate threats. This week on the *Science* podcast, Rathi explores how governments, entrepreneurs, and philanthropists are converging on potentially profitable strategies for moving toward a clean-energy future. https://bit.ly/3WjwuYk

10.1126/science.adr9659

PHOTO: DOE PHOTO/ALAMY STOCK PHOTO

Boston dynamics 001

- https://youtu.be/29ECwExc-_M
- https://youtu.be/8kolJoTf-Ew



How influencers and algorithms mobilize propaganda — and distort reality

- **The engagement-fuelled logic of social media has bequeathed us a world in which what's trending is a yardstick for what's true.**

- **Invisible Rulers: The People Who Turn Lies into Reality** *Renée DiResta* Public Affairs (2024)
- Scientific institutions, public-health authorities and academics routinely face criticism and angry denouncements from ideologically motivated detractors who wish to bury inconvenient scientific evidence. With the rise of the Internet and social media, misinformation researchers, especially, have become targets for online partisan attacks (see *Nature* **630**, 548–550; 2024). And academics routinely have to ward off political interference in many countries[1].

Life is older than most rocks

- https://youtu.be/-Gq-5qNekdo

- De schapen (en mijn dochter) zijn de echt oude voorwerpen!

Evaluating animal consciousness

- An emerging field shows how animal feelings can be studied scientifically
- https://www.science.org/doi/10.1126/science.adp4990

Australie als oplossing:

Genoeg oppervlak (solar influx)

Veel woestijn (70%)

Goede instituten

"Venture capital”

Beplanting woestijn:

=> Extra voedsel voor miljarden

=> CO2 opname vgl met jaarlijkse uitstoot van de wereld

Sequestratie (via koeien)

⇒ Vlees eten wordt goed voor milieu

⇒ Vet opslaan ook

Genoeg water (oceaan)

Hydrolyse => waterstof => lokale waterproductie in de woestijn (mijnbouw), en verkopen van de rest.

Vooral een poging om noodzakelijke verandering een positieve draai te geven. Het verhaal is nu vooral negatief.

“Advocating less does not sell well”

Voedselproductie Australie kan flink omhoog => nieuwe inkomsten

En met 10% van Australie vol met zonnepanelen kan je meer waterstof maken dan de wereld nodig heeft => nieuwe sjeiks

Water Plant

Elke plant heeft een watercyclus, maar heeft nog netto extra water nodig.

Dit komt uit de omgeving.

Water Plant haalt waterstof uit de bodem, en zuurstof uit de lucht (of bodem).

Waterstof zit niet in de lucht (behalve in vervuilde lucht !)

Wel in de bodem, als onderdeel van stikstofverbindingen (zoals NH3)

Plant die groeit op basis van deze beperkte bron is automatisch gelimiteerd

⇒ Conditional safety

Als waterstof uitgeput is, is bemesting een optie (kunstmest bestaat oa uit NH3).

Maar bij voldoende groei op basis van waterstof uit de bodem ontstaat er een watercyclus: plant verdampt water, die weer valt als regen.

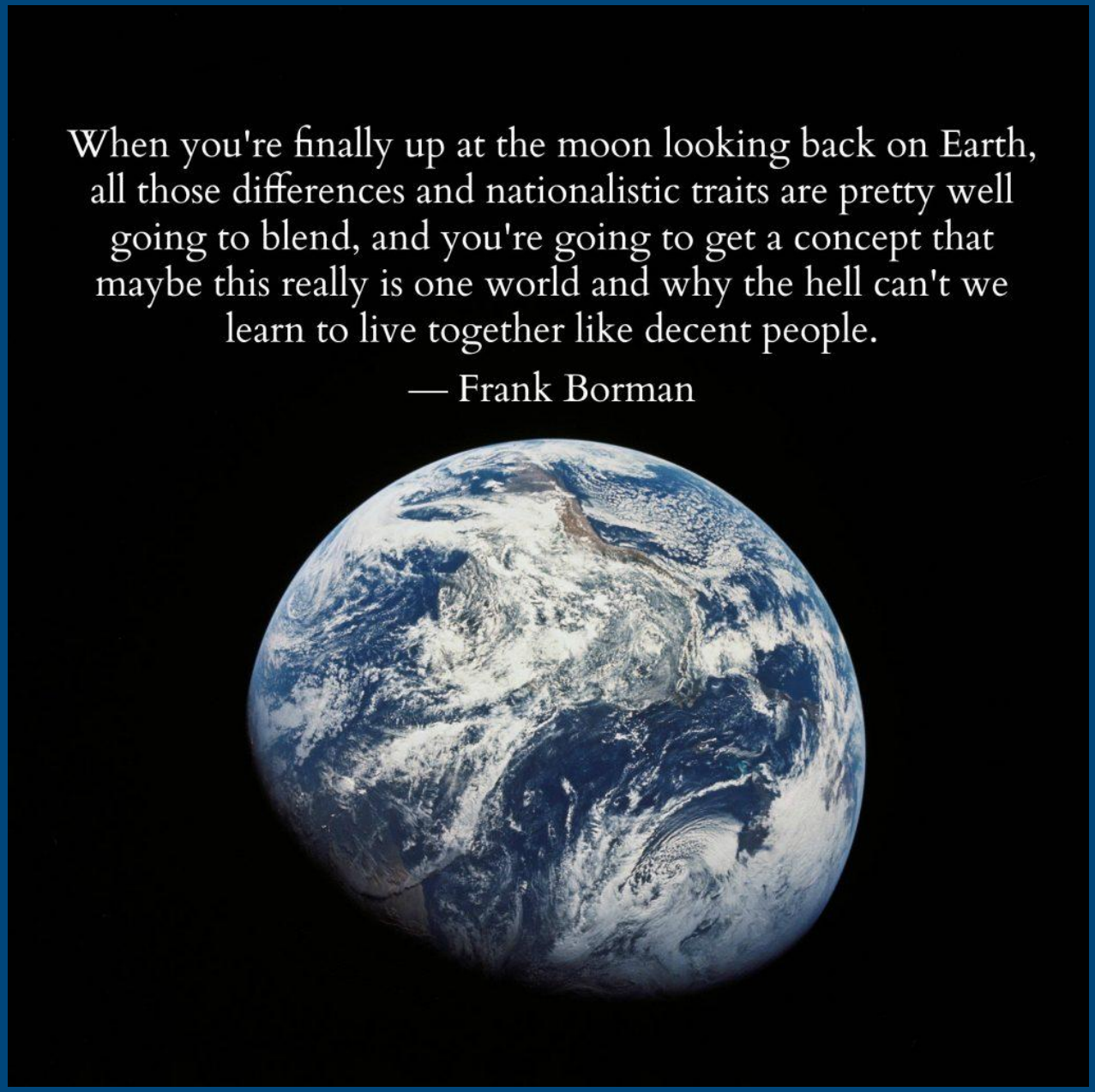
NB Bewolking en plantengroei houdt meeste verlies van water via niet nuttige verdamping tegen.

Ondanks een nog onvolledig begrip van leven begrijpen we onderdelen wel.
En daar kunnen we al veel mee doen!

De aarde verlaten
De aarde redden

The overview effect

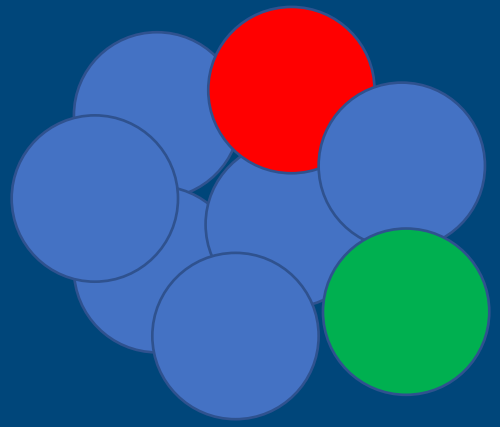
Na een blik op aarde vanuit de ruimte is iedereen pacifist

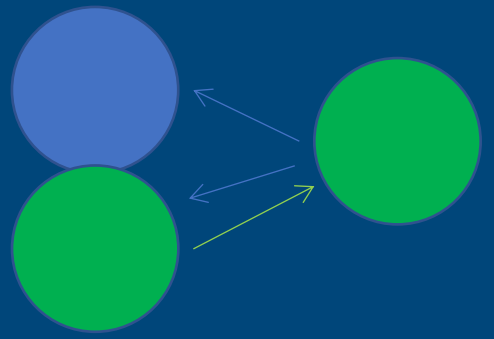


https://www.weareoverview.com/

Introducing meat–rice: grain with added muscles beefs up protein
The laboratory-grown food uses rice as a scaffold for cultured meat.

Leven is een fluide verzameling
Atomen / Cellen / Organismen





Dode cel
stamcel

Elke cel wordt op termijn vervangen.
En uit een stamcel die deelt ontstaan 2 nieuwe cellen (1 wordt de nieuwe stamcel)

Wat is licht?

- https://youtu.be/QqY8fY0TqaQ

- NB Licht is Duits voor open plek in het bos