

DUTCH SCIENCE

Powered by NWO



Teenage brain
sensitive to stress



How footballer
Arjen Robben could still
play in the World Cup

A 1/2 pound of cheese and
a cardiogram, please



Glimpse into
cosmic nursery

Syllables easier
than stress marks



NWO

Netherlands Organisation for Scientific Research

Quest
brainainment

About NWO

Each year the Netherlands Organisation for Scientific Research (NWO) invests in new research at universities and national research institutes. More than 5000 talented scientists can carry out their work thanks to this funding for top research, top researchers and innovative equipment.

NWO uses independent experts to select the best researchers and the best research in the Netherlands. With project funding these researchers can carry out their work at universities and institutes in the Netherlands and abroad.

NWO selects and funds projects in collaboration with almost 100 partners – from the government, industry, public sector bodies and civil society organisations. Research funded by NWO results in about 10,000 scientific articles, 500 professional publications and several dozen patents each year. Dutch science enjoys a considerable international reputation and ranks among the best in the world in both qualitative and quantitative terms.

NWO also actively encourages the dissemination of research results for use by industry and society. Each year NWO publishes a book that highlights some of the completed research projects. This booklet contains a selection of these.

Published by
Netherlands Organisation
for Scientific Research (NWO)

PO Box 93138
2509 AC The Hague
The Netherlands
Telephone + 31 70 344 0640
nwo@nwo.nl
www.nwo.nl/research

September 2011

Images:
p. 2 Vincenzo Rigogliuso/Gran
Angular/Hollandse Hoogte, p. 3-5,
7-10, 12, 18-20 Shutterstock,
p. 6, 11 several researchers, p. 14
Lonely Planet, p. 16 Karel van Hees,
p. 21 National Picture Library/
HollandseHoogte



Netherlands Organisation for Scientific Research

Content

Adolescent stress	2
Stress and addiction	
Successful sleep programme for adolescents	
Everything is chemistry	4
Carbon dioxide trap found	
Medical technology	5
A 1/2 pound of cheese and a cardiogram, please	
The Roman Empire	6
The Dutch Batavians were quite Roman	
Modern energy	7
Enjoying the sun	
Fighting for survival	8
Chemical warfare	
Sustainably accessible	9
A different design keeps warm cities bearable	
Fancy pay-as-you-drive	
Limited animal testing	11
Mathematics replaces laboratory animals	
Nano	12
Harry Potter magic thanks to nanotechnology?	
Children's language	14
Thrice fluent	
Universe	16
Born and raised in space	
Our bodies	18
Arjen Robben: a medical mystery explained	
Food shortage	19
Fooling plants	
Alternative poop-mobile to save us from phosphate crisis	
Development or land grabbing?	

Stress and addiction

A stressed person sometimes turns to drink or drugs to subdue restless, anxious or depressive feelings. However, the reverse situation also appears to happen, especially in adolescents. Adolescents with under arousal of the HPA

axis tend to use substances at earlier age and more frequently. People whose HPA axis is naturally less active might be extra sensitive to the arousal effects of drugs. Professor of developmental psychology and pedagogics Anja Huizink discovered

that young people who produce little of the HPA-activated stress hormone cortisol when under real stress, have used cannabis relatively often before the age of 13. They would appear to actively seek extra stimuli. ■





Successful sleep programme for adolescents

Therapy for insomnia helps adolescents.

The University of Amsterdam is experimenting with a programme to tackle youth sleep problems. The therapy can be done in groups in Amsterdam or online. For example, the youngsters learn not to let doomsday scenarios keep them from sleeping. Do not think: if I don't fall asleep now, I won't be able to play football well tomorrow and my club will lose. But be re-

alistic: sometimes I still play football well, even though I didn't sleep well. Something worrying you? Then give it some serious thought before going to bed. Then you're 'done' with it and you don't have to keep worrying.

This kind of cognitive behavioural therapy helps fight insomnia in adults. But its efficacy for teenagers is not obvious. Their brains work

differently. They plan less well, for example, and have less control over their thoughts. Nonetheless, the initial results are promising. After six weeks of therapy, the adolescents fall asleep in an average of one half hour where, before the therapy, they were still awake for an average of an hour. Group therapy and online therapy seem to work equally well. ■

Throughout the world, scientists have been searching for ways to combat climate change, and thus the melting of the polar caps. Elisabeth Bouwman accidentally found a way to convert harmful carbon dioxide into useful oxalate. Time will tell whether large-scale application of this is feasible and useful.



Carbon dioxide trap found

Searching for a new catalyst to make hydrogen and finding a carbon dioxide trap by accident. That is what happened to Elisabeth Bouwman during her research into the role of nickel in enzymes. Bouwman studied a molecule with nickel in it. For comparison, she made the same molecule, but with copper. The yellow copper compound turned out to re-

act spontaneously with the carbon dioxide in the air. It formed oxalate, a raw material for making antifreeze, for example. By adding lithium ions, the oxalate, containing the CO_2 , precipitates as a salt in crystalline form. These crystals can be easily removed; only the copper compound then remains, without the harmful CO_2 . The copper is recycled for capturing car-

bon dioxide by giving it a jolt of electricity. Then you can start again. So this newly discovered molecule acts as a catalyst for converting carbon dioxide into the useful raw material oxalate. That makes this an exciting new opportunity for combating the global increase in this greenhouse gas. ■

'A 1/2 pound of cheese and a cardiogram, please'

You leave the supermarket with a full trolley. Then someone approaches you. 'Are you insured with Humana? If so, then you can have your heart and carotid arteries checked here in this truck.' Sounds like a silly publicity stunt, but Ton van der Steen says with a straight face that it is already happening in the United States. 'A truck fitted out with a complete CT and ultrasound unit drives along various supermarkets. Your blood is tested, and they do a survey of your lifestyle, a

CT scan and an ultrasound. Together with our American colleagues, we are already tracking 7000 people in this manner; it's yielding a wealth of information about risk factors and about the behaviour of various types of vascular constriction.' Ultimately, the researchers want to be able to predict which people are at risk from an unexpected heart attack or stroke so that they can take preventive medications such as cholesterol-lowering medicines. ■

In the US a truck with a CT and ultrasound unit drives along various supermarkets.



The Dutch Batavians were quite Roman



Roman food (packed in earthenware) and utensils that were found at archaeological excavations of Batavian settlements in the Betuwe. They indicate trade and the Batavians' adoption of Mediterranean ways.

In Dutch history, the Batavians come across as brave fighters against the Roman occupiers. A nonsense story, as revealed by recent excavations near Tiel. The 'archetypical Dutch' tribe was more Roman than we think. An 'internal conflict within the Roman army,' that is how the archaeologist Stijn Heeren describes the infamous revolt (69-70 AD) of the Batavian chief Julius Civilis. Civilis was an officer in a Roman legion, had enjoyed a Roman upbringing and his father had Roman citizenship. 'Placing Julius Civilis on the same

pedestal as an early William of Orange is a figment from the time of the revolt against Spain. The parallel holds no water.' In fact, Civilis' life's story illustrates how much the Batavians were incorporated into the empire. As mercenaries, Batavians performed dangerous war work throughout the whole of the empire. After 25 years of military service, they received money to buy a farm and were given Roman citizenship. That gave their sons a chance at a career in the regular legions. The entire community in Batavian rural villages benefited from

the close ties with the empire. At excavations in the Betuwe, Heeren found Roman olive oil amphorae, coins, bathhouse accessories, 'make-up,' cloak brooches and seal boxes. These are indicative of trade and of the adoption of Mediterranean habits and communications: the Romans used bronze seal boxes for sending sealed messages. Only Batavian cemeteries contained hardly anything that was Roman. Heeren: 'Remarkably, that seems like the only place where they emphasised their non-Roman origins.' ■


 A photograph of two children sitting on a sandy beach. The child on the left is wearing a blue bucket hat and has their hands clasped under their chin, looking towards the other child with a slight smile. The child on the right is wearing a white baseball cap and a white tank top with 'NEW YORK' visible, also with hands under their chin, looking down thoughtfully. The background shows the ocean and a clear blue sky.

Fighting for survival

Solar panels on roofs are becoming commonplace. But what else can science do to maximize the use of the sun? Use energy umbrellas, for example!

Wristwatches, garden fountains, radios or cream whippers, even computer mice: if you want, you can have them work on an integrated solar cell. However, during the weekend you will have to let them ‘sunbath’ in the window. There must be a better way to do this, thought environmental engineer Nils Reich. He developed a method for predicting the energy yield of a solar cell during its design phase, depending on the surface and the light in a

certain place. Reich combined technical knowledge about solar cells with software programs for industrial design. Designers can then easily choose the right solar cell for their product and predict the energy balance in their design. Reich hopes that not only industrial designers, but also architects, will use his method. ‘Those gadgets are fun, but they make no substantial contribution to solving our energy problem. For the built-up areas it’s dif-

ferent. Here approximately one-third of our energy is used, so there’s much to gain if solar cells are integrated into the built environment. This would add up to the solar panels not integrated into but installed upon roofs, and of course open-space installations. This way solar PV can make a significant contribution in solving our electricity problems.’ ■

■ MARIËTTE HUISJES



Caterpillars feast on ragwort.

Chemical warfare

Co-evolution is a meticulous process. A tiny change to a plant's chemistry results in a major problem for caterpillars. That is what chemical ecologist Nicole van Dam discovered during her investigation into the relationship between yellow rocket (a native wild relative of cabbage) and the cabbage moth. She saw that the plant

had two variants of the same counteragent: one harmful to the cabbage moth caterpillar and one not harmful. It is easy to see which type of counteragent a plant has by looking at the growth of the caterpillars. The harmful variant also kills more caterpillars. According to the researcher, this is a wonderful example of how the battle between

plants and animals works. Plants invest in their own future with a range of chemical weapons. Animals, in turn, must defend themselves against this as best they can. Sometimes herbivores benefit from the poison. The caterpillar of the cinnabar moth stores the bitter toxins of ragwort in its body. A bird will think twice before eating such a foul snack. ■

A different design keeps warm cities bearable

Climate change will inevitably affect our mobility behaviour, especially in cities. If cycling and walking through sweltering summers become a horror, we should start tinkering with the design of public space, observes researcher Martin Dijst.

It's predicted that, in the period to 2050, it will rain harder and more often and summers will be hotter and drier. That also affects our behaviour. What are we going to do differently?

'The effect on leisure travel will be huge. If the predictions that it will be warmer in

the cities come true, then people will spend more leisure time outside the city. Shopping will be done at another time – in the evening or at night, for example. Biking and walking will be more attractive in the winter, but in hot summers less so. But you'll notice little change

in the use of cars: a car is a sort of climate machine in which you create your own microclimate.'

Why do you expect changes in behaviour especially in the city?

'The temperature difference between the city and the ►



Climate change will affect our mobility behaviour.

Fancy pay-as-you-drive

- ▶ countryside can easily reach eight to ten degrees due to the presence of buildings. That's why a city is often muggier than the countryside – especially at night – and that can affect the behavioural choices people make.'

This means you can influence the climate with buildings?

'Constructing tall or low buildings and broad or, on the contrary, narrow streets has an effect on the 'micro-climate'. By building higher, with more awnings and roofs for shopping arcades, and by creating more green areas and water features, you can keep walking and cycling in cities from becoming unattractive.'

What does the city of the future look like based on what you know now?

'There will be more electric bikes and cars driving around, more water bodies, parks and green roofs serving as water buffers and temperature reducers, and more underground construction forms. Because it's cooler underground.'

■ EDO BEERDA

Let people experience how they benefit directly from a pricing policy in traffic and transport, and they will be willing to accept these measures, says psychologist Geertje Schuitema. She refers to experiments in which car users had to pay extra for driving during peak hours. Their initial resistance to the price policy re-

duced when they saw that traffic jams were reduced by pay-as-you-drive, that the air was cleaner and that parking was less of a problem. 'For field trials, choose a location where traffic is really jammed,' warns Schuitema. 'There you have the greatest chance of the situation improving and price policy being accepted.'

Resistance to road pricing is not as stubborn as it may sometimes appear.





A medicine is injected into a mouse to test its effect.

Mathematics replaces laboratory animals

Before a new medicine is launched onto the market it must be thoroughly tested. First on living cells, then on animals. This happens with increasingly complex tests that aim to mimic the functioning of the human body with growing precision. Ultimately, an estimation can be made of how people will react to the medicine. All these interim steps require a relatively large number of laboratory ani-

mals and time. Mathematician Maciej Dobrzynski's goal is to use computer models to skip a few steps. He is trying to figure out why it is that cells sometimes respond differently to the same medicine. In tumours, for example, some cells survive a particular medicine while other cells succumb to it. The reason is that cells are amazing biochemical factories. For example, there are random processes taking

place that affect their survival rate. Dobrzynski first studied the functioning of living cells. Then he translated his findings into mathematics. With his theoretical knowledge, the scientist hopes to be able to better predict how our bodies react to certain medicines. So... mathematics as a way of saving laboratory animals and as a tool for making better medicines. ■

Harry Potter magic

thanks to nanotechnology?

Nanotechnology might just make a magical world reality. Basic research, at least, is taking the first steps towards phenomena that we have only seen in movies such as Harry Potter.





A 'magic application' could emerge from the research of Albert Polman and his colleagues: making objects invisible. They succeeded in designing a material that does not exist in nature. It has a negative refractive index: light striking the surface of this material reflects in a different direction than expected. The material is constructed from a grid of tiny silver tubes that conduct light. The wavelength of these tubes is much smaller than that of light. Each of these tubes conducts a small portion of the light. American investigators had already managed to pull off this effect using microwaves with a longer wavelength than visible light. Polman and his colleagues succeeded in this using visible light. Many applications are conceivable. This material would make a perfect lens for making extremely sharp images. And the invisibility cloak comes to mind.

● **Light wave moves backward**

Polman is careful with his predictions. First, the described effects have only been achieved at a scale of 10 micrometer. 'It will take considerable effort to scale up the process, if it succeeds at all.' Furthermore, the cloak would not make objects completely invisible. 'The material does not transmit 100% of the light, so you can perceive a bit of a dark haze. So you can't see the object, but you can see that something has been made invisible.' Polman thinks that applications are more likely in the telecom industry. 'Thanks to the negative refractive index, the light wave moves backward. This makes it possible to use light to transmit information a lot faster and more efficiently than by using electricity.' ■

■ JOP DE VRIEZE

Many children in Eritrea learn to read and write in two or three languages and scripts.



Thrice fluent

How do children with widely differing languages relate to each other when they get together? Research in his native Eritrea by the Tilburg PhD student Yonas Asfaha shows that it's easier to learn a language with 245 syllables than a language based on our alphabet of 26 letters.

After Eritrea became independent from Ethiopia in 1991, the new leaders chose the motto 'Unity through diversity'. In the renewed optimism after a long armed battle, solidarity and

respect were deployed instead of hatred and discrimination. Since then, children learn various languages in school starting at an early age.

● **Pupil learns three languages**

Nine different ethnic groups speaking nine different languages live in this East African country. All pupils are first taught in their mother

Language extravaganza

Each of the nine population groups in Eritrea has its own language. These languages are written in three different scripts: the syllabic script Ge'ez (for Tigrinya and Tigre), the alphabetic Latin script (for Afar, Bidhawyeet, Bilen, Kunama, Nara and Saho) and consonantal-alphabetic Arabic script (for Arabic).

tongue. Then they are taught Tigrinya and/or Arabic and learn English starting in the second grade. That is also the language of instruction in secondary schools and universities. So there are quite a few children in Eritrea who learn to read and write in two or three different languages and scripts.

● Syllable is easier

Asfaha investigated how the students master the various languages. And what did he find? The syllabic Ge'ez script is easier for children to learn than the Latin script based on pho-

nemes, sound characters. This is remarkable, because according to one important theory in psycholinguistics it is easier for children to learn a consistent script with small units (phonemes) than a less consistent script written with many more larger units (syllables). Apparently, it is not a problem that the Ge'ez language Tigrinya, with its 245 different syllable symbols, has considerably more than the 26 letters of the Latin alphabet.

● Mother tongue is less important

Asfaha also examined the attitudes of Eritreans towards the various languages and scripts. Three quarters of the 670 respondents said they consider it a good thing good that children learn three languages, but especially languages which will

be practically useful for them. This explains why, in many cases, parents consider English or Arabic more important for their children than their mother tongue. After all, this is often spoken by only a few people. It is also notable that the Eritreans view literacy primarily as a personal enrichment. Not so much in material terms, but as a skill that allows them to become more independent and confident. The economic benefits and better job opportunities come second.

The results of the research play an important role in the ongoing revision of the primary school curriculum in Eritrea. Asfaha is advising the developers in this. ■

■ JOP DE VRIEZE



Scientific director Prof. Rens Waters of SRON Netherlands Institute for Space Research: 'You have to be patient and take small steps each time. That's how it goes in our profession.'

Measuring instrument offers glimpse into cosmic nursery

Born and raised in space

While old stars sometimes die in unimaginably violent explosions, their successors are 'born' from huge clouds of gas and dust. Thanks to HIFI, a Dutch measuring instrument, astronomers can now 'see' what is happening in these cosmic nurseries.

Water plays an important role in the development of galaxies' 'nurseries'. In the first phase, it is essential that the hot gas and dust cloud be cooled sufficiently enough for star formation to begin. After that, it acts as a

kind of glue in the now highly cooled disk around the young star. It freezes to ice, to which more and more particles stick. This first creates rock blocks and eventually planets. On the surface of these particles, water serves as a

transport medium for more complex molecules. On earth, but possibly also on other planets in the universe, they were a prerequisite for the emergence of life.

'The water cannot be found, which is particularly intriguing.'

● **Dust clouds are impenetrable**

By looking closely at these events in the universe, astronomers hope to understand more about what happened five billion years ago during the birth of our solar system, explains Rens Waters, scientific director of SRON Netherlands Institute for Space Research. 'A limitation, however, is that the dust clouds at the birthplace of new stars is so dense that visible light can not penetrate them. For their information, astronomers therefore depend on infrared radiation that is not influenced by all those dust clouds. The European Herschel satellite was launched in 2009 to capture this radiation. Among the instruments on board is the HIFI instrument that is ideally suited to 'look for' water in these dust clouds.'

● **Water vapour pulls disappearing act**

Since Herschel looks at young stars in all stages of their evolution, astronomers

can reconstruct a film, as it were, of a star's birth by combining the data, continues the SRON director. 'And that has already provided us with new information. One of the most remarkable discoveries so far is the fact that water vapour, which has a significant presence in a dust and gas cloud, becomes essentially invisible at some point during star formation.'

● **Ice is invisible**

Astronomers suspect that the disappearing act of the water is caused by its freezing during a specific phase of the star formation. Waters: 'HIFI can only detect water in the form of water vapour. So if we do not see it any more, that must mean it's frozen. That's interesting, because only a part of a young solar system is cold enough for water to freeze.'

● **Stars have laws**

In the meantime, Herschel has provided astronomers with one spectacular discovery after another.

For example, the sensitive HIFI equipment has already discovered two new types of water in space. Another remarkable discovery, according to Waters, is that there seems to be a law regarding the size of stars in the universe. 'Everywhere in the universe we see the same picture: star clusters containing a massive star of one hundred times the mass of the sun, a dozen stars of about ten solar masses and, finally, around a hundred stars similar to our sun. The exciting thing is that Herschel has now measured the same distribution of matter in the gas and dust clouds in which stars form. The distribution of heavy and light stars in a cluster would therefore appear to be preprogrammed.' ■

■ ERIK HARDEMAN

A photograph of Arjen Robben in an orange soccer jersey, captured in motion on a green field. He is looking to his right with a focused expression. The background is blurred, showing a stadium setting.

Arjen Robben: a medical mystery explained

How could Arjen Robben play in the final of the 2010 World Cup while, as it turned out later, He had a hamstring injury? According to kinesiologist Huub Maas, muscles function in a different way than is frequently thought. 'It is increasingly clear that our muscles do not work individually, but are directly connected to each other. This is evident from the fact that tendons and muscles can take over the function of their damaged 'neighbours'. If you cut through a rat's tendon, the animal can still use the associated muscle. Apparently, the damaged muscle can transfer its force

to the skeleton via neighbouring muscles. We suspect that this happens through the connective tissue.' If his hypothesis is correct, that could explain Robben's nimble movements in South Africa, Maas concludes. 'With muscle damage, new connective tissue is often the first thing formed. This scar tissue relieves the damaged muscle fibres. At the same time, the connective tissue probably ensures that the intact muscle fibres can still generate force to produce movements. That might explain why, despite his injury, Robben could still play.' ■

Fooling plants

The best answer to the rapidly increasing demand for food in the world: more efficient agriculture. Researchers in Utrecht force plants to grow faster by fooling them.

Plants convert CO₂ into sucrose via photosynthesis. This then spreads from the leaves throughout the plant and drives its growth. But the process usually stops before all the sugar is used, for example, because the plant gets too little or too much water or light. Or because it is too cold or too hot,' says Professor of Molecular Plant Physiology Sjef Smeeckens.

● The crop must keep growing

For a greater yield per hectare, it would be nice if crops would simply continue

to grow, even under such conditions. Smeeckens: 'That would be important not only for the global food supply, but also for the production of biomass for biofuel. Only, to do that, we first need to have a detailed understanding of what a plant does with sugars. It is a complex network of genes and proteins that constantly pass messages to each other. We look at how that mechanism works with experiments and computer models. Then we turn certain genes in that system on or off, fooling the plant as it were, so that it still continues to grow – counter to

its natural tendency.'

● Adversary creates fear

Smeeckens expects genetically modified agricultural and horticultural crops to increase their yield by several percentage points. When asked why that progress has not been made yet, he heaves a sigh. 'That's because genetically modified organisms are still taboo in the Netherlands, even though there is no evidence whatsoever of any adverse effects.'

■ ERIK HARDEMAN

Through genetic modification, crops can continue to grow, even under less favourable conditions. This ensures a higher yield per hectare.





Alternative poop-mobile to save us from phosphate crisis

Without phosphates, world food production would collapse.

Everyone knows that oil is running out. But the fact that phosphate reserves will soon be exhausted too, is less well known. Yet that is just as important – since plants, animals and humans cannot do without it. ‘It’s high time we recycle our poop,’ says soil engineer and Socialist Party Senator Eric Smaling.

Alarming reports indicate that, as early as 2030, the demand for phosphates will be structurally higher than the supply. ‘We could have problems with our food

supply within 50 years,’ says Smaling. For people in poor countries, the problem will arise even earlier. As prices rise, many more people will go hungry.

● Phosphate ore becomes fertiliser

Phosphorus (phosphate) is a key element for plant growth. So it is one of the cornerstones of world food production. As a typical soil does not contain that much phosphate, but is required to yield more and more agricultural products, we get the ore from mines. Phosphates go through the food chain and eventually end up in the toilet where they are ‘lost’.

● Re-use is feasible

‘Within ten years, the EU must have a comprehensive system for phosphate recovery,’ says Smaling. He considers up to ninety percent re-use feasible. How? Separation in the toilet, for example, or in sewage facilities. Useful phosphates can then be processed into fertiliser products. ‘Collection at sewage and water treatment plants is already happening, only the EU has not yet recognised this as an agricultural fertiliser,’ says Smaling. ‘Ultimately those fertiliser granules from sewage will come... once it is also economically interesting.’ ■

■ EDO BEERDA

Development or land grabbing?

In recent years vast swathes of land in Africa have been leased to foreign investors. They use this land for agriculture, mining or reforestation and often promise the local population development. However, opinions differ as to whether this actually happens in practice. With a multidisciplinary team, anthropologist Sandra Evers is recording the details and consequences of such projects in Ethiopia, Uganda and Madagascar. Evers: 'In Madagascar families are losing the burial tombs of their ancestors even though these are incredibly important to them. Furthermore, many farmers are losing land as their ownership is often not recorded in deeds. The government can therefore legally designate farmland as state property and lease this accordingly.' The consequences of this are immense. Evers: 'For example, in Ethiopia this has led to severe water shortages as the foreigners use a lot of water for floriculture and food production. Farmers in the region are paying the price for this. Moreover, the leaseholders commonly produce for their home country or the world market. Ethiopia can therefore suffer from food shortages, even though produce is being exported.' ■

DUTCH SCIENCE

Powered by NWO

A publication by NWO in cooperation
with the popular science magazine Quest

How can mathematicians put an end to the use of laboratory animals in research? Is stem cell therapy the panacea for a wide range of ailments? How can you convince car drivers of the benefits of road pricing? How can we best conserve the vital yet shrinking supply of phosphate in the future? How do you help teenagers with sleeping problems? Are invisibility cloaks confined to the world of magic or can they become reality?

We already know that you can use chicory as a medicine against malaria. Furthermore, we have discovered that the Batavians, ancestors of the Dutch, who served as a source of inspiration for Dutch nationalistic feelings, 'collaborated' on a massive scale with the Roman oppressors. Such new knowledge takes science a step further, but can also be used to solve the problems society faces.

www.nwo.nl/research



Netherlands Organisation for Scientific Research

