

PHOTO: SHUTTERSTOCK



Like most insects, bees are also suffering from the impact of pesticides and climate change.

## INSECTS AND CLIMATE CHANGE

The impact of humans on the climate and ecosystems is becoming increasingly clear – a drastic decline in total insect biomass can be observed throughout Europe. While pollinating insect species are threatened with extinction, certain pests and vector insects are spreading to ever wider areas. To investigate the interactions between insects, the climate, and humans in greater detail, the Max Planck Institute for Chemical Ecology, the University of Lund, and the Swedish University of Agricultural Sciences are joining forces as part of the new Max Planck Center on next Generation Insect Chemical Ecology. Together, the partners are primarily focused on examining how higher average temperatures, greenhouse gases, and air pollution impact the olfactory system of insects and how insects adapt to these changes. The findings could make a significant contribution to solving global problems in the context of the climate crisis, global nutrition, and even the fight against diseases. After all, the rising temperatures also facilitate the spread of infections transmitted by insects, such as West Nile fever and malaria. Therefore, one aim of this collaboration in the Max Planck Center is to develop new methods of combating these diseases. The joint project was officially launched in January 2020 in Alnarp, Sweden.

[www.mpg.de/14403006](http://www.mpg.de/14403006)

## AWARD-WINNING ★

### ERIN SCHUMAN

8 Erin Schuman, Director at the Max Planck Institute for Brain Research, has been awarded the Louis-Jeantet Prize for Medicine 2020 for her work on local protein synthesis at synapses. These structures act as contact points between nerve cells in the brain and determine how effectively the cells can communicate with one another. Schuman found that many of the proteins that the synapses need for communication are produced locally in the vicinity of the synapses themselves, so that they are available at the right time and in the right place. This discovery paves the way for a better understanding of how synapses work and of the impact of disruptions in neuronal development. Bestowing grants of EUR 500,000, the Louis-Jeantet Prizes are some of Europe's most valuable awards for biomedical research. The money supports the prizewinners in their subsequent work.



PHOTO: MPI FOR BRAIN RESEARCH

### SVANTE PÄÄBO

The Japan Prize 2020 has been awarded to Svante Pääbo, Director at the Max Planck Institute for Evolutionary Anthropology. Pääbo is considered the founder of paleogenetics, a discipline that is concerned with the analysis of genetic samples from fossils and prehistoric finds. He investigates which of the genetic changes in the course of evolutionary history have shaped modern humans by comparing the DNA sequences of modern-day humans with those of Neanderthals and other human ancestors. Pääbo's major scientific achievements include the complete decoding of the mitochondrial DNA of a Neanderthal in 2008 and of the Neanderthal genome sequence. The Japan Prize is often referred to as the Japanese Nobel Prize and is endowed with prize money of 50 million yen (about EUR 490,000).



PHOTO: KARSTEN MOBIUS



## CUTTING- EDGE RESEARCH IN POLAND

Three additional centers will soon become part of the Dioscuri program in Poland, which was initiated by the Max Planck Society. Mathematician Pawel Dłotko, biologist Gracjan Michlewski, and physicist Bartłomiej Waclaw will lead the centers, where they will establish internationally competitive and innovative research groups. The aim of the Dioscuri program is to recruit researchers from prestigious international postings in Western Europe and the U.S. and to support them in setting up their own research group in their home country. The program thereby helps to overcome the performance gap that exists between Western and Eastern Europe. The first two Dioscuri Centers began their work in 2019.

[www.mpg.de/14310896](http://www.mpg.de/14310896)

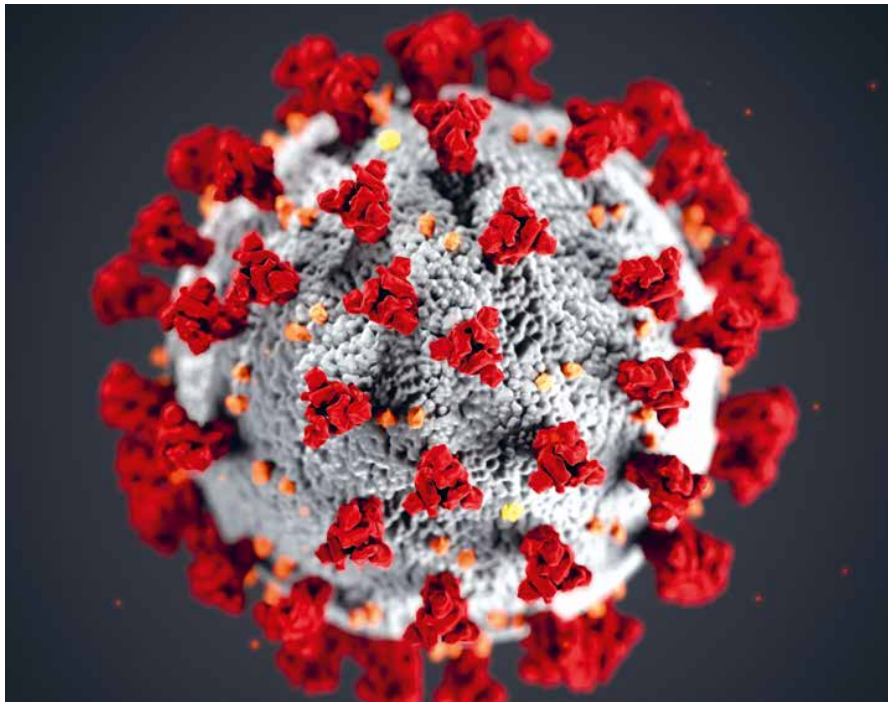


IMAGE: CDC/ALISSA ECKERT, MS; DAN HIGGINS, MAMS

## IMMUNE BOOST AGAINST THE CORONAVIRUS

Researchers from the Max Planck Institute for Infection Biology have developed a candidate for a vaccine against tuberculosis that could also be effective against an infection with SARS-CoV-2. The substance is based on the BCG vaccine, which was discovered in the early 20<sup>th</sup> century as a means of combating tuberculosis. Studies in mice have shown that BCG can mitigate the impact of viral infections of the respiratory tract. Accordingly, mice suffering from influenza showed less damage to their lungs if they had previously been vaccinated with BCG. There are also indications that the vaccination activates the immune system against viral infections, thereby reducing the risk

of severe disease progression and lowering the mortality rate. Clinical studies have so far shown the tuberculosis vaccine recently developed by the Max Planck Institute to be well tolerated and more effective than standard vaccination with BCG. This raises hopes that the new vaccine will also be better able to alleviate the symptoms of an infection with SARS-CoV-2. Its effectiveness against SARS-CoV-2 – i.e., the Covid-19 coronavirus – will now be tested in a large-scale study at German hospitals, with participants drawn primarily from at-risk groups like health care workers and older people who are particularly vulnerable to the disease.

[www.mpg.de/14610776](http://www.mpg.de/14610776)

Scientists are searching for a vaccine against the coronavirus, shown here as a 3D model.

Cross section of a mouse's hippocampus. After erythropoietin is administered, the animals have more nerve cells in this brain region, which plays a key role in learning and memory.

## A BRAIN DOPING AGENT PRODUCED BY YOUR OWN BODY

Erythropoietin, or EPO for short, is a notorious doping agent that not only boosts physical performance but also acts as a growth factor for nerve cells – reducing damage to the brain after a stroke, for example. Even patients with mental health disorders such as schizophrenia, depression, bipolar disorder, or multiple sclerosis have shown an improvement in cognitive performance with EPO. Now, researchers from the Max Planck Institute for Experimental Medicine in Goettingen have revealed how the substance works in the brain: they found that cognitive challenges in the nerve cells of the brain trigger a slight shortage of oxygen, leading to greater production of EPO along with its receptors. The growth factor subsequently boosts the activity of these nerve cells, induces the formation of new ones from neighboring precursor cells, and increases the interconnection of neurons. Taking EPO bolsters this natural effect, with test results showing that adult mice form 20 percent more nerve cells in the pyramidal layer of the hippocampus – a brain region crucial for learning and memory – after the growth factor is administered.

[www.mpg.de/14569880](http://www.mpg.de/14569880)



IMAGE: MPI FOR PSYCHIATRY

## THE THOUGHTS OF OTHERS

In order to understand what other people are thinking and assess how they are behaving, humans need to be able to comprehend someone else's perspective. They develop this ability during childhood, but researchers have so far been at odds concerning the age at which it emerges. A recent study by the Max Planck Institute for Human Cognitive and Brain Sciences shows that children aren't truly able to understand what others are thinking or to anticipate their actions until they reach the age of four. As the researchers observed using eye-tracking technology, younger children can already predict the actions of a cartoon character – but if they're asked about it, they give the wrong answer. The researchers found the reason for this by taking measurements of brain activity: different brain structures are involved in the two decision-making processes – the nonverbal version expressed in their gaze and the verbal one expressed in their answer. It is not until the age of about four that the brain regions we use to actually understand what others are thinking reach sufficient maturity for us to express this perception verbally – although in early childhood, another brain function exists that does allow us to take another person's perspective.

[www.mpg.de/14562450](http://www.mpg.de/14562450)

## A TALE OF SHEPHERDS AND HELICES

“Adoration of the Shepherds” by the Italian sculptor Giuseppe Torretti is a source of fascination not only for fans of the Baroque era, but also for chemists – because of lumpy efflorescence produced by corrosion on the restored marble relief. As researchers at the Max Planck Institute for Solid State Research have discovered, these phenomena are formed by a salt that crystallizes in the same triple helix structure as the protein collagen.

Now that restorers have access to accurate structural data for the salt (a hydrated form of calcium acetate), they can also identify that same corrosion product on other marble works and may be able to prevent the processes by which the efflorescence occurs. However, the inorganic helices could also be used as a template to cause other chemicals to adopt this structure.

[www.mpg.de/14594656](http://www.mpg.de/14594656)

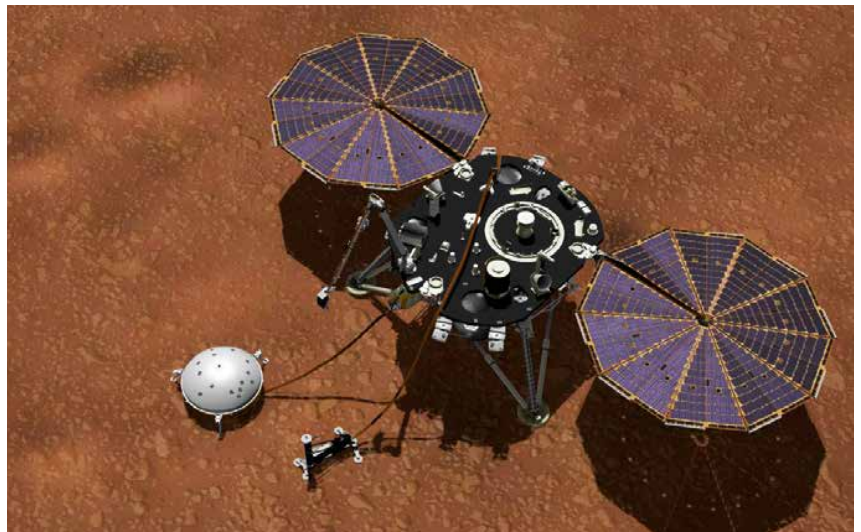


PHOTO: NASA/JPL-CALTECH

Space scout on the Red Planet: InSight – seen here in an illustration of the probe on the surface – delivers valuable insights into the inner workings of Mars.

## MARS IS SEISMICALLY ACTIVE

The Red Planet is anything but tranquil. In the first ten months since starting its scientific operations in late February 2019, the seismometer of the InSight probe detected no fewer than 174 Martian quakes. On average, this corresponds to slightly more than one quake every two days. The data obtained by a team including researchers from the Max Planck Institute for Solar System Research provides the first comprehensive proof that Mars, like

Earth and the Moon, is seismically active. However, the tremors on our neighbor in outer space are nowhere near as powerful as those on Earth: none of the recorded quakes achieved a magnitude of more than 4. For 150 of them, the probe could only detect waves that propagate in Mars's crust, whereas the other 24 passed through the planet's rocky mantle and showed similar characteristics to quakes on Earth.

[www.mpg.de/14506708](http://www.mpg.de/14506708)

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PHOTO: RATHGEN RESEARCH LABORATORY, STAÄTLICHE MUSEEN ZU BERLIN – PRUSSIAN CULTURAL HERITAGE FOUNDATION

After World War II, only fragments of “Adoration of the Shepherds” still existed. These are shown here as brownish sections in combination with a black and white photo of the intact relief.

## COOPERATIVE PARROTS

Parrots are not only extraordinarily clever but also have a high level of empathy and a strong willingness to help. This is the outcome of behavioral studies of gray parrots by researchers at the Tenerife research station that is associated with the Max Planck Institute for Ornithology in Seewiesen. In their tests, the researchers issued metal tokens to a few birds in a group, who could exchange these tokens for food. The parrots who received a token generally behaved extremely selflessly, passing the token on to their neighbor with their beak if they hadn't received one. Consequently, parrots appear to recognize when a bird of the same species can benefit from their assistance and when they cannot. In further experiments, the researchers also observed that gray parrots are not envious when a bird of the same species receives a better payoff for the same performance or has to work less hard for the same payoff. Rather than an underdeveloped sense of fairness, this behavior may stem from strong pair-bonding behavior. Unlike chimpanzees, who will not put up with unequal treatment of this kind, gray parrots tend to live with a single partner for their whole lives. Animals that form long-lasting partnerships can probably be more tolerant of unequal treatment than non-monogamous species, because their generosity pays off in the long run.

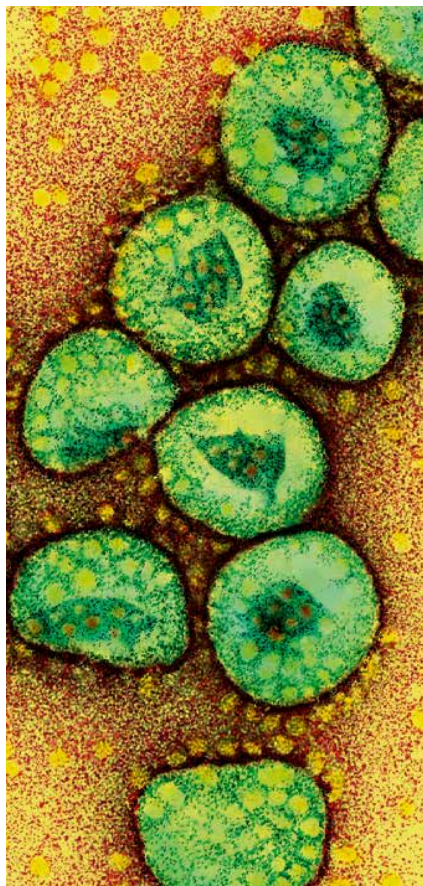
[www.mpg.de/1432811](http://www.mpg.de/1432811)

In the behavioral experiments, the parrots receive metal tokens that they can then exchange for food.



PHOTO: COMPARATIVE COGNITION GROUP

IMAGE: SCIENCE PHOTO LIBRARY/MURTI, DR. GOPAL



Electron microscopy image of coronaviruses.

## WASTE DISPOSAL FOR CORONAVIRUSES

When cells are subjected to stress, they intensify their disposal of cell components that are damaged or superfluous. Cells can also use this built-in waste disposal system to get rid of viruses. Now, a team from the Max Planck Institute of Psychiatry and the University Clinic in Bonn has discovered a protein for the elimination of waste substances that promotes the disposal of viruses and is regulated by existing commercially available antibiotics and drugs intended to combat intestinal worms. Together with scientists from the Charité hospital in Berlin, the researchers discovered that the active substances can inhibit the proliferation of the MERS coronavirus – a relative of the novel coronavirus, SARS-CoV-2. In humans, the MERS virus can cause severe pneumonia, which is fatal in more than a third of cases. As with SARS-CoV-2, there are still no drugs or vaccines available to combat the pathogen. It remains to be seen whether the active substances will boost the elimination of coronaviruses in humans. In the meantime, scientists at the Lead Discovery Center in Dortmund, a spin-off of the Max Planck Society, are investigating other substances that could stimulate cellular waste disposal systems and be put to therapeutic use.

[www.mpg.de/14453988](http://www.mpg.de/14453988)



PHOTO: WIM HOEK / SHUTTERSTOCK

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Female blackcap. The species exhibits a wide range of migration behaviors: depending on their origin, the birds fly different distances to their wintering areas, and some of them don't migrate at all.

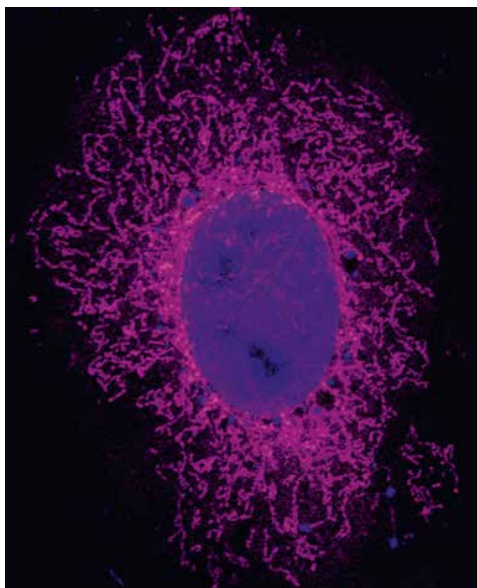
## BIRDS MIGRATE REGARDLESS OF CLIMATIC CONDITIONS

Cuckoos from Kamchatka migrate to Angola to spend the winter there—a distance of about 14,000 kilometers. Where and how far the birds fly is determined primarily by the climate, but this has changed dramatically time and again over the last 50,000 years. Researchers at the Max Planck – Yale Center for Biodiversity Movement and Global Change have used computers to model the worldwide development of bird migration during this period. The simulations show that birds migrated back and forth between summer and wintering grounds even during the last ice age. However, according to the model, the ways in which migratory birds react to climate change varies from region to region. In Europe, Asia, and Africa, for example, there were about as many migratory bird species during the last ice age as there are today, and

the flight distances remained relatively constant on average. The same cannot be said for North and South America, where there were 20 percent fewer migratory bird species during the last ice age. It appears that many of these were resident species during the ice age and only began to migrate afterwards. The migratory routes were also 40 percent shorter than they are today. Thus, bird migration has continued even during major changes in climate. But researchers still don't know how it is being affected by anthropogenic climate change. This is progressing at a faster rate than previous climate change events, and birds' living conditions are also deteriorating in many ways, such as through the loss of habitat and food sources. The computer model can now help to predict the impact of these changes on bird migration.

[www.mpg.de/14502196](http://www.mpg.de/14502196)

IMAGE: MPL-CBG/NAMBA ET AL.



The ARHGAP11B protein (magenta) in a basal brain stem cell (cell nucleus: blue).

## CANCER-LIKE METABOLISM PROMOTES BRAIN GROWTH

The size of the human brain has increased profoundly over the course of evolution. Scientists at the Max Planck Institute of Molecular Cell Biology and Genetics in Dresden have discovered that basal brain stem cells can proliferate thanks to a gene by the name of ARHGAP11B, which triggers the formation of more neurons. Now, the researchers have also established how the gene works: it interacts with another protein in order to close a pore in the mitochondrial membrane, preventing calcium leakage from these organelles. This results in a high calcium concentra-

tion, allowing the mitochondria to generate energy via the metabolic pathway of glutaminolysis and to induce the brain stem cells to proliferate more strongly. A high rate of glutaminolysis is characteristic of highly proliferating cells, notably tumor cells. It would therefore appear that one reason for the pronounced expansion of the human brain over the course of evolution was a change that allowed human metabolism to switch to cancer-like metabolism within the brain for a limited period of time.

[www.mpg.de/14324498](http://www.mpg.de/14324498)

## A FLEET OF MICROSWIMMERS

A microswimmer from the Max Planck Institute for Intelligent Systems in Stuttgart has outstripped its natural role models. A team from the Institute has developed a micro-robot that swims much faster than bacteria or algae. The tiny floating body is shaped like a hollow hemisphere with a small hole in the bottom. As soon as this is immersed

in liquid, an air bubble forms inside the hollow space. Researchers then use ultrasound to cause the bubble to pulsate, producing thrust that propels the microswimmer forward. In the future, these acoustically powered minisubmarines could be used in minimally invasive medical treatments, for example.

[www.mpg.de/14420595](http://www.mpg.de/14420595) (in German)

## FEEDBACK, DONE RIGHT

Feedback is regarded as a crucial component of a successful business culture. Used correctly, it can enhance performance and teamwork. In an experiment, researchers from the Max Planck Institute for Human Development investigated how different types of feedback influence future conduct. The best effect on teamwork was seen when participants received feedback reflecting the performance of the group as a whole. In contrast, ranking feedback – that is, information that classified an individual's personal performance relative to the other participants – led the subjects to increasingly view themselves as competitors. In the extreme, this led participants to aim their actions solely at outdoing others, even if this was ultimately harmful to the group and therefore also to themselves.

[www.mpg.de/14436490](http://www.mpg.de/14436490)



## SMOKING WITHOUT SMOKE

Not even smoking bans can protect people from passive smoking in public places. Indeed, the air in these spaces still becomes contaminated with pollutants from cigarette smoke (such as nicotine and fine particulate matter) when current or past occupants have previously been smoking elsewhere – because the substances are exuded by their clothing, skin, and hair. Now, for the first time, researchers from the Max Planck Institute for Chemistry and Yale University have been able to confirm the existence of indirect passive smoking using measurements. They recorded the concentration of 35 volatile organic compounds (VOCs)

contained in cigarette smoke in a movie theater auditorium over a period of several days. The results showed that audience members who sit in a movie theater for an hour inhale quantities of contaminants that are equivalent to the secondhand smoke from up to ten cigarettes. The degree of exposure to the individual pollutants depends on their volatility, among other things. In the case of the carcinogen benzene, for example, the exposure was equivalent to the smoke from eight cigarettes. In rooms that are less well-ventilated than a movie theater auditorium, the exposure is likely to be even higher.

[www.mpg.de/14558058](http://www.mpg.de/14558058)

ILLUSTRATION: SHUTTERSTOCK

## A STRANGER WITH AN ELEVEN-KILOMETER RADIUS

Neutron stars are compact, extremely dense remnants of supernova explosions. Occasionally, two of these exotic stellar spheres merge – as was the case in GW170817, an event that astronomers observed in gravitational waves and the entire electromagnetic spectrum in August 2017. From the data on GW170817 and from theoretical considerations, the researchers led by Collin Capano from the Max Planck Institute for Gravitational Physics determined the radius of typical neutron stars, such as those that collided in GW170817. For this, the scientists chose scena-

rios that firstly corresponded to the gravitational waves of GW170817 and secondly generated a short-lived, hypermassive neutron star as a result of the merger. Thirdly, in order to be considered, the models needed to agree with known constraints on the maximum mass, which the astrophysicists had determined from electromagnetic observations of the source of GW170817. The result was that a typical neutron star with 1.4 times the mass of our Sun has a radius of about eleven kilometers.

[www.mpg.de/14575466](http://www.mpg.de/14575466)



IMAGE: ESO / L. CALÇADA

A ball of wonder: neutron stars have a mass greater than the Sun, but matter is packed inside them at an unimaginably high density – as they typically have a radius of just eleven kilometers.

## THE FIRST SALMONELLA BACTERIA

The beginning of agriculture represented a milestone in the history of humankind. It has long been hypothesized that close contact with animals has led to the emergence of many new diseases – known as zoonoses – in humans. Now, a team of scientists from the Max Planck Institute for the Science of Human History has studied bacteria from the 6,500-year-old skeletons of farmers, thereby shedding new light on the development of zoonoses. The research-

ers reconstructed eight ancient genomes of the pathogen *Salmonella enterica*. Their analysis revealed that these were progenitors of the Paratyphi C strain of bacteria, which now exclusively infects humans but occurs only rarely. The historical salmonellae, however, probably infected humans and animals alike, which suggests that the agricultural way of life actually facilitated the emergence of new diseases.

[www.mpg.de/14506431](http://www.mpg.de/14506431)

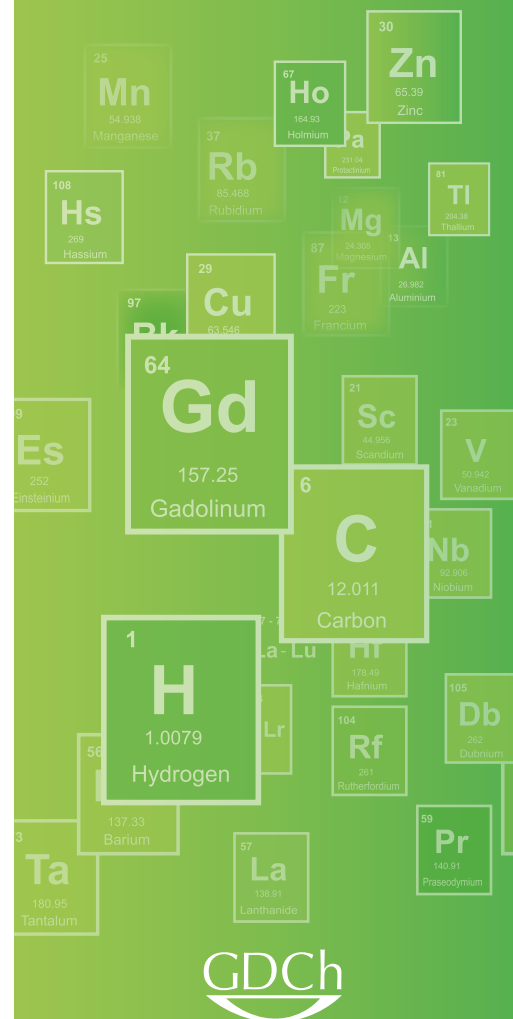
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