Off the BENCH

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The Eppendorf – LifeScienceStyle Magazine

RESEARCH OF THE EXTREME KIND

A number of scientists work in extremely remote places. What is it like?

FIGHT AGAINST CANCER

How molecular biologist Georg Winter eliminates defective proteins

Dossier Driven by Curiosity

presented by eppendorf

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INSPIRING SCIENCE

DOSSIER

INSIDE EPPENDORF

BRIGHT MINDS

EXPLORING LIFE

ISSN 2625-1116

Dear Reader,

Challenges abound in science – whether in the fields of medicine or environmental protection, or whether it concerns feeding the world's population. Research is conducted worldwide in order to continue to provide new answers to humanity's most pressing questions.

The driving force behind this effort is curiosity. It is a part of human nature, and children are the best example. Their desire to discover something new every day, to understand the world, and to learn is irrepressible. Scientists are well aware: they, too, are driven by curiosity – it makes them work tirelessly and also helps them overcome setbacks.

We asked three researchers from different disciplines about their own personal curiosity and which role it plays in their scientific work. You will find their answers in our new dossier – in fact, this issue's dossier is entirely devoted to the phenomenon of curiosity.

The dossier is one of the many new features of "Off the Bench". Better orientation through tighter categories – and therefore clearer organization of topics. This is clearly reflected in our new section "Inside Eppendorf": in eight concise pages, starting on page 25 of the magazine, you will find novel products and news by Eppendorf, as well as additional services for your demanding laboratory work.

The popular career portrait, which has always been featured on our cover, continues to be a mainstay of the magazine alongside the improvements. You can now find it in the section "Clever Minds". In this issue, we are introducing Georg Winter, a molecular biologist who works tirelessly to eliminate cancer at its source. His groundbreaking research earned the Vienna-born biologist the 2019 "Eppendorf Award for Young European Investigators"- a success which can certainly be attributed in large part to his curiosity.

We hope you enjoy reading the magazine,

Eva van Pelt
Member of the Management Board &
Chief Commercial Officer

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Science News

3D printing instead of donor organs? A miniature heart – made from "real" materials

A Heart Made from Bio-Ink

For the first time, a research team from the University of Tel Aviv, led by biotechnologist Tal Dvir, has succeeded in manufacturing a heart using a 3D printer – complete with tissue, blood vessels and chambers.

The special feature: the printer ink is made from real adipose tissue and cells, which are then processed to hydrogels. The bio-ink has the advantage that the body can accept it as autologous tissue, which could reduce the risk of transplant rejection. In a subsequent step, the team will teach the heart to pump in a coordinated fashion, which necessitates the development and printing of even smaller blood vessels. The scientists estimate that it will take another ten to 15 years until the heart will be ready for organ donation.

Meanwhile, the design studio "Nervous System", with scientists Jordan Miller of Rice University and Kelly Stevens of the University of Washington®, is working towards the development of 3D networks of blood vessels for printed organs. They constructed networks of vessels in the shape of a lung that could transport blood or air. This work promptly made the front cover of the May 2019 issue of "Science®" Magazine.

Thoughts Speak for Themselves

Science is no stranger to mind reading. Verbalizing thoughts in a comprehensible manner, however, is a milestone for the field of neurobiology. Employing their brain-computer "Interface", researchers at the University of California®, San Francisco translated thought currents into spoken language. Through a decoder, the instrument specializes in utilizing kinematic and sound-based representations that are required for speech: the control signals sent by the neurons from the brain are transferred to a vocal tract which comprises the lips, tongue and larynx and which is beginning to speak. In the future, this invention could significantly ease the lives of people with limited ability to communicate.

Excising HIV

American scientists have succeeded in removing the HIV virus from live mice. How? The process is based on a combination of therapies: using "Laser ART", the researchers injected mice with a substance that represses the activity of the HIV virus for several days. During this time window, "Crispr-Cas9" was deployed. The gene scissors removed the viral genetic material from the DNA of the affected cells. According to the team of scientists from Pennsylvania and Nebraska, they have now come closer to the goal of curing people suffering from AIDS.

100

years will it take for all insects to become extinct – according to the Australian research team led by Francisco Sánchez-Bayo. They calculated this number based on the hypothesis that the insect mass will continue to decline by 2.5 percent annually – with devastating consequences for humans, animals and the environment.

Creativity Knows No Age

Are we really more creative when we are younger? Researchers at Ohio State University® and the University of Chicago have come to a different conclusion. In a study, they have identified two distinct groups of creative people. "Experimental innovators" is the term for imaginative and inventive people over 50. They use their vast life experience, as well as "trial and error", to arrive at creative solutions. They are different from "conceptual innovators" in their mid-twenties whose creativity is generally fueled by their youthful and carefree outlook on life. The conclusions drawn from this study are based on a comprehensive analysis of the 31 most respected Nobel Laureates from the field of economics.

To the Limit

Only approximately four percent of the land mass on Earth is habitable for us humans. Scientists, however, frequently push forward into the most extreme corners of the planet and even into space. Four projects illustrate how it is possible to work in such places – and endure.

Alone in Eternal Ice

For the past ten years, the stakes of Neumayer Station III have been protruding from the ice at Atka Bay. Here, on the edge of Antarctica, darkness, temperatures as low as minus 47 degrees Celsius and gale-force winds determine everyday life for the nine researchers of the Alfred-Wegener-Institute (AWI) in Bremerhaven, Germany, who reside at Neumayer III. They are dedicated, among other pursuits, to the study of atmospheric chemistry, geophysics and meteorology. While Antarctica may offer the perfect conditions for their research, in addition to the weather, loneliness poses a real danger. "Isolation, plus the eight weeks of continuous darkness of the polar winter, paired with everyday monotony, place an enormous amount of stress on the psyche", says Tim Heitland. As station head, the medical doctor himself spent 14 months at Neumayer III. Heitland conducted a study on the impact of the exceptional psychological and physical stress of isolation, which is meant to provide important insights into space medicine.

The Last Laboratory of its Kind

In the shallow waters off the coast of Florida, the Aquarius Reef Base has been in existence since 1986. After numerous underwater habitats had been released into the ocean during the second half of the last century, the Aquarius base is now the last remaining active research laboratory. "The running maintenance and operating costs are tremendous; for example, two years ago, the life-sustaining buoy of the platform was damaged. Repairs were incredibly complex", explains marine biologist Heather Bracken-Grissom of Florida International University which operates the laboratory. The scientific knowledge gained from below the surface, however, makes the effort worthwhile: "We are in the process of collecting samples of sea sand for the purpose of taking inventory of the living organisms contained therein. Aquarius is ideally suited to such missions." The 37 square meters provide enough space for up to six people. During the missions, most of which last for ten days, the scientists remain permanently inside the base. "You literally live underwater", says Bracken-Grissom, and she asks: "What could be cooler?"

Microbes in Space

Is there life on other planets? With this question in mind, modern scientists focus their efforts on our neighboring planet, Mars. While the Mars Rover Curiosity tours the surface of Mars searching for signs of life, a team of researchers from the BIOMEX project have embarked on a detour: this project studies microbes in space. In 2014, the German Aerospace Center (DLR) had seeded bacteria, algae, lichen and fungi onto an external platform of the International Space Station (ISS). The conclusion after 533 days: "Some of the organisms have displayed remarkable resistance to cosmic radiation and have actually returned from space as 'survivors'." Dr. Jean-Pierre Paul de Vera of the DLR® Institute of Planetary Research in Berlin-Adlershof is impressed. "Among other organisms, we have studied Archaea – single-celled organisms that have existed on Earth in salty ocean waters for more than three and a half billion years." Such unicellular organisms could therefore be feasible candidates whose existence on Mars might be possible. "This does not mean, however, that life really does exist on Mars", cautions de Vera. "But the search for life is now, more than ever, the strongest driving force for the next generation of space missions to Mars."

Lofty Heights

High above the clouds, in the Bernese Alps, it is not only the view that is breathtaking – so is the research. Just recently, "Platform Chemistry" honored the high alpine research station "Jungfraujoch®" with the "Chemical Landmark 2019" award for its role as a pioneering and historic research station. Exactly what is the subject of study at an altitude of 3,450 meters above sea level? "The station is predestined for atmospheric studies", explains station director Professor Markus Leuenberger. Current projects calculate the percentage of human contribution to the CO_2 levels in the atmosphere, the terrestrial biosphere and the oceans – knowledge crucial to our survival. However, the exposed location itself poses an immediate risk to the researchers. The station is subject to extreme weather conditions year-round. Leuenberger: "With a mean annual temperature of minus 7.2 degrees Celsius, snowfall is a possibility at any time during the year. Add to this the strong gusts of wind well above 200 kilometers per hour and, of course, the low air pressure that quickly leads to shortness of breath. Despite all this, the influx of researchers is considerable. "We are talking about up to 1,000 overnight stays per year", says Leuenberger. Up here at the Jungfraujoch, researchers have found their perfect extreme.

Unique

With his microscope, biologist Gary Greenberg discovers the world anew each day. His favorite object: sand.

Gary Greenberg was cleaning out his office when he came across a film cannister full of sand. His brother David had sent it to him from Maui to freezing Philadelphia. This was where Gary was busy making accessory devices that converted 2D microscopes into 3D microscopes. On the brink of tossing out the can, he suddenly thought, „I wonder what this looks like in the microscope?“

What he beheld through the eyepiece amazed him. How could each individual grain be so unique, so colorful, so beautiful – and so different from what we, at first glance, perceive to be mere sand? As a scientist, he was not satisfied with a single “sample”, and he asked a friend to send him sand from the Virgin Islands. It turned out to be astonishingly different. Each grain brought Greenberg closer to the realization that even seemingly banal items may harbor exceptional secrets – secrets that are hidden from view. “I was hooked”, recounts Greenberg. “I asked all my friends to send me sand and started photographing these little jewels.“

Sand from the Moon

For Greenberg, the physically loose sediments with a grain size of between 0.063 and 2 millimetres are unique gems. They are formed when rocks weather physically or chemically and occur to varying degrees on the entire earth's surface. At Greenberg, for example, sand from Japan to Belgium was now also on the microscope slide.

What fascinates the scientist most, however, is a specimen from even further away: moon sand, collected by NASA® during its "Apollo" missions. Greenberg’s book on sand had come to the attention of the Space Agency, which first provided him with samples and later with a grant to photograph the lunar sand. While the latter consists of the same minerals as those found in the Earth’s crust, its appearance is vastly different: it is darker and is reminiscent of shimmering metal, instead of appearing glossy and resembling precious stones, like most terrestrial sand. This difference is rooted in their creation: “The lunar surface is continually bombarded by meteors and micrometeorites“, explains Greenberg. “so there are darker glassy mineral sand grains produced by the heat and pressure of these collisions.“

Microscopic improvements

Earth itself still holds plenty of secrets, and more laws of nature are waiting to be discovered. Long before sand, Greenberg had been searching for the precise way to visualize things. In the eighties, during his time as assistant professor at the University of Southern California®, he researched the formation of birth defects by studying tissue. He regretted the lack of depth of the two-dimensional images that were generated by the microscopes available to him. He began experimenting with their illumination system by changing the angle at which the light hit the sample. Depth of field improved dramatically. With this discovery, Greenberg initiated the development of his own 3D microscopy, for which he holds 20 US-patents today. His company, Edge-3D, equips industry and research with instruments that are used in such diverse areas as neuroscience, geology and pathology. They continue to uncover secrets that are right under your nose. All you have to do is look closely. ■

Each particle is unique
Visible under a 3D microscope: no two grains of sand are alike

Interview

Dr. Greenberg, why is it worth looking at sand through one of your 3D microscopes?

Gary Greenberg: Conventional microscopes can only provide 2D images with extremly limited depth of focus. Only a very thin slice of the specimen can be seen in focus at one time. 3D microscopes automatically take a sequential series of photographs of the specimen at different focus levels. A software then combines the individual photographs to generate an image that is entirely in focus and that can be viewed in 3D on the screen.

Are there advantages to other areas?

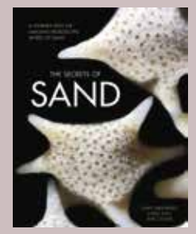
Greenberg: Yes, for investigations of objects that are naturally thick and complex. They are particularly useful in areas such as neurobiology, developmental biology, cancer biopsies, plant biology, geology and live-cell tissue culture.

Why?

Greenberg: Because of the shallow depth of focus of 2D microscopes, microscopists usually prepare 5-micron sections of their samples to eliminate the problem of out-of-focus blur. This is problematic because the average cell is between 10 and 30 microns. Examining 5-micron sections leads to under-sampling errors, resulting in misinterpretation of the data.

! BOOK SUGGESTION

„The Secrets of Sand“
A new face of the world is presented in the book by Gary Greenberg, Carol Kiely and Kate Clover. The microscopic images of sand from the Earth to the Moon convey not only undiscovered beauty, but they also reveal new fascinating facts about our planet.



The Secrets of Sand, 128 pages, Publisher: Voyager Press, aprox. 18,99 Euros, ISBN-13: 978-0760349441

A Different Kind of Harmony

Mussels and melons, coffee and carrots, blue cheese and chocolate: those whose cooking adheres to the principle of “food pairing” combine foods that share common aromas. What is the secret behind a dazzling flavor?

Imagine a summer salad: “cucumber, olive oil, flaxseed, salmon …” This is how Professor Thomas Vilgis sends us on our imaginary journey of flavors. “All these ingredients feature green, grassy, cucumber-like aromas that make a wonderfully harmonious salad.” This imaginary meal embodies the central idea of food pairing. The hypothesis behind the culinary concept: ingredients go particularly well together if their predominant aromas are similar. The physicist at the Max Planck Institute® for Polymer Research in Mainz, Germany, has extensively studied this trend, which dates back to 1992.

British star chef Heston Blumenthal, owner of the restaurant “The Fat Duck”, experimented to find out how to best combine foods. The object of his studies: caviar. He followed his intuition and sampled it together with white chocolate – quite the contrast. However, the taste experience tells a different story. The salty caviar is complemented superbly by the fatty sweetness of the chocolate. The reason why certain foods are a perfect match still remained elusive. Is there a pattern, a system?

At approximately the same time, François Benzi was intrigued by the scent of jasmine. Wasn’t he detecting an ever so slight whiff of liver? The discovery was on his mind until, finally, he decided to incorporate jasmine flowers in one of his liver pâtés – and hit the culinary jackpot. The perfumer and food technologist was working for an aroma and fragrance manufacturer, a position that equipped him with the necessary tools to study the unique pairing. Eventually, through his employer, he received a request from the UK concerning caviar and chocolate. This is how Blumenthal and Benzi met, and together, they continued to analyze different ingredients and combinations until they were certain that their novel hypothesis was correct. The principle of food pairing was born.

Harmony versus contrast

The concept is based on the balance between individual aromas. In this respect, foods are more compatible than meets the eye. A random example: strawberries and pollock. Both contain fatty acids that form during ripening or growth, respectively, in the cell membranes of the strawberry and in the muscle tissue of the pollock. “These fatty components then give rise to identical flavors”, explains physicist Thomas Vilgis. “Since each food contains a certain proportion of fats, there will always be an overlap between some of the molecules.” Does this mean that anything goes?

According to Vilgis, there are definitely differences; they are, however, rooted in contrast, rather than harmony. “The strawberry adds something to the pairing that the fish lacks: fruity aromas and sugars”, explains the researcher. To him, complementation is the key to a cuisine that continues to amaze, as described in his book “Foodpairing: Harmonie und Kontrast“. On this note, he has something to add to the above mentioned summer salad: “It is entirely devoid of contrast. Three spoonfuls in you will know exactly what to expect from the fourth.” Thus, food pairing does not automatically equal interesting.

Nuance is key

Vilgis advises concentrating first on flavor – on the six qualities that our tongues will recognize: sweet, sour, salty, bitter, umami and fatty. If combinations are not balanced, no chemically organized pairing of aromas will salvage the dish. In addition, the amount, as well as the presentation and delivery, will decide whether a combination can be considered a success. One famous example is the squeeze of lemon with fish. A pool of lemon juice will skew the proportions.

Even though Blumenthal’s and Benzi’s concept may be controversial, it has been firmly established in the culinary world. Even the system-based restaurant chain Vapiano began advertising food pairing specials at the beginning of the year. Thomas Vilgis welcomes more openness in the kitchen. Right now, he himself experiments with Harzer cheese and fruit. Ever the brave palate! ■

AND TOMORROW?

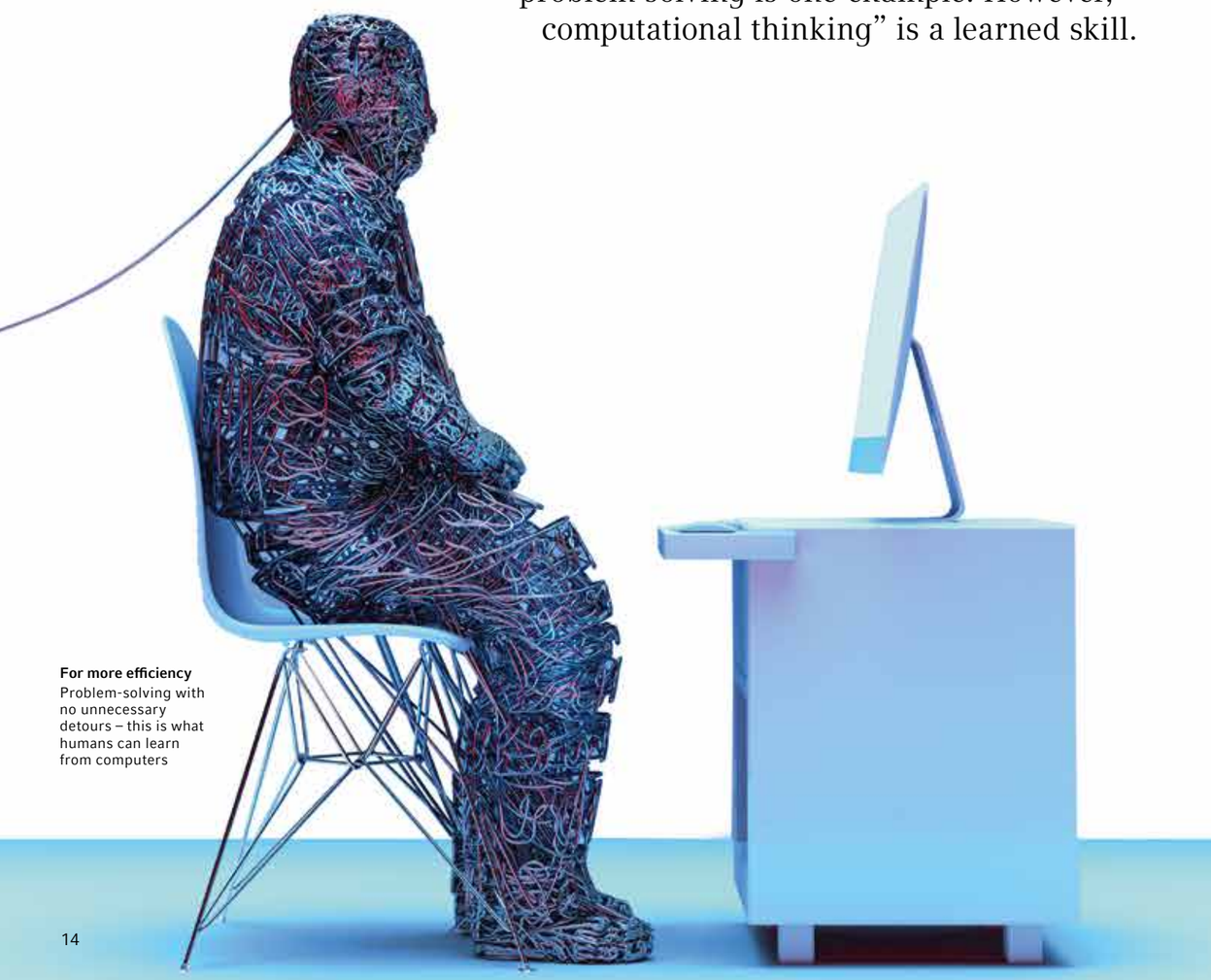
The taste of Big Data

Roughly 10,000 flavoring agents are known to occur in nature; an overwhelming place to start for possible pairings – and a springboard for the tech industry. Bright minds combine the principle of food pairing with the systematization of large amounts of data. The most important ingredient: artificial intelligence. The Belgian firm Foodpairing NV has created one of the largest food databases sorted by aroma. Their algorithm creates ingredient pairings, even complete recipes, for the gastronomy sector as well as for industry. In collaboration with the magazine Bon Appétit, IBM® and its artificial intelligence Watson have created an app. The supercomputer analyzed 9,000 recipes from the Bon Appétit inventory in order to detect patterns and recommend combinations. Will chefs be replaced by computers in the near future? “It depends on their eventual ability to learn”, says Thomas Vilgis. In the meantime, the best is still reserved for us humans: eating.

Delicious combinations
Dark chocolate, squid, pears and dried chamomile blossoms

Thinking in Algorithms

Computers can only do what we teach them – but what can we learn from them? Efficient problem solving is one example. However, “computational thinking” is a learned skill.



For more efficiency
Problem-solving with no unnecessary detours – this is what humans can learn from computers

If a child looks at a drawing of a fire truck just once, she will immediately recognize a real fire truck on the street. Moving from the drawing, through language, to the real object, and back to language, requires enormous transformational power. In order to match a performance of such magnitude, computers must be fed vast amounts of information.

Once equipped with that information, they are capable of accomplishing remarkable feats: for the very first time, a computer software program has been victorious more times than any one of the human players during poker games with more than one opponent. All in!

> *“Computational thinking does not mean that humans should think like computers.”*
>
> Jeanette Wing

In order to allow “Pluribus” to rise to this level of superiority, scientists at Carnegie Mellon University® in Pittsburgh, USA, fed it millions of poker moves. With the variant “No Limit Texas Hold’em”, the program eventually succeeded – a breakthrough that is considered a milestone in the development of artificial intelligence (AI). As such, “Pluribus” learned from humans, through algorithms, how to solve certain problems. Can it work both ways? Are humans, like computers, capable of learning a more efficient way of thinking and benefiting from it?

Step by step towards a solution

It is most likely the combination of computers and human intelligence that can contribute to the goal-oriented solution to problems. For this purpose, “computational thinking” – often described as “informatics thinking”, is the crucial tool. “It means that information is collected, sorted, ordered and compared, that patterns are generated, simplified and converted into algorithms”, explains Wolfgang Müller, Scientific Director and Head of the HITS group Scientific Databases and Visualization at the Heidelberg Institute for Theoretical Studies (HITS). It is an approach that computer scientists use to develop a problem and subsequently convert into a computer program which, step by step, leads to the solution. This way of thinking always follows the same pattern, and it can even be helpful in the resolution of everyday problems.

Finding one’s own algorithm

Müller uses the following example to clarify: at a party, bottles are arranged on a table in multiple rows. The front row, close to the table’s edge, is at risk of falling. What to do? The host has the option of moving every individual bottle back a bit. It would take less effort, however, to simply move all the bottles from the front row directly to the back. The other bottles could thus remain in place.

The effort per bottle – gripping it, moving it and setting it down – is the same for both options, whereas the second solution requires considerably less total effort. Expressed in mathematical terms: the host has developed an algorithm – an efficient way of solving a problem in multiple steps, using concrete instructions. For this reason, “algorithmic thinking” has been used as an alternative term to “computational thinking”.

It is, however, uncertain whether the host will immediately arrive at the solution of grouping the front row bottles and moving them to the back. Computational thinking must be learned – ideally in elementary school, suggests Jeanette Wing, Professor of Informatics at Columbia University in New York and an advocate of “computational thinking”. “It is a universally employable attitude and ability that everyone should learn and use, not only computer scientists”, she started early on in her article in the journal “Communications of the ACM”.

At the same time, Jeanette Wing disperses a commonly held misconception: “computational thinking” does not mean that humans should think like computers. In fact, she assesses their abilities critically. In her address on the occasion of the opening of the Heidelberg Institute for Theoretical Studies (HITS), Wing said: “Computers are expressionless and boring; humans are intelligent and innovative.” ■

INFOBOX

Computational thinking in five steps

1. **Decomposition:** a complex task is broken down into individual components.
2. **Pattern recognition:** the individual components are compared and searched for possible relationships and emerging patterns.
3. **Abstraction:** the detected patterns are examined for general validity.
4. **Generalization:** the task is completed in individual steps – algorithms.
5. **Evaluation:** the results are reviewed with respect to scope and time expenditure.

DOSSIER

Our Fascination with the Unknown

Curiosity helps children understand the world. Later in life, it is essential for successful learning. In the fields of science and economics, it drives innovation.

Albert Einstein explained the secret of his success thus: "I have no special talent. I am just passionately curious." The very trait that the Physics Nobel Laureate praised as "the wellspring of all technological achievements" had been proclaimed a sin for centuries prior. The Roman philosopher Augustine counted curiosity among the major vices; in the biblical story of Genesis, Eve's curiosity surrounding the forbidden fruit led to humans being banished from paradise.

A peek through the keyhole

No question – curiosity carries risks. How quickly one discovers the forbidden when peering through the keyhole in secret! Children don't mind – their curiosity is inherent. They are magically attracted to new places, people and things. "Babies learn more during their first three months of life than students do in four years", writes Alison Gopnik, Professor of Psychology at the University of California Berkeley in her renowned work "The Scientist in the Crib". The things that two year-old children are already capable of sensing, perceiving

and anticipating show the surprising precision that the marvel of biology, our brain, utilizes to conquer the world. Parents whose child has just asked for the hundredth time: "Why?" may take solace in the fact that only those who ask are going to learn.

Whereas childlike curiosity tapers off over time, many facts speak in favor of continuing to encourage the thirst for knowledge in adolescents. Curiosity, after all, endows a person with many advantages in our knowledge-based society. A meta-analysis by psychologists from the UK and Switzerland demonstrates that curiosity, as well as conscientiousness, are just as important for the success of students as intelligence. As such, even with a lower IQ, young people who described themselves as being curious achieved good marks that were comparable to those of their higher-ranked fellow students. "Teachers have a great opportunity to inspire curiosity in their students, to make them engaged and independent learners. That is very important", concludes curiosity researcher Sophie von Stumm of the University of York.

A sense of achievement

The neuropsychologist Michael Gruber, too, confirms that curiosity assists in the learning process. He presented his test subjects at the University of California® Davis with test questions. While they were searching for answers, a functional magnetic resonance tomograph recorded their brain activities. The result: the more intent and curious the participants were with respect to a certain answer, the better they remembered it later. "Satisfied curiosity provides the brain with a sense of achievement", concludes Gruber. At the end of the day, curiosity makes us smarter: in a state of curiosity, the test subjects' brains were also better at retaining information that was only casually obtained.

Recruiters pay special attention to curiosity

Even one's career is bound to benefit from a cosmopolitan outlook and a thirst for knowledge. After all, the curiosity of its team members determines a company's ability to innovate. Among the most valued characteristics that firms look for in their employees, curiosity ranks fifth – according to the employer-branding specialists Universum, based in Stockholm. For this reason, psychologist von Stumm advises recruiters to pay special attention to a candidate's curiosity.

They are not that easy to find. While every person is born with a certain degree of curiosity, this trait is not at all evenly distributed. How come? Twin studies provide some clues: evidently, genes are responsible for roughly 60 to 70 percent of a person's curiosity.

> *Inquiring, researching and discovering will become a part of the company culture."*
>
> Carl Naughton

Making room for new ideas

With all this in mind, the question remains: how is curiosity best awakened in a person? The American psychologist Daniel E. Berlyne defined four aspects that inspire fascination with the unknown: novelty, complexity, surprise and conflict. In his study entitled "Curiosity Management – Fuel for Innovation" Carl Naughton describes how curiosity may be encouraged in one's fellow humans. His tips: asking inspiring questions, making room for the development of ideas and allowing for the possibility of mistakes. "Inquiring, researching and discovering will become a part of the company culture", says Naughton.

Pandora's Box

In order to discover new things, humans regularly surpass their limitations. The temptation of the forbidden seems simply overpowering. It appears that the legend of the beautiful Pandora, who opened the mysterious box belonging to the father of the gods, Zeus, instead of keeping it securely closed and passing it down to the humans – thus unleashing unprecedented calamity upon the world – has been all but forgotten.

In their study entitled "The Pandora effect – The Power and Peril of Curiosity", the American scientists Christopher K. Hsee and Bowen Ruan demonstrated that humans are willing to research new things, even if they can expect negative consequences. To give an example, test subjects voluntarily subjected themselves to electric shocks in order to satisfy their curiosity. "This research reveals the potential perverse side of curiosity, and is particularly relevant to the current epoch, the epoch of information, and to the scientific community, a community with high curiosity", emphasize the authors.

Indeed, many scientific questions that stir curiosity and which promise groundbreaking, forward-thinking knowledge are highly controversial. The results are often unpredictable, and there is a likelihood that experiments may run out of control. Progress in the field of brain research, for example, evokes the hope for a cure for a number of hereditary diseases. With the help of the so-called gene scissors (CRISPR-Cas9), for example, perfect designer babies have become a distinct possibility. This constitutes a classic dilemma for science, as research almost always walks a tightrope between insatiable curiosity and the ethical boundaries of society.

Curiosity on Mars

Despite all disagreement and contradiction, curiosity is now considered to be the driving force behind human development. There is a reason that the suggestion, brought forth by a student, to name NASA®'s Mars Rover "Curiosity" was received with such overwhelming enthusiasm. In a PR-video for the Mars mission, American cosmologist Neil deGrasse Tyson says with justifiable pathos: "We didn't just send a robot to Mars. We sent the most essential, the most valuable, the most human piece of ourselves: We sent our curiosity!" ■

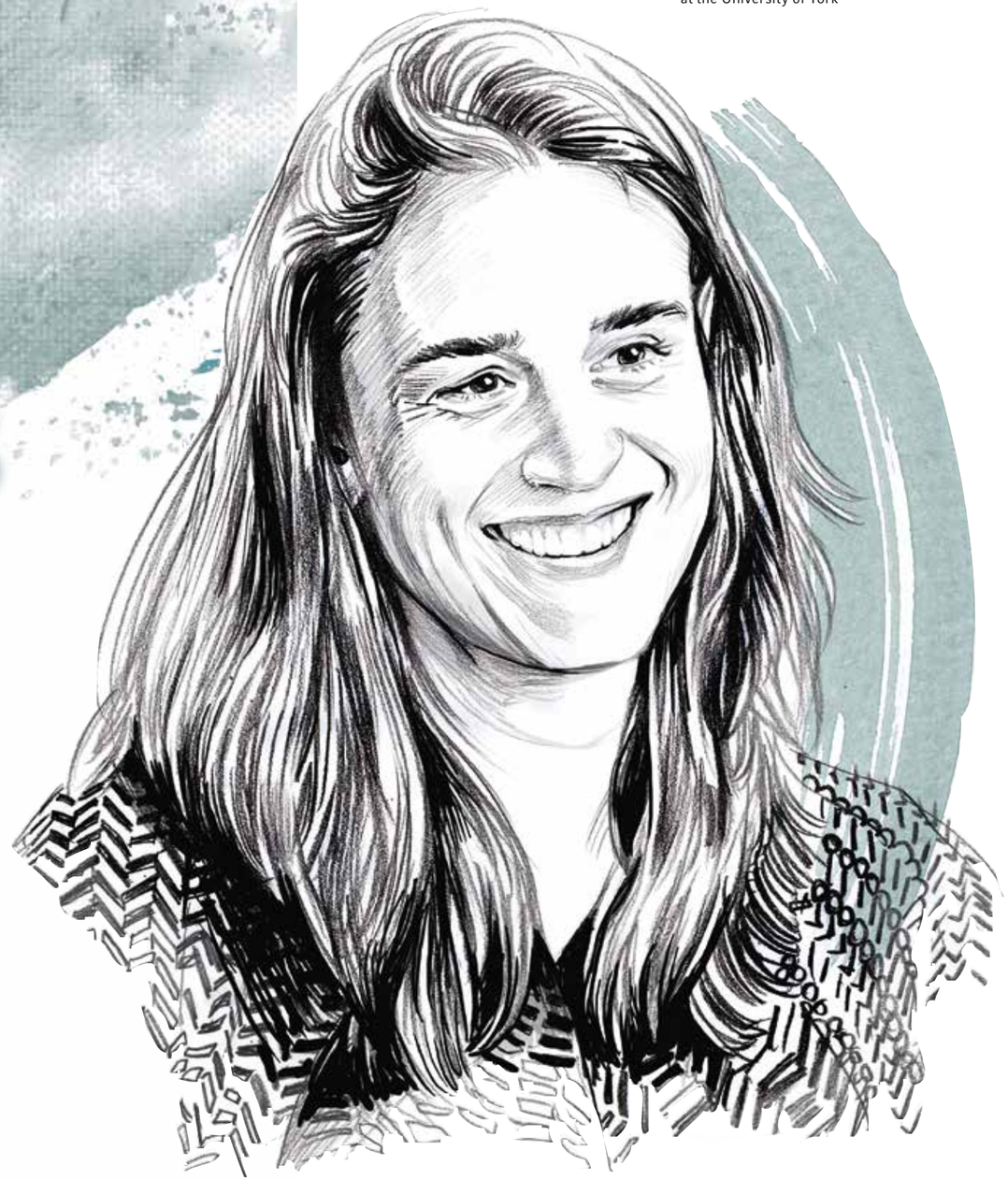
GOOD TO KNOW

Vice or virtue?

Curiosity killed the cat – such reads an old English proverb from the 16th century. And those who are not careful might just explode with curiosity. That being said, the thirst for knowledge was not always considered a vice. Plato considered "amazement" to be the beginning of all philosophy. According to his pupil, Aristotle, curiosity is innate. "All humans, by their very nature, strive for knowledge", he wrote. The world changer Galileo Galilei was convinced: "Curiosity lies at the root of all problems that have a desire to be solved." Today, curiosity is synonymous with the ability to innovate as well as creativity.

A Peek Behind the Scenes

They are enthralled by the unknown and by the as-of-yet impossible: for scientists, curiosity and creativity are the driving forces that allow them to think one step ahead and get to the bottom of unanswered questions. Three scientists share how curiosity inspires their everyday research.



Sophie von Stumm
Professor of Psychology in the Department of Education at the University of York

“Thirst for knowledge”

Curious about curiosity – this is how best to describe Psychology Professor Sophie von Stumm at the University of York. Her research concentrates on the question why, and in which way, people differ from one another. “I am particularly interested in differences in the ability to learn, which are crucial for success at school as well as for professional development”, says the psychologist. The ability to learn is strongly shaped by personality traits such as curiosity. “I have shown in my studies that curiosity is one of the most important indicators of success when it comes to learning”, says von Stumm.

Curiosity times three
The researcher differentiates between three types of curiosity: the hunger for knowledge (epistemic curiosity), as cultivated by scientists and bookworms; the hunger for experience, meaning a craving for adventure and the desire to experiment with the unknown; and the hunger for understanding other people (social curiosity). “As a psychologist, it is the epistemic and social curiosities that lure me into the office. Personally, the hunger for adventure drives me into the theater, into a Nepalese restaurant and even to the occasional surf course.”

According to von Stumm, curiosity plays a significant role in science: “Curiosity drives scientists to conduct research and to get to the bottom of questions.” At the same time, scientists must be tolerant of the unknown. “Oftentimes, our questions cannot be answered to our full satisfaction, or we must accept contradictory results”, says the psychologist.

The thirst for knowledge is a good thing
“Today, knowledge is valued more highly than in earlier times”, says von Stumm. Whereas 100 years ago, fewer than ten percent of students applied to university, almost every other student does so today. As a result, personality traits that are conducive to learning have also experienced a boost in significance. Von Stumm is convinced: “In today’s information age, you can’t be thirsty enough for knowledge.”

> *“One can learn anything – even the curiosity to learn.”*
>
> Sophie von Stumm

A researcher dives deep

Even as a child, the passionate diver and wind surfer Soeren Ahmerkamp wanted to know what lies beneath the surface of the ocean – and made his passion for the ocean his profession. At the Max Planck Institute® for Marine Microbiology in Bremen, Germany, he studies ripple marks – sandy elements on the ocean floor. "To me, scientific curiosity means observing nature closely and then seeking to understand the underlying processes", says the environmental scientist.

In Ahmerkamp's opinion, curiosity is the lifeblood of a scientist which helps him get through the occasional dry spell. "If you dedicate your life to science, you have to accept and live with a number of limitations: short-term contracts and constant uncertainty about the future", says Ahmerkamp. That being said, he never once doubted his career choice. "It is such a privilege to be able to follow one's curiosity by conducting scientific research."

Observing, questioning, researching

Early on, the water sportsman noticed the patterns on the ocean floor and on sand banks – ripples of a corrugated pattern that are formed by sediment transport. From the observations arose questions: how do these ripples come to be, and what is their significance? This is how the sandy elements became one of the main foci of Ahmerkamp's research. "Isn't it fascinating that more than 50,000 bacteria, which one way or another have adapted to very dynamic environmental conditions, live on a single grain of sand?"

The time that the research diver spends on and under the surface of the ocean continues to spark his scientific curiosity. As a basic scientist, it is important to him to be able to understand and explain connections. Ahmerkamp considers the support of basic science, independent of current "hot topics", to be of extraordinary importance. "It is the only way in which the problems of the Anthropocene can be solved in the long term."

"Scientific curiosity should be supported – at every level. This is the only way in which the problems of the Anthropocene can be solved in the long term."

Soeren Ahmerkamp

Soeren Ahmerkamp
Environmental scientist at the Max Planck Institute for Marine Microbiology in Bremen

Carsten Robens
Physicist at the Center for Ultracold Atoms at the Massachusetts Institute of Technology (MIT) in Cambridge/Massachusetts

"Actually, why not?"

"Will we be able to do this too?" This question motivates quantum researcher Carsten Robens of the Center for Ultracold Atoms at MIT in Cambridge, USA, at work on a daily basis. In the laboratory, the physicist researches ultracold atoms that he and his colleagues cool to the lowest temperatures known in the universe using laser beams. "Using such ultracold matter makes it possible to visualize and study in detail those quantum mechanical effects that would not ordinarily be accessible to us", explains Robens. The dipolar molecules are possible future candidates which may be considered for the hardware of a quantum computer.

Just like competitive sports

"Discovering and observing something that had hitherto been unknown to mankind is an unparalleled experience; particularly if a number of challenges had to be overcome that had until then been considered insurmountable", elaborates the physicist. Robens draws a comparison with competitive sports: one is always trying to incrementally best one's own performance.

How do high temperature supraconductors actually work? Can we build a machine that shows that quantum mechanics can compute faster than a computer that follows the rules of classic Newtonian physics? "In order to answer such questions, we have to bring together a vast number of tiny puzzle pieces – which often requires new technologies", explains the physicist. For Robens, curiosity and creativity are the driving forces behind the essential scientific question: "Actually – why not?"

Last but not least: a question of ethics

Are there boundaries? "Oftentimes, it turns out that game-changing discoveries are abused for the purpose of harming other people", cautions Robens. While scientists should not suppress their research out of fear of negative consequences, they should always keep the question in mind whether the research, in the end, will serve humanity. "This is why it is crucial that everyone has access to our science", demands the researcher.

"Discovering and observing something that had hitherto been unknown to mankind is an unparalleled experience; particularly if a number of challenges had to be overcome that had until then been considered insurmountable."

Carsten Robens

Failing with Grace

The Irish writer Samuel Beckett (1906 – 1989) wrote a declaration of love to failure: "Ever tried. Ever failed. No matter. Try again. Fail again. Fail better." This quote can be found in countless startups, on motivational postcards and on social media, and it makes a point: only detours, dead ands and failed attempts have led people all over the world to groundbreaking discoveries. Those who, in everyday life, allow themselves to be wrong from time to time are more courageous and more creative. Experiments are an experience – the only way to learn, and enjoy, new things.

Playing Journalist

Even though it may sound contrived at first, declare yourself to be the researcher of a new topic that is completely foreign to you. While the actual topic that you choose is not the deciding factor, it is important that you continually immerse yourself over a period of a few days. How best to prepare the pasta classic Carbonara, or who is really behind the faces on your coins and banknotes? Alternatively, you could read the section of the newspaper that you normally put aside. Cover to cover. What catches your eye? Are there any topics about which you would like to learn more? Which detail surprises you?

Changing the Habits

On your way home, take a different route. You will be surprised at all the novel sights to see during one small detour. When we move through our environment with an open mind, life is more interesting. Become an everyday explorer and focus on the details of your familiar environment – whether you are at the gym, on the subway or at the grocery store. Simply turn your head, look up from your phone, and take it all in.

Awake Your Curiosity!

Children know no censorship and no taboos. These four tips can help you activate your inborn urge to explore.

Asking Questions

There are no stupid questions. It is often surprising how different the answer to a seemingly simple question may turn out once you actually dare ask it. Partners or colleagues rarely feel imposed upon – most will welcome the interest.

INSIDE Eppendorf

Pure Eppendorf: on the following eight pages, we will focus on innovations, product news and other interesting laboratory topics – including a contest.

YOUR WISH IS OUR COMMAND

Closing a gap: new conical tubes by Eppendorf for volumes up to 25 milliliters

SIMPLIFYING LABORATORY WORK

Unlabeled samples are not an option. How to stay on top with simple measures

The Next Level

How Eppendorf once again meets the needs of the user in the laboratory by introducing a new tube format and thereby changes the world of the classic “Conical Tubes”.

Two lid options

Innovative SnapTec™ cap and screw cap with flattened and grooved sides

Many customers have asked us whether Eppendorf has a solution for storage, centrifugation and preparation of sample volumes between 15 and 25 milliliters. This volume range indeed presents a gap in the lineup of conical tubes. Classic conical tubes come in the 15 and 50 milliliter formats, and they are among the most commonly used plastic consumables in laboratories worldwide. Users must decide whether to continue processing a sample between 15 and 25 milliliters in volume using several 15 milliliter tubes or whether to choose a 50 milliliter tube, which is clearly too large for the volume at hand.

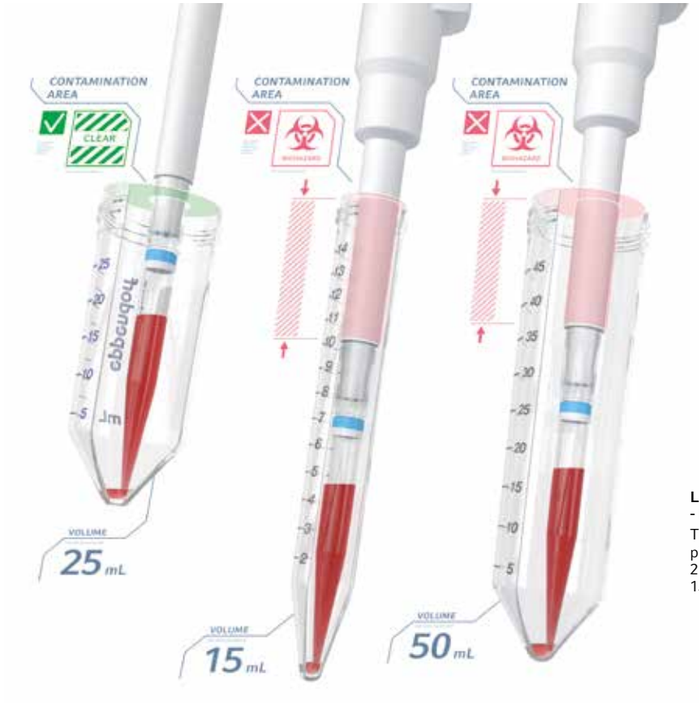
We have listened to our customers

We were happy to take on the challenge of developing a suitable tube format, and we were successful – not least due to our long-standing experience of almost 60 years in the development of laboratory vessels. The result: two variants of conical tubes for volumes of up to 25 milliliters.

Throughout this process, it was not only important to bring another tube of a different volume to market – we intended to optimize tube handling and, most of all, provide our customers with the option of integrating this new tube format seamlessly into the environment of existing laboratory instruments.

We care about the detail

Both new 25 milliliter tubes have the same diameter as a 50 milliliter conical tube, while being 20 percent shorter. One tube features the characteristic Eppendorf screw cap with flattened and grooved sides which prevent the lid from rolling off the laboratory bench. The second variant represents a true innovation that offers the clear advantage of single-handed secure opening and closing. This SnapTec™ cap, newly developed and patented by Eppendorf, offers



Lower height - improved safety - better sample availability

The insertion depth of the pipette into the tube is about 20 % shorter compared to 15 mL or 50 mL conical tubes

a wide range of options, just like the screw cap lid, a reliable seal at temperatures ranging between -86 and 100 degrees Celsius. Both variants of the Eppendorf Conical Tubes 25 mL can be safely centrifuged at up to 17,000 *g** and – another true innovation – the Conical Tube 25 mL by Eppendorf with SnapTec™ cap can even be autoclaved for 20 minutes at 121 degrees Celsius.

The wide opening of the considerably shorter tube permits working with small-volume pipetting systems. The sample at the bottom of the tube is always within reach, without running the risk of the pipette cone touching the inner wall of the tube – a frequent source of contamination.

Single-handed operation for swift and efficient work

The SnapTec™ cap of the Eppendorf Conical Tube 25 mL can be opened and closed with one hand, similar to the well-known Eppendorf Safe-Lock Tubes. In this way, protocols which require frequent opening and closing of the tube can be processed more efficiently. Since the lid is connected to the tube – which means that it does not have to be put down, as is the case for screw cap lids – the contamination risk is also largely avoided.

Like all Eppendorf Tubes®, tips and plates, the new Eppendorf Conical Tubes 25 mL are manufactured from pure polypropylene (PP) of the highest quality; no biocides, plasticizers or latex, nor lubricants, are used during the manufacturing process. Both variants are available in the purity grades Eppendorf Quality, PCR clean and Sterile/pyrogen-free*/ DNase-/RNase-/human and bacterial DNA-free*. ■

** The suffix/wording "-free" in the context of purity grades means that the test showed conformity within the detection limits.*

MANY EXTRAS

Ample accessories

Along with the new Conical Tubes 25 mL come a few extras: to compensate for the height difference, the 50 milliliter centrifuge rotor can be easily equipped with adapters that accommodate the 25 milliliter SnapTec™ cap tube, or the 25 milliliter screw cap tube, respectively, and which are easily inserted into the trough of the rotor. Adapters are also available for the 50 milliliter Eppendorf SmartBlock™, Eppendorf ThermoMixer® C and the Eppendorf ThermoStat™ C. The MixMate® Tube Holder is suitable for both tube variants. For weighing a single 25 milliliter tube, a single tube stand is available, and space-saving boxes made from polypropylene allow storage of more samples within the same storage volume.

Safe and reliable identification
Barcodes on sample vessels supported by printed plain information

Knowing What's Inside

Whether they are hand-labeled, equipped with a barcode or labeled using a datamatrix-code: laboratory samples must carry an ID.

MASTHEAD

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Over many years you have collected hundreds, or even thousands of samples – samples that are the result of years of hard work, samples of high value. Sample storage at –80 °C should be safe and reliable, but also allow samples to be easily identified by the label. "Stored samples must be labeled" – in principle, every lab member confirms this. In reality, you always find some (or even more) vessels in your ULT freezer without any labeling or with labeling based on hieroglyphs. No one can read what is in the vessel, when it was created and to whom it originally belonged. In many labs, there is a second rule: non-readable vessels are discarded as soon as they are found.

No fun to identify
Handwritten, partly wiped away vessels

How to improve?

If you prefer handwriting, a simple piece of transparent tape improves the stability and, ultimately, the readability of the writing. Based on the ergonomic aspects of easy reading, the contrast between letters and label background should be maximized.

Printed letters are easier to read compared to handwritten letters, independent of the author. Special adhesive labels based on water-resistant paper and water-resistant printing are the next step. Labels should be attached to the side of the tube; the lid surface is challenging due to the small area.

When combining both aspects, a white label with black printed letters on a vessel is recommended to make reading and sample identification as easy as possible for everyone.

Multiple barcodes in use

The best choice for safe sample identification is to use barcodes. A barcode is an optical representation of data, which is machine-readable. This means it is readable by a scanner – for example a handheld barcode-scanner such as the one we encounter in the supermarket. The label may be limited to the pure barcode or barcode plus plain writing for human readability. The barcode can be printed on adhesive labels or directly printed/lasered on vessels.

Today, many different barcodes are in use:

- A classic "1D barcode" codes data by varying the width of the parallel lines as well as their spacing. 1D barcodes are based on different types (i.e. languages), e.g. type 128.
- Two-dimensional codes (2D) are based on specific geometric patterns. The codes can handle far more information on the same area compared to 1D barcodes. These 2D codes have different languages as well.
- QR codes are commonly known from printed internet addresses which can be scanned by mobile devices to open the related webpage. QR codes are easily recognized by their three square spots in the corners. Some people also use them to code samples in the lab.
- 2D datamatrix codes are based on a finder pattern that consists of two constant (mainly black) lines at the left and at the bottom and an empty quiet zone surrounding this finder pattern. This area should be free of any black-white contrast.

A simple lesson: proper labeling of sample vessels, combined with organized sample management software for reliable sample management, is crucial for safe results. ■

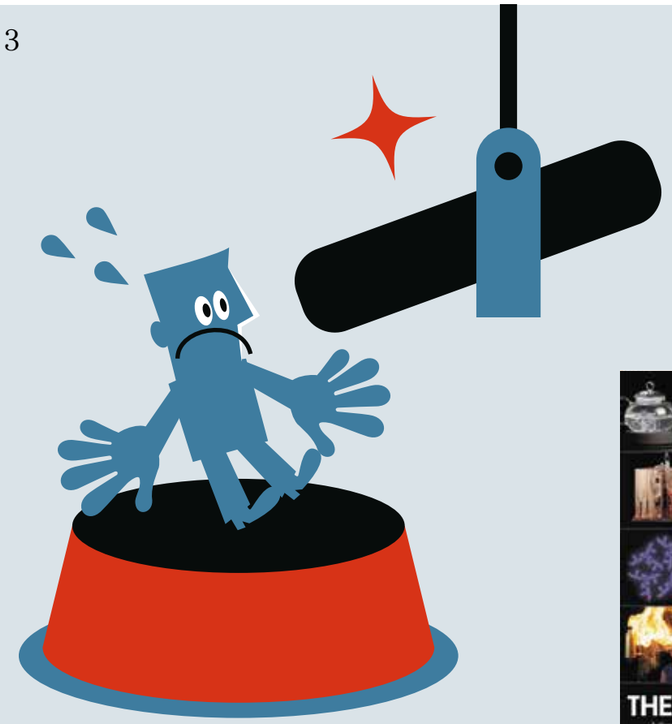
DID YOU KNOW?

Sharing information and knowledge

Countless working hours of engineers, chemists, molecular biologists, biotechnology experts, and other colleagues flow into the development of Eppendorf products – thus creating a large pool of invaluable knowledge and experience in the fields of Liquid Handling, Cell Handling, and Sample Handling. We are happy to share this expertise at www.eppendorf.com/handling-solutions. One of the latest additions includes contributions about sample storage at –80 °C.

Lab Lifestyle

3



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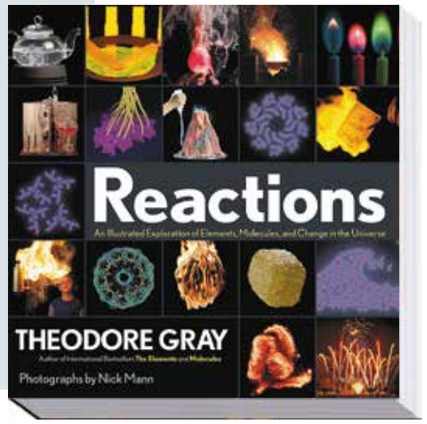


2

1 Pictures That Speak

The glossy images created by photographer Nick Mann in the third volume of "Reactions" offer insight into the deep chemistry of structural forms and atomic models, which author Theodore Gray explains in a comprehsenible fashion.
"Reactions", 244 pages, approx. 20 euros, Black Dog & Leventhal

2 Favorite Science Slam

The "Übel & Gefährlich", a popular club in Hamburg –mostly known for its concerts and parties – is also a regular "Science Slam" venue. The idea is inspired by the popular "Poetry Slams": Each "science slammer" has ten minutes to explain his or her current research topic as illustratively and entertainingly as possible. Afterwards, the audience debates and decides, and finally selects the winner for the evening.

Science slams are very popular around the world. Which one do you like the most? Share your thoughts with other science slam enthusiasts from all over the world on Eppendorf's Facebook® page!

www.facebook.com/eppendorf

!

Win a Snuggle-Cell!

Brain cells and red blood cells: they're microscopic and full of secrets. For those who don't wish to explore them, but want to cuddle with them right away, you can win one of these fluffy specimens. To do so, just visit the Eppendorf website **https://bit.ly/2Yfrpow** and answer the following question:

What is so special about the filter caps of the Eppendorf Cell Culture Flasks with regard to protection against mycoplasma?

Send us an e-mail to magazine@eppendorf.com or register as a subscriber and leave us a message with the correct answer. Please find the terms and conditions on our website.

www.eppendorf.com/otb

3 Science, Panic, Slam

My heart is hammering in my chest, my mouth feels dry. My brain keeps repeating Eminem lyrics: "His palms are sweaty, knees weak, arms are heavy, There's vomit on his sweater already, mom's spaghetti." Well good thing there was no spaghetti on my menu today. Those lyrics have never been more relatable to me. I try to breathe slowly as panic rises in me and I wonder if anyone would notice if I just ran out. I get mad at myself for signing up to this. Why in the world did I decide I want to get up on a stage in a club to talk about my research?

"Next up: Dr. Ann-Charlott from the University of Cologne". I guess people would notice if I ran now, so instead I get up, I walk towards the steps that lead up to the small stage.

I smile nervously, I grab the microphone and look out into the spotlight. I cannot see the faces hidden in the dark, but I know they are expecting me to be funny, to entertain them and to teach them something about my research. I open my mouth "So my research is about the cornea, more specifically why blood vessels are terrible for the cornea", I say way too fast into the microphone. But my breathing calms as I continue speaking. I make my first joke, people grin and laugh, I start to relax. Half of my talk is already done, I feel more comfortable on stage now and almost forget that there are hundreds of people looking at me who have paid money for this.

"… and now you know why blood vessels are bad for the cornea and next time you are on a train maybe think of me!" I finish my science slam. Applause – I smile awkwardly, give a half-bow and quickly flee the stage. I sit back down next to the other science slammers. Still with shaking hands, I smile, this time relieved. "Why was I so nervous? This is an excuse to talk about my research, what can be better than this?" And already I am planning to sign up for a science slam again. And then I will be right back where I started.

Ann-Charlott Salabarria, recent PhD graduate from Cologne University (Germany), now immunology postdoctoral scientist in San Diego (USA), lover of books and the beach, passionate about science and talking about science and Faith.

https://bit.ly/2GIcFnA

News in Brief

What are the talking points at Eppendorf? Innovation news from the company for the lab world – at a glance.

Increase and Expand

New rotor FA-6x250 extends application range of large benchtop Centrifuges 5910 R and 5920 R. This includes harvesting of bacteria, algae and yeast, as well as mammalian cells in vessels up to 250 mL. Its qualities:

- High speed: 15,054 × g (10,100 rpm)
- Simple and fast handling: Eppendorf QuickLock® lid
- Stress-free work: low weight of only 5,450 kg

A broad selection of 12 different adapters minimizes the need for cumbersome rotor exchanges during the workflow. This simplifies handling and saves time.
www.eppendorf.com/next-benchmark

You and Your Lab

Nothing has moving forward with fastpace so much then digitalization. We experience digitalization in everyday life and are impressed by its benefits. The convenience and efficiency of interoperability is also within reach for our customers.

VisioNize® is moving now into your laboratory. Using our smart digital companion VisioNize, you can confidently guide your lab toward a smarter future.

It offers you the possibility to remotely monitor your freezer and gives you the opportunity to set customizable notifications to meet your and your lab's needs. Leverage the built-in capabilities of your Eppendorf lab instruments by subscribing for our VisioNize services for free.
www.eppendorf.com/visionize

Sustainable Work

epT.I.P.S.® pipette tips are known for their outstanding quality. To be able to guarantee this quality at all times, in particular for applications that require sterile work, Eppendorf has comprehensively renewed their process for producing single-use racks for use with sterile pipette tips and filter tips. The result is a modern rack design that, depending on its size, reduces the amount of high-purity polypropylene required by up to 40 percent and also significantly improves handling.

Tireless

Vienna-based molecular biologist Georg Winter intends to eliminate cancer-causing proteins on the spot. To this end, he pursues a novel approach to "waste disposal" in the human body. ▸

A discovery in the lab is like landing on the Moon."

Georg Winter

In our bodies, waste disposal occurs strictly according to plan: the garbage is collected on a regular basis; it is sorted, recycled or incinerated. What happens, though, if waste collection goes on strike? The entire process will grind to a halt: mountains of waste will pile up outside our door; they will attract rats and mice – reminiscent of those conditions that in the late Middle Ages led to outbreaks of the plague.

Just like a metropolis, every single cell in the human body possesses a perfectly orchestrated system for waste removal. It transports defective proteins that come off the conveyor belts of the cellular protein factories to the cell's proteasome, where they are shredded.

This process is of crucial importance to the organism, as these faulty proteins contribute to the development of cancer. However: each system has its weaknesses, and some of the disease-relevant proteins will slip through the cracks of the self-cleaning program because they are not discovered and they are therefore not identified as harmful. This is where Dr. Georg Winter enters the stage of the cellular waste management operation and engages in systematic clean-up.

Action on the spot

How? By blazing new trails as a researcher. "The basic problem is that by using conventional therapeutics, we are able to block only about twenty percent of all disease-relevant proteins", explains the molecular biologist who, for the past two and a half years, has been spearheading a research team of six at the Research Center for Molecular Medicine (CeMM) of the Austrian Academy of Sciences (ÖAW) in Vienna. According to Winter, the problem is rooted in the way that we look at medication: "Medication is defined as a chemical substance that binds to a biochemical activity within a protein by docking directly into a 'pocket'". Many disease-relevant proteins, however, do not possess such a pocket. The Austrian therefore pursues a different strategy. He wants to not only block the faulty proteins, but he wants to make short work of them right then and there. To this end, he is attempting to reprogram the body's own protein degradation machinery using novel agents.

The main actors on Winter's disposal team are enzymes called ubiquitin ligases. "We have developed molecules which ensure that disease-causing proteins dock directly onto those ligases. In this way, they are labeled and eliminated within minutes." Bingo! Georg Winter has achieved his goal – this discovery has afforded him his own personal moon landing. "This is the exact feeling I have when I discover something that nobody else in the world has been able to explain!" He laughs, and he adds: "This is incredibly motivating."

The tireless scientist

Georg Winter is a doer, an energy person, a solution-nerd. When the unknown calls, he does not hesitate. "I like being hands-on – just trying things out and not spending too much time fretting in advance why it may not work", says the 33-year-old who does not lose sleep if an experiment fails. "I'll just try again – and again – until it works."

Research electrifies the microbiologist, and he knows exactly how it works: "You need dialogue, not isolation." The team player has his best ideas during discussions with his students and colleagues. "I love collaborating, brainstorming and developing new concepts together with others." To Winter, thinking outside the box is not a voluntary exercise; it is a duty: "Research needs lateral thinkers and boundary pushers."

Following his bachelor studies of molecular biotechnology at the FH Campus Vienna, he earned his doctorate from the CeMM Research Center for Molecular Medicine of the Austrian Academy of Sciences. His subsequent move to the renowned Harvard University® happened by "planned coincidence", as Winter describes it. By chance, he met his future mentor, head of a laboratory at the Dana Farber Cancer Institute at Harvard Medical School, at a conference in Boston. And – equally by chance – Georg Winter started his three-year postdoc in Boston not long after. He was at the right place at exactly the right time.

Scientist at work

Upper left picture: Dr. Winter is transferring one of the chemical degrader substances

Upper right picture: Cancer cells that were engineered to test novel degraders at high-throughput

Lower picture: The scientist assesses the anti-cancer activity of novel drug substances by microscopy

With his research group, situated at the intersection between gene regulation, cancer development and chemical biology, he developed a new type of therapeutic agent that breaks down cancer-relevant proteins. For his pioneering work which, back in Austria at the CeMM, he is in the process of adapting to general application, Georg Winter has already been recognized and awarded a number of prizes – most recently the Eppendorf Award for Young European Investigators 2019.

The starting signal

The basis of the active therapeutic agent is a substance that was at the root of the largest scandal in the history of medicine: thalidomide. The tranquilizer was prescribed to pregnant women between 1957 and 1961 to treat morning sickness – with tragic consequences: the babies were born with severe malformations. A dangerous drug as a new hope for modern cancer research? "Thalidomide is one of the saddest chapters in pharmaceutical research" regrets Georg Winter. "However, in the 1990s it was discovered that thalidomide derivatives were capable of eliminating cancer cells." The mechanism of action was not discovered until 20 years later: inside the cell, the substances bind to ubiquitin ligase which regulates protein degradation. "That was the starting signal for our research!"

Georg Winter has a vision: to develop a drug that "makes a difference in patients' lives" – that paves the way to good health. For the scientist, this would be his own personal jackpot. And those who know Georg Winter, his competence, his team spirit, his ambition, his curiosity and his patience, will have no doubt that he will win. ■

THERE'S MORE:

„nature" – podcast with Georg Winter!

https://go.nature.com/2lGpln5

Visit the website

https://cemm.at/research/groups/

Bacteria Paint Pictures

For the past 20 years, Erich Schopf has collected single-celled organisms that are invisible to the naked eye. The inventor of "Bacteriography" ensures their transformation into visible art.

Microbes play an important role in our bodies – and Erich Schopf has discovered their hidden talent. Bacteria and fungi are their most common representatives – and they can paint. It may sound distasteful to some, but it is fascinating to the painter without paint. The Vienna-based chemist takes advantage of the fact that bacteria use pigment to protect themselves from UV radiation, and he utilizes the phenomenon to create art. "I am merely set designer and director – the bacteria are my actors", says Erich Schopf. "My ensemble includes 80 bacterial strains that I apply to a special nutrient surface using a brush."

From microbe to masterpiece

For the past 20 years, the 65-year-old has been collecting bacteria from all over the world. His casting occurs in petri dishes with growth medium that he always carries with him. Whether through an open car window or in the grout of a 5-Star hotel bathroom: Schopf has found single-celled organisms in the air, while swimming in various bodies of water, and while digging in the earth. In Iceland, he discovered an orange-colored bacterium. "I call it Snorri-orange for its place of origin and in honor of Icelandic poet Snorri Sturluson", says Schopf. He explains: "Everywhere I go, I like to visit churches. Holy water is particularly exciting because bacteria like to colonize it – just like subway hand-holds and children's car seats."

Biologist and artist
Erich Schopf has been collecting bacteria for more than 20 years whenever the opportunity arises – and uses them to create pictures with unique color compositions

It is, however, a far cry from captured bacterium to completed picture. It has taken the chemist eight years, while working full-time at the Institute for Meat Hygiene at the Veterinary Hospital in Vienna, to develop his technique of "Bacteriography". "9,000 samples are discarded every year because many bacteria are not suitable", says Schopf.

Bacteria synthesize pigments like carotenoids only under certain environmental conditions. Schopf explains: "The bacteria have to make an effort." However, in addition to the culture medium, the scientist, who also considers himself an artist, must tightly control the temperature and the climate of the room. His testing method for color: 100 degrees Celsius in the oven, for two weeks. Every bacterial pigment that withstood the heat has entered his collection, which is stored at minus 80 degrees Celsius.

Schopf then conducts scientific hierarchy studies. He learns which bacteria get along and which are capable of producing certain effects. Equipped with this knowledge, he plans each art piece. One bacterium may cover an entire legal sized page in 24 hours or only move a centimeter – it depends on the growth medium. And on what other bacteria join in at what time.

Some microorganisms produce an antibiotic that suppresses the growth of other microbes. If used in a targeted fashion, white areas will arise inside the painting. "My bacteria engage in power struggles, and certain primadonna members of the cast will not assume the desired color", says Schopf.

Painting with invisible paint

Painting with microbes is particularly difficult because bacterial suspensions are colorless: Schopf's paints are invisible. He follows the blueprint he copied onto the nutrient medium. Prior to that, his studio is sterilized by exposure to UV radiation. Plus, the artist himself needs to be as germ-free as possible. Painting while wearing a hazmat suit? "No, I shower, and I paint wearing swim trunks", explains Schopf. After all, additional germs could destroy his art.

Next, the painting needs to rest. For two to four days, it is kept in an incubator at 24 degrees. The bacteria propagate slowly on their nutrient surface while producing pigment. The painting grows. Finally, to kill the bacteria, Schopf transfers the painting to an oven at 100 degrees Celsius. It takes about ten hours to fix the painting in this way. The enzymes are destroyed, rendering the painting stable. By the way: his art is for sale, and it contains only harmless bacteria. Dangerous pathogens, such as those that cause typhoid fever or cholera, are of no interest to the chemist. Schopf: "Most pathogens are colorless." ■

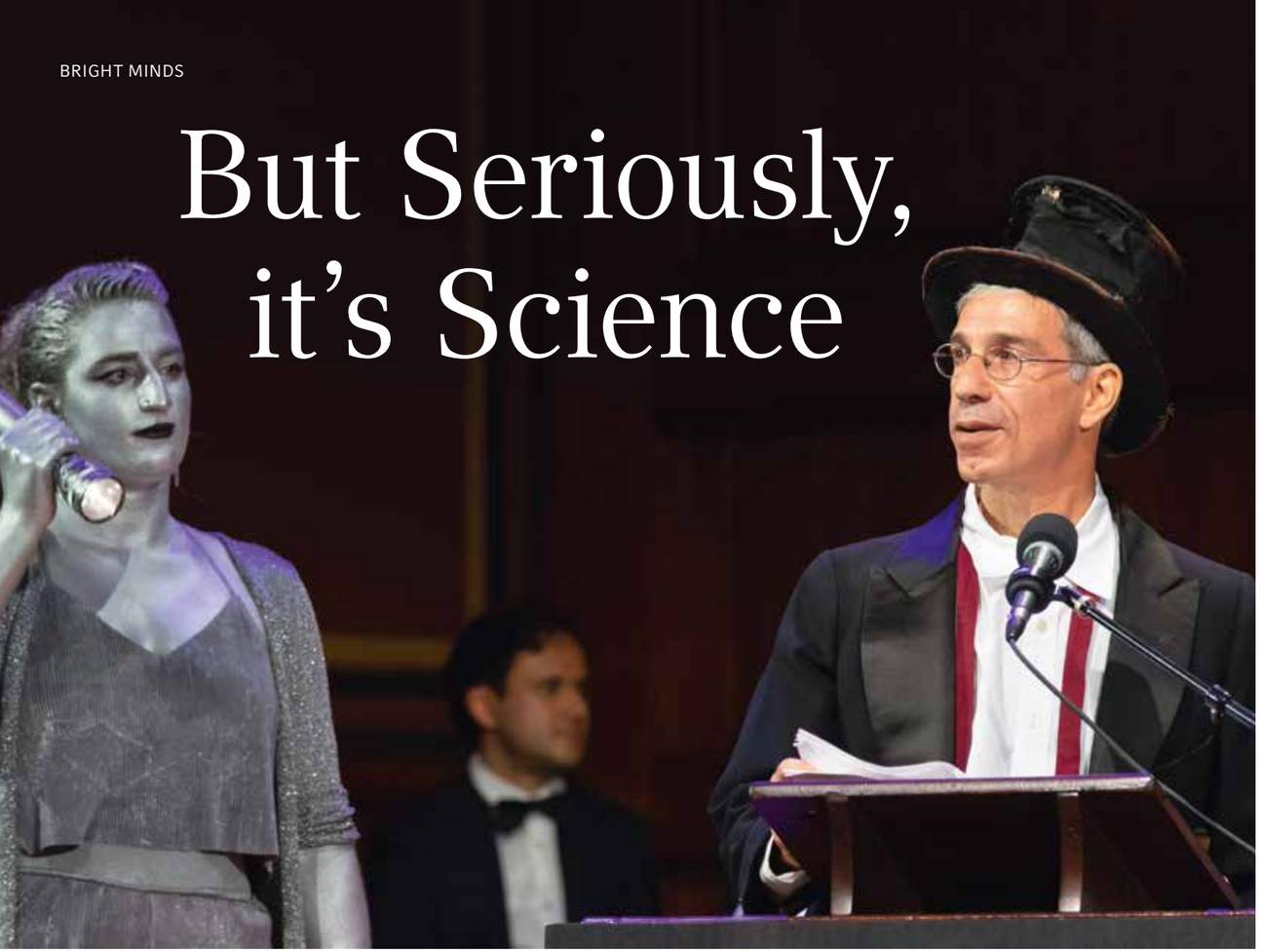
"The bacterium from which this stunning starfish grew after three weeks at 24 degrees Celsius had led an insignificant existence until I caught it in the Herfatz tunnel in the Allgäu", says Schopf

"The portrait of the famous bacteriologist Louis Pasteur took me 17 hours to complete because the blueprint was so complicated", remembers Schopf

"In order to paint Falco, I had been conducting prior studies with purple bacteria. I sold this piece to a huge Falco fan", says Schopf

"The first bacteriographic images are color compositions. Over the course of the studies, the hierarchical structure of the bacteria became evident.", explains Schopf

But Seriously, it's Science



Scientific curiosity
The inventor of the Ig Nobel prize: Marc Abrahams

For off-the-wall science that at first strikes you as funny, Marc Abrahams has invented the Ig Nobel Prize, the Anti-Nobel prize. At Harvard University®, Abrahams celebrates the winners in a flamboyant ceremony. Why?

Mr. Abrahams, those who discover how to quickly turn a bra into a face mask or how long a cow will, on average, remain recumbent after initially lying down, will receive your award. How did you come up with the idea of the Ig Nobel Prize?

Marc Abrahams: Ever since I was a child, I have been fascinated by everything that was funny, bizarre or unexpected. Crazy news from around the world was my favorite newspaper column – I used to collect the articles. For example: "Man flushes toilet – house explodes!" For a ten-year-old, it can't get any more fascinating. Later, as a science editor, I noticed most scientists who conduct funny research will never be heard from. What a shame. So we founded the satirical magazine "Annals of Improbable Research" and invented the Ig Nobel Prize in order to honor those very researchers. Right away, in 1991, it was a success – four Nobel Laureates came and presented the prizes.

Ig stands for "ignoble". Every year in September, shortly before the Nobel Prize winners are announced in Stockholm, you honor the winners of the Anti-Nobel Prize in a flamboyant ceremony which takes place at the elite Harvard University. This year marks the 29th ceremony. What are some of the things that have changed over the years?

Abrahams: In the beginning, we did not actually invite the winners; we did not expect them to want to attend. You should know that we do not cover the cost of travel and that there is no monetary prize. Nevertheless, the prize has quickly gained in popularity. Many of the scientists are not aware that their subject of study is funny until we celebrate them. Currently, we receive roughly 10,000 nominations a year. Ten to twenty percent of those nominations come from researchers who nominate themselves.

> *"The thing that fascinates me the most about many of the research questions is their applicability to everyday life."*
>
> Marc Abrahams

Are there any honorees that you distinctly remember?

Abrahams: Oh yes, quite a few, actually. I was especially fascinated by the Blonskys who intended to help pregnant women by constructing a birthing table. The woman about to give birth is fixed to the table; the table rotates, and the resulting centrifugal forces are expected to assist in the birth. It is believed that the couple had been inspired by a lady elephant at the zoo that turned and turned in order to expedite the birthing process.

Or those researchers who were awarded the Ig Nobel Prize for Biology because they discovered that dogs like to align themselves with the Earth's magnetic field when conducting their business. The preferred orientation, by the way, is north-south.

Do you select your award winners by taking into consideration whether you have asked yourself the same scientific question in your daily life?

Abrahams: We had a dog for the longest time, but unfortunately he passed away. The thing that fascinates me the most about many of the research questions is their applicability to everyday life. But that is not necessarily a prerequisite for being awarded the Ig Nobel Prize. The science may be funny, even crazy, but it must always inspire one to think.

Are there researchers who decline the prize?

Abrahams: Yes, but not many, and of course we accept that. Some are afraid to damage their reputation, especially at the start of their careers. Our only exception has been the case of the VW software developers whom we wanted to recognize for their solution to the exhaust problem. We did award the prize, even though the company was obviously not very keen to accept it.

What do you tell critics who feel that you ridicule science?

Abrahams: I do not ridicule – I report facts and research that really exist. During presentations about the Ig Nobel Prize I continually have to assure the audience that I do not tell jokes, but that in fact the science itself is humorous. This is why I show pictures that prove that the science is real. Everyone is then free to decide for themselves whether it is crazy or funny, or whether it is wonderful and important.

One person who received the Ig Nobel Prize from you was later awarded the real Nobel Prize.

Abrahams: Yes, in 2000, we honored the physicist Andre Geim. Together with his colleague Michael Berry and the use of magnets, he succeeded in making a live frog hover. Ten years later, Geim was awarded the Nobel Prize for Physics for his studies of graphene.

What would you like to see at the 30th birthday of the Ig Nobel Prize next year?

Abrahams: I would like to see more and more people become curious – about science and about other people, and that we may contribute to this development through our prize. I wish to see young people dare make their own decisions, irrespective of whether important people tell them that something is good or bad. I have spoken with many great scientists who have confided in me that in the beginning, nobody believed in their idea. Just because something sounds silly or funny, it does not mean that it is useless – quite the opposite. The best example: in 2015, we bestowed the Ig Nobel Prize on Australian researchers who had discovered how to return a hard-boiled egg to its soft state. At the current time, they are conducting research on how to use this knowledge to manufacture expensive pharmaceutical products in a much more cost-effective manner. ■

Marc Abrahams The 63-year-old is himself a Harvard alumnus from the field of applied mathematics. Abrahams, however, did not embark on a scientific career; instead, he decided to write about it. He founded the satirical journal "Annals of Improbable Research" and, in 1991, he invented the Ig Nobel Prize to recognize quirky and bizarre research. In April, Abrahams presented his Ig Nobel Prize show in Germany for the first time. Together with Mark Benecke, Germany's famous criminal biologist, he first made the audience laugh – then think.

Start-up With Courage

A scientist with entrepreneurial spirit
Marius Rosenberg's start-up success

All over the world, doctoral students are working on innovative technologies. Perfect conditions for setting up companies.

A biodegradable adhesive that has the potential to stop life-threatening bleeding during surgery? When his supervisor told Marius Rosenberg about this invention by two chemists from the university environment, the former paramedic was immediately fascinated. "An ingenious idea. It was clear to us that we wanted to make something out of it", recalls Marius Rosenberg, who at the time was coaching young start-up entrepreneurs at the RWTH Aachen Start-Up Center and also working on a B2B trading platform for materials. "So the two scientists, my supervisor and I, wrote a business plan, set up a company with the help of private investors and further developed the adhesive."

In Germany and England, there are about 25,000 doctoral students per year, in America there are about twice as many. The doctoral students write about topics with a huge amount of creative potential that promise future-oriented products and innovative business models. However, especially in Europe, scientific findings rarely leave the ivory tower of the university. "Unfortunately", says Jürgen Mlyenk, former President of the Humboldt University and President of the Helmholtz Association of German Research Centers. "This means that valuable resources are lost."

Awakening the entrepreneurial spirit

To awaken an entrepreneurial spirit among doctoral students, many universities in Germany, Sweden, France and England are setting up start-up centers that support students on their way to self-employment. The KTH Royal Institute of Technology in Stockholm now even offers a master's program in Entrepreneurship and Innovation Management. In Estonia, the Estonian Entrepreneurship University of Applied Sciences is participating in an inter-university training program for entrepreneurship initiative.

In Berlin, Jürgen MIynek has launched "Young Entrepreneurs in Science", a workshop format for students of all disciplines. "What if I had to make a living from my dissertation? How much start-up is there in my doctorate? These are the questions that academics will have to deal with for four days, accompanied by coaching by successful founders", reports the physicist. "The students include lawyers, agricultural scientists, computer scientists, business economists and doctors. The project started in 2017 and is now active at over 30 locations. I am eagerly awaiting to see the first new company that will emerge from our workshops."

What Jürgen Mlynek has in mind with his platform for science start-ups is nothing less than to initiate a cultural change in Germany towards more decision-making and a greater interest for entrepreneurship among young scientists.

Silicon Valley as a model

Looking to the US can be an incentive for this. California's Silicon Valley in the southern part of the San Francisco Bay Area is considered a Mecca for the start-up scene. There is a lively exchange with the US elite universities Stanford and Berkley. Marius Rosenberg, who expanded into the states with his company, after winning half a million dollars at the world's largest business plan competition in Texas, is there regularly. "When you stroll across the Stanford campus and listen to the students, you notice that every freshman wants to start a business. This means that science start-ups as a topic are present there from the very beginning. The infrastructure at the universities covering patent utilization, legal departments and financial consulting is accordingly structured under one roof. That's where we need to be in Europe in the long term."

Marius Rosenberg is convinced that it is always a good idea to set up a company during one's doctorate. "The doctorate provides uncomplicated access to technology and research and a network of scientists. In addition, most students don't have to look after a family or pay a mortgage during their doctoral thesis. Perfect conditions for taking the plunge into the cold waters of a start-up." ■

BACKGROUNDS

Young Entrepreneurs in Science is an initiative by the non-profit Falling Walls Foundation which is supported by the Federal Ministry of Education and Research as well as private organizations. With its programs and formats, the Falling Walls Foundation builds bridges between science and society. Drawing inspiration from the fall of the Berlin Wall in 1989, the events and formats are dedicated to current scientific breakthroughs and show which walls in science, politics and society will fall next. At Falling Walls Venture, start-up entrepreneurs from all over the world present their scientific ideas that have the potential to change the world. Marius Rosenberg won Falling Walls Venture with his company Adhesys Medical in 2015.

www.falling-walls.com/venture

young-entrepreneurs-in-science.de

Noah's Ark for Plants

The threat of environmental disasters and wars surrounds us, and crop plants disappear. Seed banks promise a solution – a backup for eternity?

The salvation of humanity resembles an ancient wartime bunker. On its roof, glass ornaments glisten in the night. Carved deep into the snow-covered Platåberget, the entrance to the concrete monstrosity emerges from the permafrost of the Norwegian Arctic island of Spitsbergen, with the icy polar sea below. The Svalbard Global Seed Vault is located on the 78th parallel; approximately 1,300 kilometers from the North Pole. This frosty vault harbors seeds from more than 984,000 crop plants and their wild relatives – more than anywhere else in the world. Tightly packed in aluminum bags and crates and loaded onto rolling containers, the seeds are pushed deep into the vault by blue-helmeted workers.

Collecting seeds is not unusual. All over the world, seed banks shelter plant seeds – mostly in locations much less glamorous. Since 2008, the icy vault has served as a common backup. According to the Global Crop Diversity Endowment Fund, Crop Trust for short, its location makes the North Pole bunker particularly safe: the seeds are meant to survive not only a refrigeration breakdown, but also earthquakes, climate change, wars, fallout and epidemics. Norway seems ideal: it is peaceful, and it does not operate nuclear power plants. The demilitarized zone of Spitsbergen is located at the northernmost place on earth that is accessible via commercial aircraft.

Samples from around the world

As a UN organization, the Crop Trust manages the backup of the most critical of the world's roughly 1,750 seed banks. The seemingly apocalyptic project is, in fact, visionary: it does not require a global catastrophe – even today, industrial monoculture causes the loss of crop varieties. The stores are meant to secure the rehabilitation of agriculture. At -18 °C, the North Pole vault harbors mainly varieties of grain, rice and corn on ceiling-high shelves. Also, seeds from potatoes and vegetables such as tomatoes and beans are stored here to secure food for humans in the event of a crisis. Research institutes are the main suppliers of samples that are sent to northern Norway: bananas from Belgium, potatoes from Peru, and rice from the Philippines.

> *We may be able to freeze seed, but we cannot freeze our ecosystem."*
>
> Elke Zippel

The idea has its limitations: stored in permafrost, the seeds will not retain their ability to germinate forever. Whereas peas are estimated to remain viable for more than 10,000 years, sunflowers and radishes lose their germination capacity in as little as 55 to 80 years. For this reason, samples must be continually replaced. "Certain species cannot be frozen at all", explains Elke Zippel. The botanist, head of the Dahlem Seed Bank of the Botanical Garden in Berlin, is dedicated to the protection of wild plants. "The ability of a seed to tolerate dry conditions is crucial. If the water content is too high, ice crystals may destroy the tissue during freezing", says Zippel. Dehydrating small seeds of cruciferous plants such as Brussels sprouts and turnips is easy; large seeds from mangoes and avocadoes, however, would dry out.

Wild plants, too, are at risk of extinction. Many regions have witnessed the loss of varieties, among them species of gentian. Every ten years, the scientists in Berlin test the state of their samples and, if necessary, establish fresh cultures. Is it worth the effort? "We have no choice; species die out due to changes in land use, due to nutrient influx, through the use of pesticides and through overbuilding", says Zippel. "We may be able to freeze seed, but we cannot freeze entire ecosystems." Protection of natural habitats should therefore take priority.

Syrian seeds lost

It seems ironic that the icy vault experienced the very catastrophe that it was expected to withstand: global warming. The Arctic is melting. In May 2017, melt water flooded the 100 meter long access tunnel and seeped through the walls. Exceptionally high temperatures led to the melting of the permafrost. According to the Crop Trust, the seed samples were not in any danger, and the entrance has since been reinforced.

Withdrawals have already been made from the bank in the not-so-permanent frost. Fighting in Syria cut off the Aleppo Seed Bank from the outside world. Farmers, growers and researchers ran out of seed. Fortunately, staff had managed to ship samples to Norway even in times of conflict. In 2015, the International Center for Agricultural Research in the Dry Areas (ICARDA) in Beirut ordered a substantial portion of the crates filled with chick peas, lentils and wheat back from Spitsbergen. Seed banks work best as parts of a network. They are already standing the test of time. ■

INFOBOX

The Crop Trust finances and supports a global network of seed banks. Since many of these are not safe from disaster, they send duplicates of their samples to Spitzbergen – the icy vault thus serves as a second backup. Two-thirds of its stock originates from research centers of the Consultative Group on International Agricultural Research (CGIAR). In 1984, the Nordic Gene Bank (today: NordGen) opened their first storage area in the former coal mine. The ice vault has existed in its present state since 2008: it accommodates 4.5 million samples of species, each containing 500 seeds – resulting in a total capacity of 2.25 billion. At this time, 984,000 samples rest on the shelves at -18 °C. The majority of stored samples comprise wheat and rice (150,000 samples each), barley (80,000 samples) and millet (50,000 samples).

Concrete protector
Almost 500 million agricultural crop seeds are stored in the Svalbard Global Seed Vault

Beauty By the Sea

Those who think of Barcelona will think of Antoni Gaudí, the Catalan architect of buildings covered in colorful tiles. These buildings liken Barcelona to a fabulous creature of art that continues to grow.

Colorful, playful, unmistakable
Park Güell with Barcelona in the background

The Sagrada Família in the middle of central Barcelona, a petrified forest of turrets and towers, colorful dreamy windows and stone curlicues: Antoni Gaudí commissioned the mighty cathedral, which is visited by more than four million people a year, in 1882. Construction has not been completed to this day. "My client is in no rush", was Gaudí's alleged response to the question of when the Roman Catholic Basilica would finally be completed. The client to whom Gaudí referred was God himself – and he will now have to be patient until at least 2026. This is when the church is expected to be completed.

As such, building and construction have been ongoing for the past 130 years in Barcelona. The landmark is a work in progress, and it experiences the changes within a cosmopolitan metropolis; the joy of becoming and a relaxed approach to time. These developments are perfectly complemented by the sea. Sometimes lively and exuberant, at other times slow and languid, the water laps at Barceloneta, the peninsula to the South-East. It promises happy times to those who walk, run or picnic along its shores. The sand was introduced in 1992 for the Summer Olympics, and ever since then, there is hardly a tourist who can resist immersing their feet in the water for at least a little while.

A salamander and a mansion in the park

The Park Güell is considered Barcelona's second largest attraction, after the Sagrada Família. Here, too, Antoni Gaudí and the Spanish Art Nouveau are omnipresent. By the main entrance, two gate houses with sweeping roofs are reminiscent of sugary cupcakes, and a huge Salamander with a carapace of colorful mosaic stones is sunning itself – Barcelona experiences only 90 days of rain in a year. Next to the amphibian, an open staircase leads to a tiled terrace that invites one to take a break and rest, and enjoy the view across the rooftops. Beginning in 1900, Antoni Gaudí de- ►

signed the garden for the industrial tycoon Eusebi Güell, and he lived there for almost 20 years. Today, furniture designed by him is on display in his turreted mansion.

By the Boulevard of Splendor, Passeig de Gràcia, in Barcelona's largest neighborhood L' Eixample, looms Gaudí's Casa Batlló. Its ceramic roof tiles glisten green and blue, and they resemble the scales of a dragon. A gallery on the second floor represents the mouth of the beast. On April 23rd, when all of Barcelona celebrates its Patron Saint, St. George, who slayed the dragon and freed a princess and a village from its tyranny, the inhabitants of Casa Batlló decorate their balconies with red roses. According to the legend, a rose emerged from the dragon's blood. Almost directly across from Casa Batlló, you will find Casa Milà, for which Gaudí layered six stories, one upon the other, and designed a façade in the shape of a wave. Because the stonemasons began working on the large panels of the front section only after they had been installed, the natives call Casa Milà "la Pedera" – the quarry. Since 1984 it has been listed as a UNESCO® world heritage site – the first building of the 20th century.

The upper floor comprises an apartment with furniture dating back to the 1920s. On the rooftop terrace, ventilation shafts in the shape of soldiers make up the natural ventilation system of the building that renders air conditioning superfluous.

Miró's chimeric being of man and woman

Those who have seen enough of Gaudí and the Modernisme Català may embark on a new adventure by following in the steps of the painter Joan Miró. Miró was born in 1893 in Barcelona's old town. The son of a goldsmith, he first studied at the Escola de Belles Arts de la Llotja, a school which was also attended by Picasso. All over the city, Miró left joyful works: the airport is adorned with a wall ceramic; downtown, a round floor mosaic decorates the pedestrian zone of La Rambla, and in the Parc de Joan Miró stands a concrete sculpture with the title "Dona i Ocell". One needs a little imagination to recognize a woman and a bird within the sliced-open stem, but the garden with its forest of palm trees, eucalyptus trees and pine trees offers pleasant shade and a cool breeze on a hot day.

Baroque still life in a market hall

Relaxed, yet busy – that is the life in a covered market near the Rambla. At the Mercat de la Boqueria, prawns glow pink through the ice. Bunches of pepperoni and garlic dangle like braids from the ceiling, and oranges, lemons and plums are piled up in delicious pyramids. The scent of basil and mint fills the air. The fresh food market, with its overflowing wares, resembles a still life from the Baroque era. At the same time, it is Barcelona's tourist attraction that is most closely interwoven with the everyday lives of the local population. This is where the Spanish shop for spices, meat and vegetables, while tourists try Paella, the national dish of the East Coast, or Crema Catalana. The moment one senses the hearty, savory taste of the rice dish in one's mouth or the sweetness of a dessert covered in caramel, one will feel at home in Barcelona, Catalonia's colorful beauty by the Mediterranean Sea. ■

Cathedral under construction
The Sagrada Família is scheduled to be finished by 2026

Picturesque
Casa Batlló also bears the hallmarks of Antoni Gaudí

Mercat de la Boqueria
Locals buy fresh food here

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Heading into its 31st edition in 2020, in-cosmetics® Global is the leading event for personal care ingredients. More than 800 exhibitors are offering ingredients, fragrances, testing and regulatory solutions, as well as lab equipment, as represented by Eppendorf. The exhibition brings together suppliers of personal care ingredients (exhibitors) and finished product manufacturers (visitors) from all over the globe, each looking to network, learn about future trends and discover new products. Between March 31st and April 2nd, 2020, Eppendorf is looking forward to welcoming you with a broad portfolio and plenty of expertise on all things laboratory.

LET'S GO!

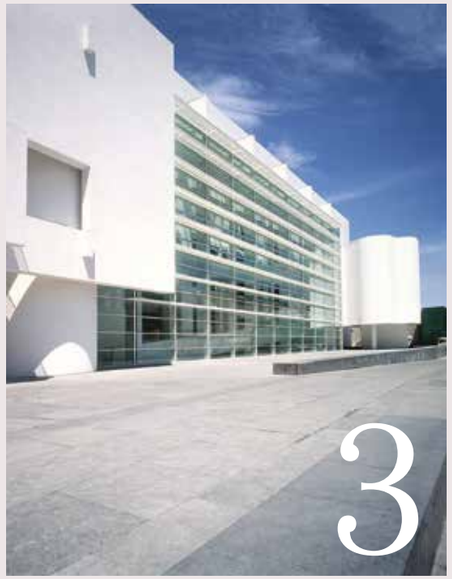
Art and architecture in Barcelona – give me more!

In 1895, **Pablo Picasso** moved to Barcelona with his family, where, barely 14 years old, he succeeded in passing the entrance exam of the Academy of Arts. Today, a number of travel agencies offer tours of his favorite spots in Barcelona; for example, the artists' café **Els Quatre Gats** (The four cats) – the venue of Picasso's first solo exhibit. Another stop is the **Museu Picasso**, which resides in five contiguous gothic city palaces dating as far back as the 13th to 15th centuries. The rooms mainly display works from Pablo Picasso's youth.

bit.ly/2Pj7HnS

The **Antic Hospital de la Santa Creu i Sant Pau** is considered one of the lesser known modernistic buildings in Barcelona. It was built at the beginning of the 20th century by Catalan architect Lluís Domenèch i Montaner. It comprised 48 different pavilions that are connected underground. Each one of the new façades is unique – with sculptures, mosaics, peaks and bays. Since the structure no longer serves as a hospital today, it is open to visitors.

Carrer Hospital, 56,
08001 Barcelona

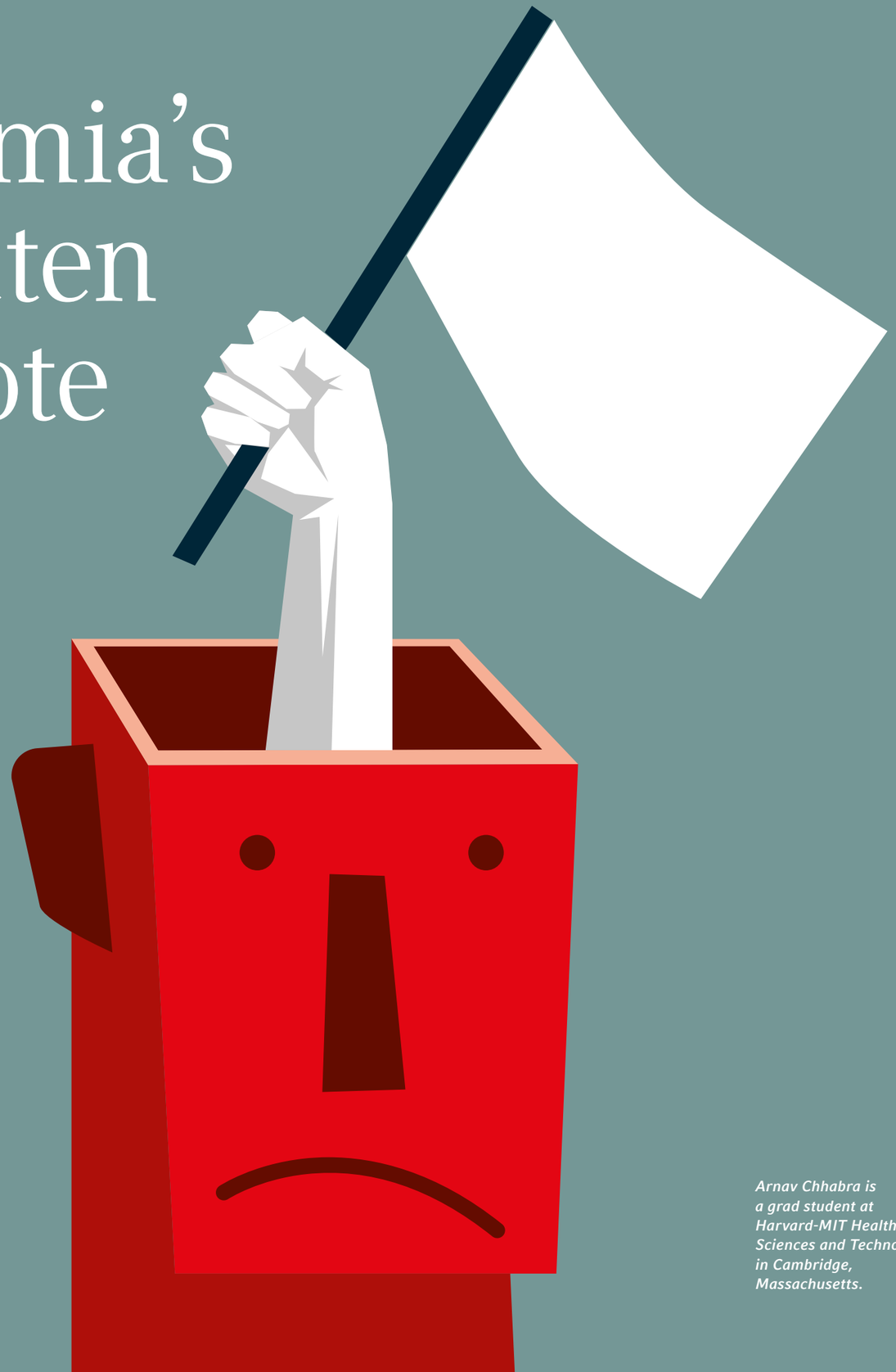


The **Museu d'art Contemporani de Barcelona** (MACBA) was designed by star architect Richard Meier, and it rises up close to the Rambla in the shape of a bar of glass and white aluminum among the medieval backdrop of the neighborhood of Raval. Inside, art from the 20th century until the present day is on display; for example, Graffiti works by Keith Haring or material art by Antoni Tapies. Outside, youth enjoy skateboarding, and tourists indulge in café con leche.

Plaça dels Àngels, 1,
08001 Barcelona

www.macba.cat/en/

Academia's Forgotten Footnote



Science
AAAS

INFOBOX

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In my third year of grad school, everything seemed to fall apart. I was dealing with my grandmother's death, and then my girlfriend and I broke up. I spent the following year in a painful feedback loop of depression and despair. Every day, I would trudge into lab and try to get excited about my projects. But when I encountered minor hurdles such as a failed replication or contaminated samples, I would become discouraged and give up. Even when my experiments went smoothly, I felt guilty about the time I had wasted being unproductive. I knew I was struggling, but I didn't ask for help. I thought I could deal with my state of mind just as I had dealt with every other problem in my life: Bottle up my emotions, attack the problem with logic and iterate until I arrived at a solution.

This time, however, that approach didn't work. I wasn't sleeping well. I couldn't focus enough to read even a brief paper in one sitting. During a lab presentation, I got so dizzy from exhaustion that I had to stop midway through. Balancing work and my mental health had become untenable. I concluded that trying to persist with my lab work was not fair to myself or to my group. When I gathered the courage to discuss time off with my adviser, she encouraged me to take a hiatus.

In the beginning, it felt like a blessing to have time to focus on personal projects and self-care I had neglected, including a healthy dose of binge-watching basketball. But after three months, feelings of academic guilt crept back. Despite not feeling fully up to it, I convinced myself that it was time to return.

I tried to mask my depression, but the impact on my work was apparent again. A few months after my return, my adviser called me into her office and initiated a forthright discussion about why I was not being productive. I wondered whether it was time for me to leave my PhD program. I felt like a failure, and I thought of suicide for the first time. These thoughts finally pushed me to see a therapist.

At first, therapy felt awkward and ineffectual. I was not accustomed to introspection, and I certainly was not accustomed to being probed about my problems. But over time, my counselor and I developed a rapport. She helped me figure out that while my girlfriend and I were together and my workload ramped up, I had socially isolated myself, which meant that I didn't have a support network to draw on when things got tough. She also encouraged me to connect with MindHandHeart (MHH), a coalition of students, faculty and staff promoting mental health and well-being at the Massachusetts Institute of Technology.

A year and a half of counseling and MHH gave me the tools I needed to strengthen my relationships and establish a support structure to help cope with any future episodes. I revitalized friendships and opened up about my feelings. My lab work improved, and I am on track to graduate in the next year.

Studies have shown that 40 percent of PhD students are depressed. But if it weren't for my own experiences, I would not be aware of this – and therein lies the problem. Academics tend to be averse to discussing mental health openly, and higher education's mental health safety net is patchy – a forgotten footnote that all too often fails its students. I am lucky that I have a supportive adviser and health insurance that covers mental health care. And I am lucky that I made it to therapy when I considered suicide. I could easily have waited too long.

Even if you aren't personally burdened by these issues, everyone must take action to support those who are struggling, and to ensure that institutions have support frameworks: advisers trained to deal with mental health issues; student-run support programs; and community events with a focus on diversity and inclusion, because students from underrepresented groups are more likely to experience depression. If your institution doesn't, what can you do to help before someone you care about becomes a different kind of footnote? ■

Arnav Chhabra is a grad student at Harvard-MIT Health Sciences and Technology in Cambridge, Massachusetts.

Astounding Images

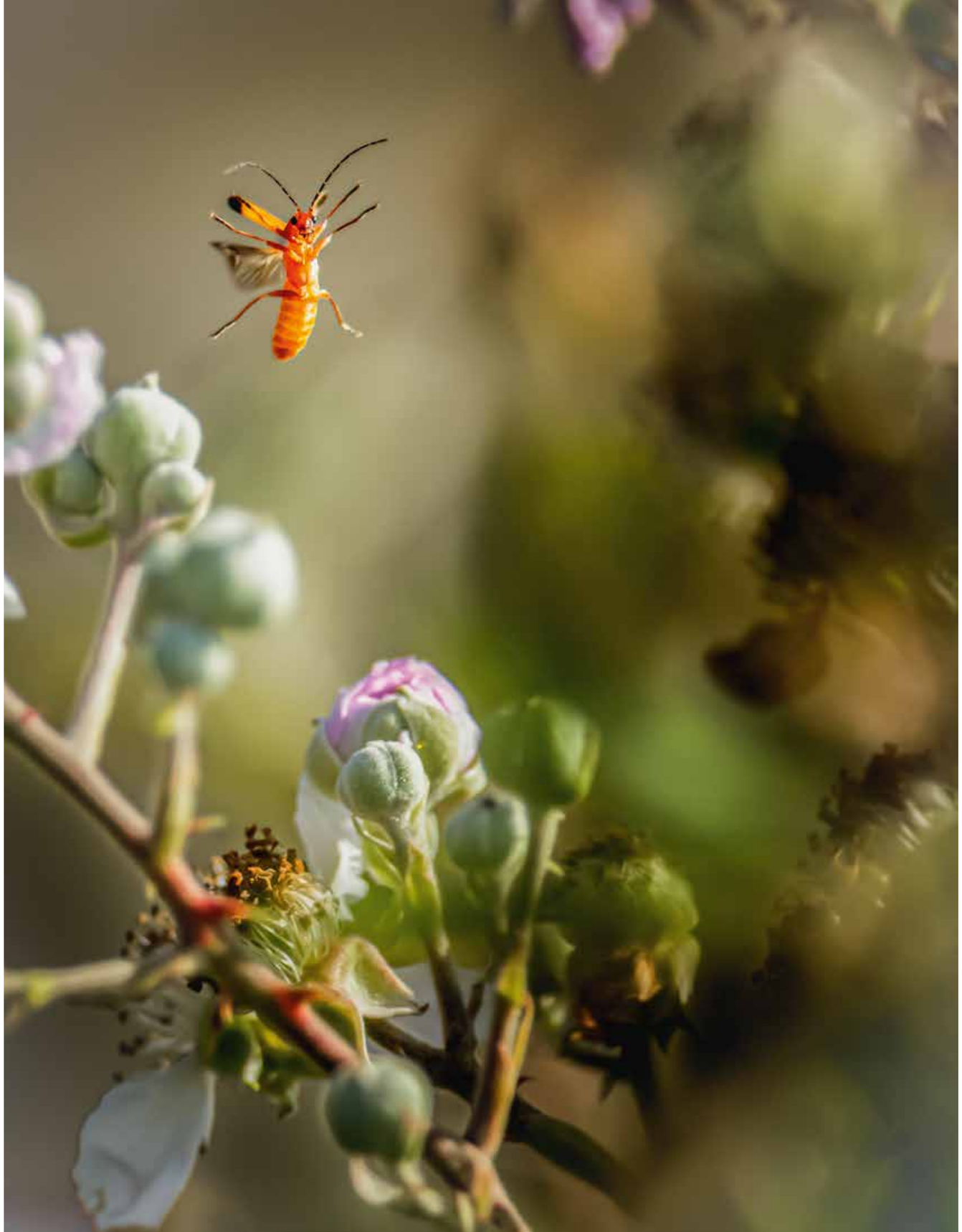
With distinction: “Capturing Movement” was the motto of the photography contest of the “Royal Society of Biology” 2019 – and here are the two winning images.

Photographer of the Year: About the Master ▸

“The common red soldier beetle in the photograph looks elated as he flies towards the camera. I have never seen a happier looking insect. Being a soldier, he must be going home to be that elated! I took the photograph of the beetle mid-flight, clearly capturing his movement.”

Photographer: Nick Edwards
Title: Demob Happy
Location taken: Thorness Bay, near Cowes, Isle of Wight, UK

“Capturing Movement” is the theme of this year’s Royal Society of Biology Photography Competition. Life on Earth is constantly changing, and photographers are invited to take a photo of nature in motion. Supported by Eppendorf, the competition has two age categories: 18 and over and under 18s.
www.rsb.org.uk/photocomp



▲

Young Photographer of the Year and his Master

„The photograph shows two male white-headed duck fighting in Spring. I believe the image fits with the competition’s theme, Capturing Nature, as it is an action scene with the birds jumping over the water.“

Photographer: Carlos Perez Naval
Title: Fighting
Location taken: Navaseca, Ciudad Real, Spain

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