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CORAL REEFS WILL DISAPPEAR IN 10 YEARS

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PLASTIC SNOWFALL IN THE ALPS

Teamwork: Scientists ascending to the research station in the Hohe Tauern National Park. Credit: ZAMG/Niedermoser

A new study is investigating how much plastic is trickling down on us from the atmosphere.

According to the study, some nanoplastics travel over 2000 kilometers through the air. According to the figures from the measurements about 43 trillion miniature plastic particles land in Switzerland every year. Researchers still disagree on the exact number. But according to estimates from the study, it could be as much as 3,000 tonnes of nanoplastics that cover Switzerland every year, from the remote Alps to the urban lowlands. These estimates are very high compared to other studies, and more research is needed to verify these numbers

The study is uncharted scientific territory because the spread of nanoplastics through the air is still largely unexplored. The result of Brunner's research is the most accurate record of air pollution by nanoplastics ever made. To count the plastic particles, Brunner and his colleagues have developed a chemical method that determines the contamination of the samples with a mass spectrometer.

EXTREME CONDITIONS

The scientists studied a small area at an altitude of 3106 meters at the top of the mountain "Hoher Sonnenblick" in the "Hohe Tauern" National Park in Austria. An observatory of the Central Institute for Meteorology and Geodynamics has been located here since 1886. The observatory is run by meteorologist and Arctic researcher Elke Ludewig. Since research began here in the late 19th century, the observatory has only been non-operational on four days. The research station also served as a base for the study on the spread of nanoplastics in remote areas.

Every day and in all weather conditions, scientists removed a part of the top layer of snow around a marker at 8 AM and carefully stored it. Contamination of the samples by nanoplastics in the air or on the scientists' clothes was a particular challenge. In the laboratory, the researchers sometimes had to remain motionless when a colleague handled an open sample.

The origin of the tiny particles was traced with the help of European wind and weather data. The researchers could show that the greatest emission of nanoplastics into the atmosphere occurs in densely populated, urban areas. About 30% of the nanoplastic particles measured on the mountain top originate from a radius of 200 kilometers, mainly from cities. However, plastics from the world's oceans apparently also get into the air via the spray of the waves. Around 10% of the particles measured in the study were blown onto the mountain by wind and weather over 2000 kilometers – some of them from the Atlantic.

NANOPARTICLES IN THE BLOODSTREAM

It is estimated that more than 8300 million tonnes of plastic have been produced worldwide to date, about 60% of which is now waste. This waste erodes through weathering effects and mechanical abrasion from macro- to micro- and nanoparticles. But discarded plastic is far from the only source. Everyday use of plastic products such as packaging and clothing releases nanoplastics. Particles in this size range are so light that their movement in the air can best be compared to gases.

Besides plastics, there are all kinds of other tiny particles. From Sahara sand to brake pads, the world is buzzing through the air as abrasion. It is as yet unclear whether this kind of air pollution poses a potential health threat to humans. Nanoparticles, unlike microparticles, do not just end up in the stomach. They are sucked deep into the lungs through respiration, where their size may allow them to cross the cell-blood barrier and enter the human bloodstream. Whether this is harmful or even dangerous, however, remains to be researched.

RED SNOW PHENOMENA

Researchers from Institute of Industrial Science, The University of Tokyo find that the occurrence of red snow is closely tied to the length of the snow melt season and new snowfall events. Credit: Institute of Industrial Science, The University of Tokyo

Red snow is a unique phenomenon caused by blooms of red algae that live on the surface of snow.

Researchers from Japan have developed a model to predict the occurrence of red snow events. In a recent study published in the Journal of Geophysical Research: Biogeosciences, researchers from Institute of Industrial Science. The University of Tokyo found that red snow algae blooms are associated with the duration of snow melt and the timing of new snowfall.

Red algae are photosynthetic microbes that live on the surface of snow and ice. The algae appear in the spring on thawing snow surfaces and can speed up snow melt as they darken the snow surface. The dark surface becomes warmer and snow melts faster. The abundance of snow algae is influenced by factors such as the snow conditions, like snow depth and nutrient availability, as well as local meteorological conditions.

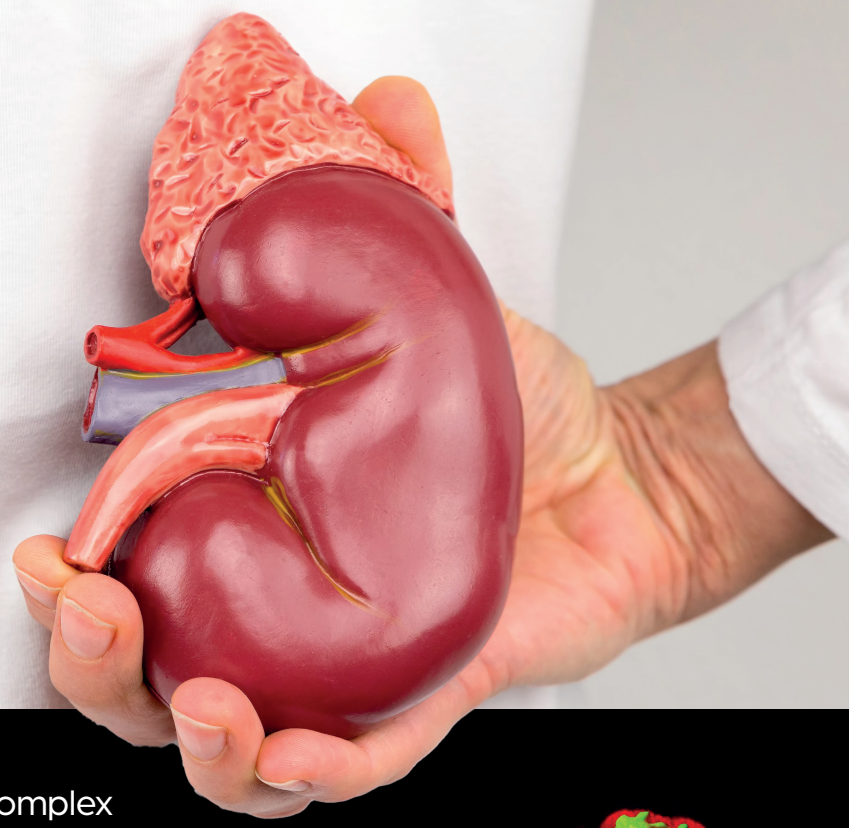
"It's important to understand why and when these algal blooms occur," says lead author of the study Yukihiko Onuma. The cryosphere, which includes all the frozen places on Earth, is dwindling as global temperatures rise. "Our aim with this research was to try and predict the location and timing of red snow events and their effects on global snow cover."

The researchers took a previously developed simple snow algae model and incorporated additional factors that influence the occurrence of algal blooms, such as snowfall and daylight length. When they tested the new model using real-world data from fifteen sites around the world, they found it performed well.

The team then incorporated the snow algae model into a land surface model to create a global snow algae simulation. "The simulation predicted algal blooms in places where they have previously occurred," explains Onuma. "We also know that new snowfall during the melting season can cover the algae and, in the simulation, we found that the timing of blooms was closely tied to how long the snow cover persisted and the timing of fresh snowfall during the season."

Given that snow cover is decreasing globally, this new model is a valuable tool for predicting future snow algae blooms and their effects on this important global habitat.

3D KIDNEY TISSUE CREATED IN THE LAB



Research team from Japan has created complex 3D kidney tissue in the lab solely from cultured mouse embryonic stem (ES) cells.

These organoids could lead the way to better kidney research and, eventually, artificial kidneys for human transplant. Research team based in Kumamoto University (Japan) has created complex 3D kidney tissue in the lab solely from cultured mouse embryonic stem (ES) cells. These organoids could lead the way to better kidney research and, eventually, artificial kidneys for human transplant.

By focusing on an often-overlooked tissue type of organoid generation research, a type of organ tissue made up of various support and connective tissues called the stroma, Dr. Ryuichi Nishinakamura and his team were able to generate the last of a three-part puzzle that they had been working on for several years. Once the three pieces were combined, the resulting structure was found to be kidney-like in its architecture. The researchers believe that their work will be used to advance kidney research and even lead to a transplantable organ in the future.

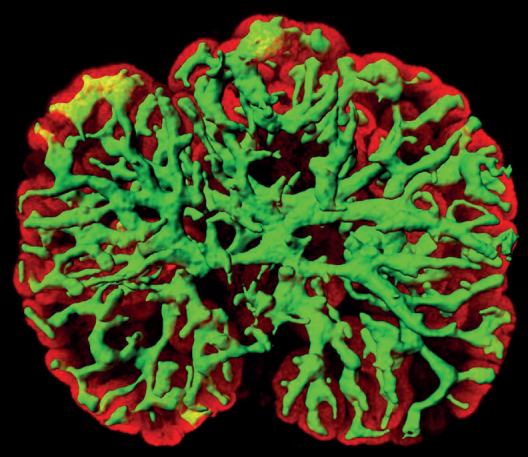
The kidney is a very important organ for continued good health because it acts as a filter to extract waste and excess water from blood. It is a complex organ that develops from the combination of three components. Protocols have already been established by various research teams, including Dr. Nishinakamura's team at the Institute of Molecular Embryology and Genetics (IMEG) at Kumamoto University, to induce two of the components (the nephron progenitor and the ureteric bud) from mouse ES cells.

In this, their most recent work, the IMEG team has developed a method to induce the third and final component, kidney-specific stromal progenitor, in mice.

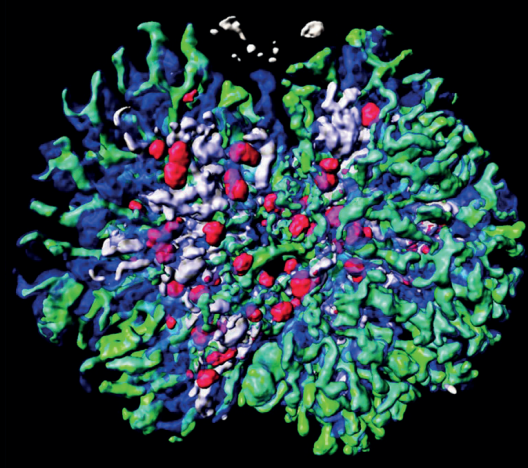
Furthermore, by combining these three components in vitro, the researchers were able to generate a kidney-like 3D tissue, consisting of extensively branched tubules and several other kidney-specific structures.

The researchers believe that this is the first ever report on the in-lab generation of such a complex kidney structure from scratch. The IMEG team has already succeeded in inducing the first two components from human iPS cells. If this last component can also be generated from human cells, a similarly complex human kidney should be achievable.

"We are now working very hard to generate a fully functional human kidney," said Dr. Nishinakamura. "We hope to use our developments to screen drugs for various diseases, and for transplantation in the long run."



Researchers in Japan have generated a kidney-like 3D tissue, consisting of extensively branched tubules, from cultured mouse embryonic stem cells. Credit: Dr. Shunsuke Tanigawa



Researchers in Japan have generated a kidney-like3D tissue, consisting of many types of kidney-specific structures, from cultured mouse embryonic stem cells. Credit: Dr. Shunsuke Tanigaw

AIR POLLUTION CHANGES THE SCENT OF FLOWERS, REDUCING POLLINATION

"The findings are alarming because this pollution is common in the air most of us breathe every day."

A new study has shown that air pollution can alter the scent of flowers and limit the pollination ability of bees and butterflies. The researchers found that the presence of common air pollutants, such as those emitted from diesel exhausts, reduced pollination levels by up to 31 percent. The study is the first to reveal how air pollution negatively affects this critical process in the natural environment.

Leader of the study from the University of Reading Dr. Robbie Girling said,"We knew from our previous lab work that diesel exhaust could have adverse effects on pollinators, but the effects we detected in the field from air pollution were much more dramatic than we expected."

The study found that there were up to 70 percent fewer pollinators in the region where levels of common air pollutants increased. When the ozone level and diesel exhaust fumes, substances that can react with the scent of flowers, were high flower visits decreased by up to 90 percent.

Dr. James Ryalls from University of Reading said, "The findings are alarming because these pollutants are common in the air most of us breathe every day. We know that these pollutants are harmful to our health. The significant reductions we've seen in pollinator numbers and pollination activity show clear implications for the natural ecosystems we depend on."

Dr. Christian Pfrang, co-author of the study, added that this impact of atmospheric pollution has "direct consequences for food production and the resilience of our natural environment."

AIR POLLUTION IN THE COUNTRY IS AS TOXIC AS THE SMOG OF THE CITY

Researchers have found unhealthy particles floating in the atmosphere even in the rural areas, where the air looks clearer.

That sweet country air may not be as invigorating as we once thought.

Fine particulate matter less than 2.5 micrometers in diameter (PM2.5) is thought to cause the most harm to human health, as these pollutants are small enough to seep deep into our lungs, damaging the cells and tissues that reside there.

As guidance, the World Health Organization has therefore set a safety threshold for ambient PM2.5 levels, and yet this line in the sand overlooks the nuances of intrinsically toxic chemicals.

Emerging research suggests the mass of fine particulate matter we breathe could be less important for human health than its chemical makeup.

That's because some lighter particles are more likely to produce reactive oxygen species, which can have toxic effects on human health.

When researchers in the United States compared three urban areas to one rural area in the midwest, they found similar levels of oxidative potential at all four sites. That was true even though the rural site had a relatively lower mass of PM2.5.

While agricultural activities only contributed 12 percent of the rural site's PM2.5 mass, they accounted for more than 60 percent of the region's cellular oxidative potential.

The oxidative potential of most urban sites, on the other hand, was less than 54 percent.

"Overall, our study indicates that the sources contributing substantially to PM2.5 mass are not necessarily equally important in terms of their health effects," the authors write in a newspaper.

Instead, the researchers argue our health metrics for air pollution should be based more on the toxic potential of fine particles than their actual mass.

The study is based on weekly samples of PM2.5, which were retrieved in the summer and fall of 2018 and the winter and spring of 2019 from Chicago, Indianapolis, and St Louis, as well as a rural location in Illinois.

Analyzing the composition, mass, and oxidative potential of these samples, the team found a poor correlation between the mass and toxicity of fine particulate matter.

Lighter chemicals in rural areas were much more likely to produce unhealthy byproducts.

Floating traces of iron and organic carbon, for instance, were strongly correlated with cellular oxidative potential throughout the year. Other industrial chemicals like lead, aluminum, copper, and manganese, tended to increase during winter and fall.

The strong seasonality of these results suggests many of the potentially toxic chemicals being breathed in rural Illinois are due to agricultural activities, like the application of fertilizers and herbicides.

Phosphate fertilizers that are sprayed on crops, for instance, contain heavy-metal pollutants, like lead and chromium, that can easily infiltrate the air and our lungs. Copper fungicides are also sprayed in a similar way.

Despite being located 12 kilometers (7 miles) from a coal-fired power plant, coal combustion and biomass burning accounted for more than 80 percent of rural Illinois' PM2.5 mass.

If the authors had simply measured PM2.5, it would look like coal was the most dangerous factor for human health. But that may not be true. Instead, agricultural sources, which are lighter in mass, appeared to be twice as toxic as burnt biomass.

"Despite a minor contribution to PM2.5 mass, health risks of the agricultural activities cannot be ignored," the authors conclude.

Nor can we afford to ignore other lighter forms of fine particulate matter.

For instance, a study conducted in Beijing in 2019 found vehicle emissions only contributed 10 percent of the region's PM2.5 mass. Yet they accounted for more than half of all the toxic potentials measured in the air.

Clearly, the way that we are measuring air pollution is flawed and is not capturing the full extent of harm.

Measuring the oxidative potentials of individual chemicals, however, is much trickier than simply weighing the mass of all ambient pollutants. The authors of the current study hope their new methodology can make testing for toxic air easier for environmental regulators and policymakers going forward.

The study was published in the Journal of Hazardous Materials:

Sources of cellular oxidative potential of water-soluble fine ambient particulate matter in the Midwestern United States

https://doi.org/10.1016/j.jhazmat.2021.127777

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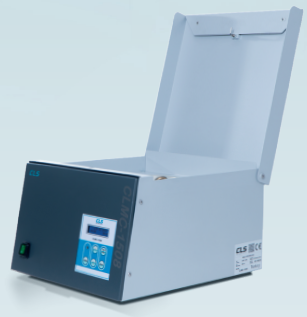

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CORAL REEFS WILL DISAPPEAR IN 10 YEARS

Coral reefs have long been regarded as one of the earliest and most significant ecological casualties of global warming.

In new research published in the journal PLOS Climate, the future of these tropical ecosystems – thought to harbor more species than any other – situation is probably worse than anticipated.

Climate change is causing more frequent marine heatwaves worldwide. Corals have adapted to live in a specific temperature range, so when ocean temperatures are too hot for a prolonged period, corals can bleach – losing the colorful algae that live within their tissue and nourish them via photosynthesis – and may eventually die.

Across the tropics, mass bleaching and die-offs have gone from being rare to a somewhat regular occurrence as the climate has warmed. More frequent heatwaves mean that the time corals have to recover is getting shorter.

In a 2018 report, the Intergovernmental Panel on Climate Change predicted that 1.5°C of global warming would cause between 70 and 90 percent of the world's coral reefs to disappear.

Now, with models capable of examining temperature differences between coral reefs one kilometer apart, our team found that at 1.5°C of warming, which the world is predicted to reach in the early 2030s without drastic action to limit greenhouse gas emissions, 99 percent of the world's reefs will experience heatwaves that are too frequent for them to recover.

That would spell catastrophe for the thousands of species that depend on coral reefs, as well as the roughly one billion people whose livelihoods and food supply benefits from coral reef biodiversity.

THERMAL REFUGIA

The thermal stress of a heatwave can affect corals over a huge geographic area, like the entire northern Great Barrier Reef or archipelagos like the Maldives. A marine heatwave in 2015–16 caused widespread bleaching in each of the Pacific, Atlantic, and Indian Oceans.

Corals are small polyp-like animals that form colonies of thousands by secreting a calcium carbonate skeleton that builds a reef. Corals grow slowly, so their recovery following bleaching and die-offs can take a long time and can be hampered by pollution and overfishing. Some species grow faster and are more capable of recovering quicker.

Scientists hope that local conditions on some reef tracts will ensure suitable temperatures for corals in the future, even when surrounding areas warm. These conditions may be possible due to upwelling, where cooler water is brought to the surface, or strong ocean currents. Reef managers can prioritize these so-called refugia, which offer corals a greater chance of survival.

Finding these refugia is difficult, though, as they are likely to be small and the resolution of climate projections that model changes in ocean temperatures over time tend to be too coarse.

Our team increased the resolution of climate model projections by downscaling them with historical data from satellite observations to find out where refugia are likely to persist in the future.

We found that, from 1986 to 2019, 84 percent of the world's reefs offered sufficient thermal refuge. This meant corals had enough time to recover in between bleaching events.

With 1.5°C of global warming above pre-industrial levels, only 0.2 percent of these refugia remain. At 2°C of warming, safe havens from heat for coral reefs will no longer exist.

Preliminary findings from another study (yet to complete the peer-review process) would seem to confirm the catastrophic effects of 1.5°C of global warming on coral reefs. This research was carried out independently by scientists in the US using a different method but the same climate models and spatial resolutions.

THE FUTURE OF CORAL REEFS

Global warming of 1.5°C is the lower limit that world leaders aspired to maintain when they signed the Paris agreement in 2015. This target is moving further out of reach.

For coral reefs, there is no safe limit to global warming. Given the rate at which the global average temperature is increasing, marine heatwaves are likely to become so frequent that most of the world's coral reefs will experience intolerable heat stress regularly. Most reefs have already experienced at least one such event this decade.

Not all regions are stressed at the same time as heatwaves are not global, nor do all corals bleach. Some coral species are more capable of coping with extreme temperatures than others due to their growth form or the type of algae within their tissue.

Still, the magnitude and frequency of heatwaves predicted in this study will probably affect even resistant coral species, suggesting the world will lose most of its reef biodiversity. Coral reefs of the future are likely to look very different to the colorful and diverse ecosystems we know today.

Climate change is already degrading coral reefs globally. Now we know that protecting the last remaining temperature refuges will not work on its own. Slashing greenhouse gas emissions this decade is the best hope for saving what remains.

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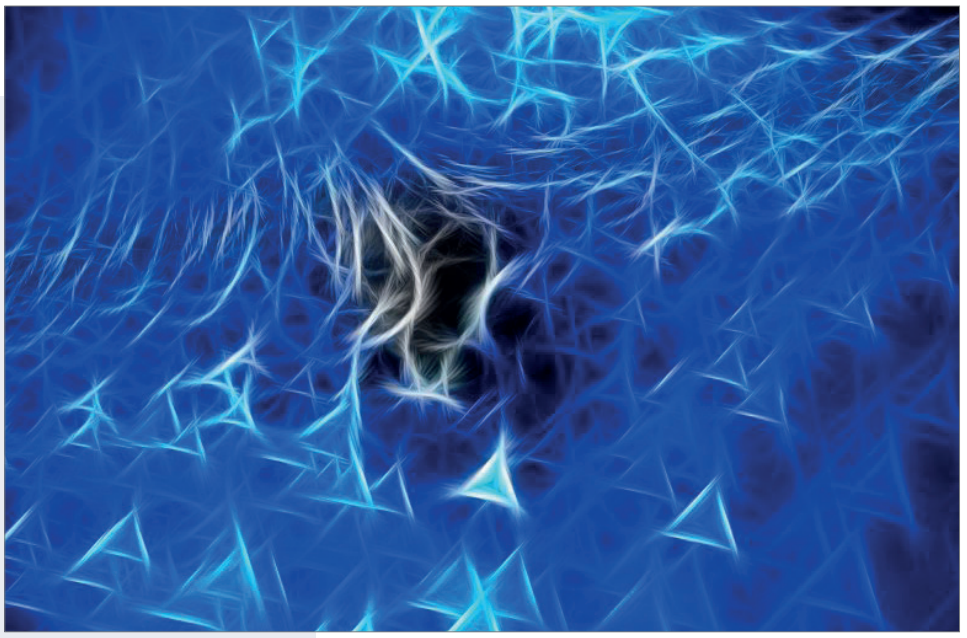
SCIENTISTS FINALLY SYNTHESIZED CARBON BASED MAGNETIC MATERIAL

Researchers synthesized and crystallized a molecule that is otherwise too unstable to fully study in the laboratory.



Researchers from Osaka University and Osaka City University synthesized and crystallized a molecule that is otherwise too unstable to fully study in the laboratory, and is a model of a revolutionary class of magnets.

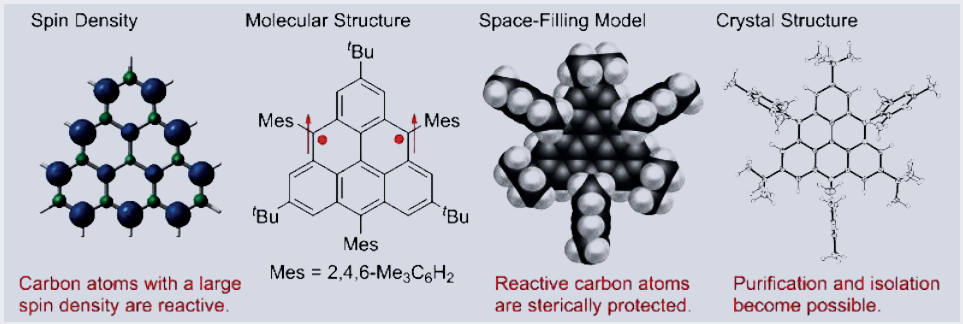
Since the first reported production in 2004, researchers have been hard at work using graphene and similar carbon-based materials to revolutionize electronics, sports, and many other disciplines. Now, researchers from Japan have made a discovery that will advance the long-elusive field of nanographene magnets. In a study recently published in Journal of the American Chemical Society, researchers from Osaka University and collaborating partners have synthesized a crystalline nanographene with magnetic properties that have been predicted theoretically since the 1950s, but until now have been unconfirmed experimentally except at extremely low temperatures.

Graphene is a single layer, two-dimensional sheet of carbon rings arranged in a honeycomb lattice. Why does graphene excite researchers? Graphene has impressive properties—it exhibits efficient, long-distance charge transport and has a much higher strength than similarly thick steel. Nanostructures of graphene have edges that exhibit magnetic and electronic properties that researchers would like to exploit. However, graphene nanosheets are difficult to prepare and it's difficult to study their zigzag edge properties. Overcoming these challenges by using a simpler, yet advanced, model system known as triangulene is something the researchers at Osaka University aimed to address.

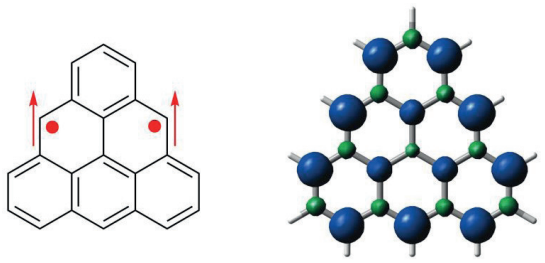
"Triangulene has long eluded synthesis in a crystalline form because of its uncontrolled polymerization," say both Shinobu Arikawa and Akihiro Shimizu, two key authors of the study. "We prevented this polymerization by steric protection—bulking up the molecule—and did so in a way that didn't affect its underlying properties."

The researchers' triangulene derivative is stable at room temperature but must be kept in an inert atmosphere because it slowly degrades when exposed to oxygen. Nevertheless, crystallization was possible—which enabled confirmation of its theoretically predicted properties, such as localization of unpaired electrons on the zigzag edges of the molecule. "By measuring its optical and magnetic properties, we confirmed that our molecule is in the triplet ground state," explains Ryo Shintani, senior author. "This is an electronic state that can serve as an experimentally tractable model for zigzag-edged nanographene."

These results have important applications. Researchers can extend the long-sought synthetic procedure reported here to increase the number of carbon rings in the molecule and perform chemical syntheses of advanced forms of nanographene. In so doing, Osaka University and Osaka City University researchers may be able to synthesize materials that are foundational for future advanced electronics and magnets, and supplement the silicon that's ubiquitous in modern electronics.



Spin density distribution of triangulene and space-filling model and crystal structure of triangulene derivatives. Credit: Shinobu Arikawa et al.



Structure and spin density distribution of triangulene. Credit: Shinobu Arikawa et al.

BUNCH OF BACTERIA HAVING 'WILD SEX' IN YOUR GUT

A team of researchers from the University of Illinois at Urbana-Champaign and University of California Riverside has now learned just how far this bacterial bump-and-grind goes, finding exchanges that go beyond what we knew previously.

Bacteria, of course, don't have genitals, but technically 'sex' in biology refers to any process that exchanges genetic material.

By forming a 'temporary union' with another bacterium in our gut, a microbe can therefore transfer its genes to another – it doesn't even have to be the same species.

All the microbe has to do is stick out a tube, called a pilus, and attach itself to another cell, shooting off a transferable package of DNA called a mobile genetic element when it's ready.

The discovery of bacterial sex was made over 70 years ago, when scientists realized this horizontal gene transfer was how microbes were sharing resistance genes for certain antibiotics, thereby spreading antibiotic resistance.

More recently, it's become clear that bacterial sex doesn't just occur when microbes are under attack. It happens all the time, and it's probably part of what keeps our microbiome fit and healthy.

New research has now identified what genes bacteria are actually sharing when they do this.

> To survive, the microbes in our digestive tract are having 'wild sex' with each other on a regular basis, all in the name of swapping secrets on how to survive deadly doses of antibiotics.

The study was conducted among a phylum of gut microbes, called Bacteroidetes, which comprise up to 80 percent of the human microbiome and are important digesters.

"The big, long molecules from sweet potatoes, beans, whole grains, and vegetables would pass through our bodies entirely without these bacteria," explains microbiologist Patrick Degnan from the University of California Riverside.

"They break those down so we can get energy from them."

To colonize the human gut and help us break down carbohydrates, however, these microbes must compete for limited resources in the large intestine. Such resources include vitamin B12 and other related compounds, which help fuel the bacteria's metabolism and synthesis of proteins.

Most microbes in the gut don't have the ability to synthesize these crucial compounds on their own, which means they have to soak up what they can from their environment.

For this to be effective, it pays to have genes for an efficient vitamin B12 transport system at the ready.

In both petri dishes and in living mouse models, researchers have now identified B12 transporters that are shared via bacterial sex.

"We're excited about this study because it shows that this process isn't only for antibiotic resistance," says Degnan.

"The horizontal gene exchange among microbes is likely used for anything that increases their ability to survive, including sharing [genes for the transport of] vitamin B12."

When two gut microbes were placed on a dish in the lab, researchers noticed the bacterium that couldn't synthesize B12 transport systems connected up with the bacterium that could. Once the sex pilus bridged the gap between the two, the 'receiving' bacterium could unpack its precious cargo.

After the experiment, researchers examined the genome of the receiving bacterium, which was still alive, and found it had incorporated an extra band of DNA from the donor.

Among living mice, something similar appears to happen. When researchers administered two forms of Bacteroidetes to a mouse – one that possessed the genes for transferring B12, and another that didn't – they found the genes of the former had 'jumped' to the latter after five to nine days.

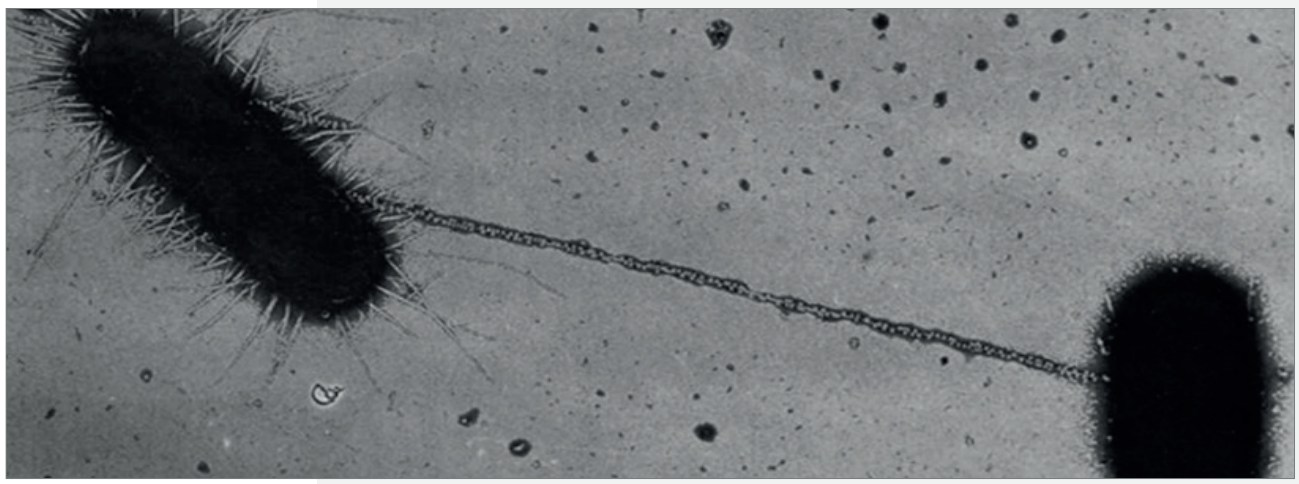
"It's as if two humans had sex, and now they both have red hair," says Degnan.

Interestingly, the authors note that a secondary round of gene transfer, between Bacteroidetes of the same species, occurred slightly faster than the first round, which was between two different species.

The findings suggest there may be a slight 'species barrier' when it comes to bacterial sex. Although, that barrier is nothing like what we see with mammals, where a species can only reproduce with another of its kind.

Bacteria, it seems, aren't nearly so picky about their partners, and our stomachs are very grateful for their promiscuity.

The study was published in Cell Reports.



ANCIENT TREES WITH INCREDIBLE LIFESPANS KEEP THEIR FORESTS ALIVE

The venerable elders of a forest are hugely important to the diversity, fitness, and survival of the woodland as a whole. They also bring with them a hardiness and experience in dealing with change, as well as a lifetime of ecological interactions preserved in their immediate surrounds.

Scientists used models extrapolated from several previous studies to assess how many trees typically make it beyond the normal boundaries of tree old age, and to analyze the sorts of effects these ancient trees had on the rest of the flora around them.

A very small number of trees – less than 1 percent of a population – achieve ancient status, sometimes growing as many as 10 or 20 times longer than the average for the forest overall, the study shows.

These incredible outliers of the tree world can achieve such grand old ages among species that don't have set lifespans like us. Year after year, thanks to their genes, they weather whatever life throws at them, until one day their luck runs out.

Yet the longer these rare gems live, the greater the chance they might pass on these golden genes to a new generation.

"We examined the demographic patterns that emerge from old-growth forests over thousands of years, and a very small proportion of trees emerge as life-history 'lottery winners' that reach far higher ages that bridge environmental cycles that span centuries," says botanist Chuck Cannon from the Morton Arboretum in Illinois.

"In our models, these rare, ancient trees prove to be vital to a forest's long-term adaptive capacity, substantially broadening the temporal span of the population's overall genetic diversity."

In other words, these old-timers have seen it all – and that experience written into the tree genetics is something that rubs off on the rest of the forest and younger trees as new seeds are planted. In some cases, thousands of years of experience can be passed on.

Trees that have stood the test of time aren't just important because of their genetic and biological diversity. However they also provide shelter for endangered species and are better at soaking up carbon than younger trees, the researchers found.

These old and ancient trees are now under severe threat though – not just through climate change, but through worldwide deforestation, meaning that trees of extraordinary age are becoming less common, with mortality rates for trees rising across all kinds of woodland.

"As the climate changes, it is likely that mortality rates in trees will increase, and it will become increasingly difficult for ancient trees to emerge in forests," says Cannon.

"Once you cut down old and ancient trees, we lose the genetic and physiological legacy that they contain forever, as well as the unique habitat for nature conservation."

Ancient trees, by their very nature, can't be quickly replaced. The only way to ensure we still have them is to protect mature trees as they continue to grow – and that means curbing the effects of climate change and deforestation.

The researchers liken the killing off of ancient trees as being similar to killing off animal species, in that once they're gone they're not coming back. Even trees that eventually grow to be as old won't have the same evolutionary history written into them.

As humans we have a long history of respecting and even revering ancient trees – and the authors behind this latest study say that we need to bring back some of that concern for the most elderly members of forests, to ensure their survival for the future.

"This study recalls the urgent need for a global strategy to conserve biodiversity, not only by preserving intact forests, but in particular the small remnant of a few ancient trees that have survived in managed forest landscapes," says ecologist Gianluca Piovesan from Tuscia University in Italy.

The research has been published in Nature Plants.

ROBOT NANNY DESIGNED TO TAKE CARE OF BABIES IN ARTIFICIAL WOMBS

Scientists in China have created a robotic artificial intelligence system to track and care for human embryos growing in artificial wombs. The artificial intelligence robot is being developed as a possible solution to the population growth problems in the world's most populous country. Birth rates in China have recently fallen to their lowest level in 60 years.

Researchers from the Suzhou Institute of Biomedical Engineering and Technology in Eastern China's Jiangsu province developed the robot to take on the labor-intensive task of observing, documenting and manually adjusting carbon dioxide, nutrition and other environmental inputs. The robot can also sort embryos according to their developmental potential.

The research paper published in the Journal of Biomedical Engineering describes how the robot nanny is currently used to feed animal embryos in an artificial womb environment.

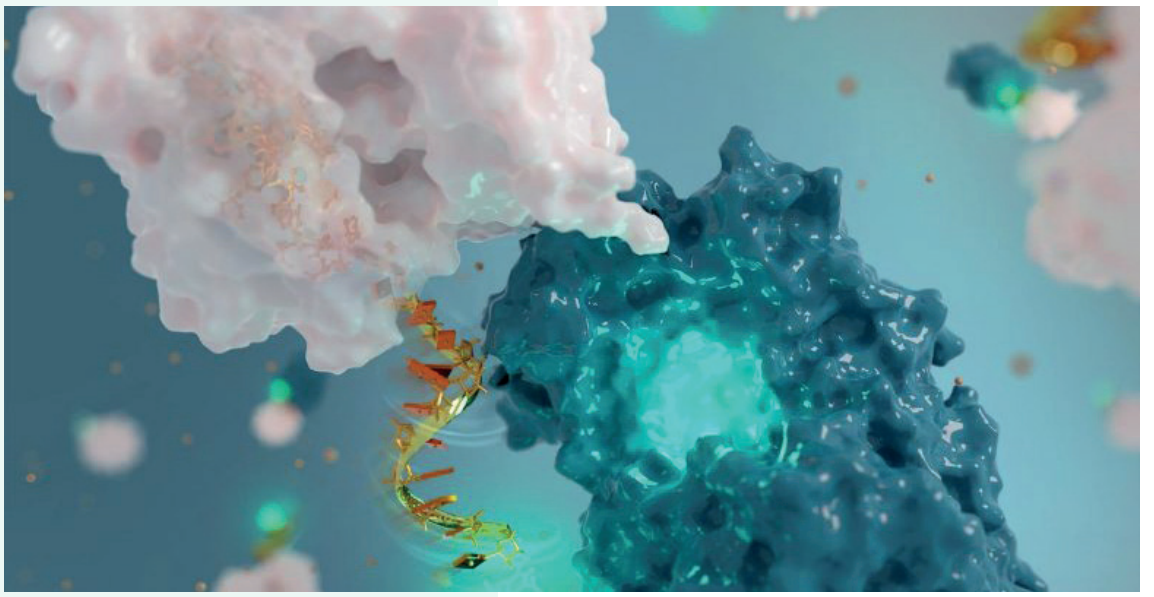
While the article states that "many mysteries remain unsolved about the physiology of human embryonic development," the technology "will not only help to better understand the origin of life and embryonic development in humans, but will provide a theoretical basis for solving congenital disabilities and other important reproductive health issues" also stated.

According to the article, the system enables the fetus to grow more safely and efficiently than in the natural environment of the female uterus. In Chiang's story, a child who is only brought up by an automatic nanny grows up incapable of interacting with other people.

While Chinese researchers have proven that it can be used safely for the development of embryos, legal barriers still exist to prevent the technology from being used in human fetuses that have completed two weeks of development.

DNA USED FOR BUILDING THE WORLD'S TINIEST ANTENNA

"The DNA based nanoantennas can be synthesized with different lengths and flexibilities to optimize their function."



Like a two-way radio that can both receive and transmit radio waves, the fluorescent nanoantenna designed by Alexis Vallée-Bélisle and his team receives light in one color and depending on the protein movement it senses, then transmits light back in another color, which we can detect. One of the main innovations of these nanoantennas is that the receiver part of the antenna (bright green) is also employed to sense the molecular surface of the protein studied via molecular interaction. Credit: Caitlin Monney

Researchers at Université de Montréal have created a nanoantenna to monitor the motions of proteins. The device is a new method to monitor the structural change of proteins over time – and may go a long way to helping scientists better understand natural and human-designed nanotechnologies.

"The results are so exciting that we are currently working on setting up a start-up company to commercialize and make this nanoantenna available to most researchers and the pharmaceutical industry," said UdeM chemistry professor Alexis Vallée-Bélisle, the study's senior author.

AN ANTENNA THAT WORKS LIKE A TWO-WAY RADIO

Over 40 years ago, researchers invented the first DNA synthesizer to create molecules that encode genetic information. "In recent years, chemists have realized that DNA can also be employed to build a variety of nanostructures and nanomachines", added the researcher, who also holds the Canada Research Chair in Bioengineering and Bionanotechnology.

"Inspired by the 'Lego-like' properties of DNA, with building blocks that are typically 20,000 times smaller than a human hair, we have created a DNA-based fluorescent nanoantenna, that can help characterize the function of proteins." he said

"Like a two-way radio that can both receive and transmit radio waves, the fluorescent nanoantenna receives light in one color, or wavelength, and depending on the protein movement it senses, then transmits light back in another color, which we can detect."

One of the main innovations of these nanoantennae is that the receiver part of the antenna is also employed to sense the molecular surface of the protein studied via molecular interaction.

One of the main advantages of using DNA to engineer these nanoantennas is that DNA chemistry is relatively simple and programmable," said Scott Harroun, an UdeM doctoral student in chemistry and the study's first author.

"The DNA-based nanoantennas can be synthesized with different lengths and flexibilities to optimize their function," he said. "One can easily attach a fluorescent molecule to the DNA, and then attach this fluorescent nanoantenna to a biological nanomachine, such as an enzyme.

"By carefully tuning the nanoantenna design, we have created five nanometer-long antenna that produces a distinct signal when the protein is performing its biological function."

Fluorescent nanoantennas open many exciting avenues in biochemistry and nanotechnology, the scientists believe.

"For example, we were able to detect, in real time and for the first time, the function of the enzyme alkaline phosphatase with a variety of biological molecules and drugs," said Harroun. "This enzyme has been implicated in many diseases, including various cancers and intestinal inflammation.

"In addition to helping us understand how natural nanomachines function or malfunction, consequently leading to disease, this new method can also help chemists identify promising new drugs as well as guide nanoengineers to develop improved nanomachines," added Dominic Lauzon, a co-author of the study doing his PhD in chemistry at UdeM.

One main advance enabled by these nanoantennas is also their ease-of-use, the scientists said.

"Perhaps what we are most excited by is the realization that many labs around the world, equipped with a conventional spectrofluorometer, could readily employ these nanoantennas to study their favorite protein, such as to identify new drugs or to develop new nanotechnologies," said Vallée-Bélisle.

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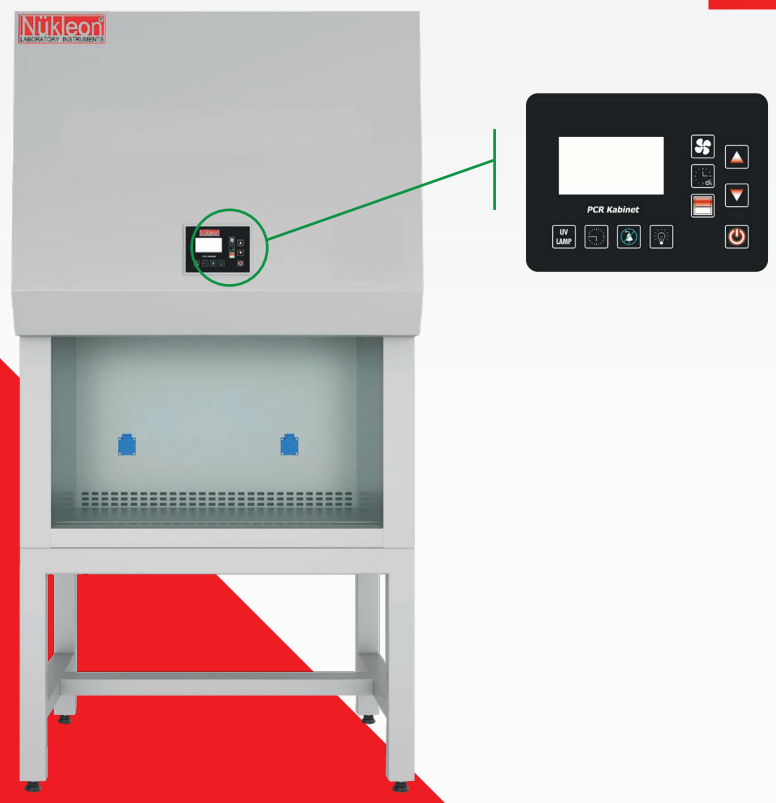

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INCREASED RED BLOOD CELL DESTRUCTION IN SPACE TRAVELS CAUSES ANEMIA

On Earth, our bodies create and destroy 2 million red blood cells every second, but astronauts are destroying 3 million red blood cells when they are onboard the International Space Station.

In a new study, a team of scientists from the Ottawa Hospital Research Institute and the University of Ottawa found that astronauts were destroying 54% more red blood cells during their 6-month missions onboard the International Space Station, or 3 million every second.

"Space anemia has consistently been reported when astronauts returned to Earth since the first space missions, but we didn't know why," said Professor Guy Trudel, a rehabilitation physician and researcher at the Ottawa Hospital Research Institute and the University of Ottawa.

"Our study shows that upon arriving in space, more red blood cells are destroyed, and this continues for the entire duration of the astronaut's mission."

Before the new study, space anemia was thought to be a quick adaptation to fluids shifting into the astronaut's upper body when they first arrived in space. Instead, the authors found that the red blood cell destruction was a primary effect of being in space, not just caused by fluid shifts. They demonstrated this by directly measuring red blood cell destruction in 14 astronauts during their six-month space missions.

"Thankfully, having fewer red blood cells in space isn't a problem when your body is weightless," Professor Trudel said.

"But when landing on Earth and potentially on other planets or moons, anemia affecting your energy, endurance, and strength can threaten mission objectives."

"The effects of anemia are only felt once you land, and must deal with gravity again."

In the study, five out of 13 astronauts were clinically anemic when they landed — one of the 14 astronauts did not have blood drawn on landing.

The researchers saw that space-related anemia was reversible, with red blood cells levels progressively returning to normal three to four months after returning to Earth.

Interestingly, they repeated the same measurements one year after astronauts returned to Earth, and found that red blood cell destruction was still 30% above preflight levels. These results suggest that structural changes may have happened to the astronaut while they were in space that changed red blood cell control for up to a year after long-duration space missions.
The discovery has several implications:

- It supports screening astronauts or space tourists for existing blood or health conditions that are affected by anemia;
- The longer the space mission, the worse the anemia, which could impact long missions to the Moon and Mars;
- Increased red blood cell production will require an adapted diet for astronauts;
- It's unclear how long the body can maintain this higher rate of destruction and production of red blood cells.

According to the scientists, their findings could also be applied to life on Earth.
"If we can find out exactly what's causing this anemia, then there is a potential to treat it or prevent it, both for astronauts and for patients here on Earth," Professor Trudel said.

OUR BRAIN SHOWS US 15 SECONDS 'IN THE PAST' TO SEE A STABLE WORLD

Our eyes gather millions of visual information to our brain. However defining and reorganizing them is not that easy for our brain.

On the one hand, the visual world alters continuously because of changes in light, viewpoint, and other factors. On the other, our visual input constantly changes due to blinking and the fact that our eyes, head, and body are frequently in motion.

To get an idea of the "noisiness" of this visual input, place a phone in front of your eyes and record a live video while you are walking around and looking at different things.

The jittery, messy result is exactly what your brain deals with in every moment of your visual experience.

Yet, seeing never feels like work for us. Rather than perceiving the fluctuations and visual noise that a video might record, we perceive a consistently stable environment.

So how does our brain create this illusion of stability? This process has fascinated scientists for centuries and it is one of the fundamental questions in vision science.

THE TIME MACHINE BRAIN

In latest research, scientists discovered a new mechanism that, among others, can explain this illusory stability.

The brain automatically smoothes our visual input over time. Instead of analyzing every single visual snapshot, we perceive in a given moment an average of what we saw in the past 15 seconds. So, by pulling together objects to appear more similar to each other, our brain tricks us into perceiving a stable environment.

Living "in the past" can explain why we do not notice subtle changes that occur over time.

In other words, the brain is like a time machine which keeps sending us back in time. It's like an app that consolidates our visual input every 15 seconds into one impression so that we can handle everyday life.

If our brains were always updating in real time, the world would feel like a chaotic place with constant fluctuations in light, shadow, and movement. We would feel like we were hallucinating all the time.

We created an illusion to illustrate how this stabilization mechanism works.

Looking at the video below, the face on the left side slowly ages for 30 seconds, and yet, it is very difficult to notice the full extent of the change in age. In fact, observers perceive the face as aging more slowly than it actually is.

To test this illusion we recruited hundreds of participants and asked them to view close-ups of faces morphing chronologically in age in 30-second timelapse videos.

When asked to tell the age of the face at the very end of the video, the participants almost consistently reported the age of the face that was presented 15 seconds before.

When we watch video, we are continuously biased towards the past and so the brain constantly sends us back to the previous ten to 15 seconds.

Instead of seeing the latest image in real time, humans actually see earlier versions because our brain's refresh time is about 15 seconds. So this illusion demonstrates that visual smoothing over time can help stabilize perception.

What the brain is essentially doing is procrastinating. It's too much work to constantly deal with every single snapshot it receives, so the brain sticks to the past because the past is a good predictor of the present.

Basically, we recycle information from the past because it's more efficient, faster, and less work.

This idea – which is also supported by other results – of mechanisms within the brain that continuously bias our visual perception towards our past visual experience is known as continuity fields.

Our visual system sometimes sacrifices accuracy for the sake of a smooth visual experience of the world around us. This can explain why, for example, when watching a film we don't notice subtle changes that occur over time, such as the difference between actors and their stunt doubles.

REPERCUSSIONS

There are positive and negative implications to our brain operating with this slight lag when processing our visual world. The delay is great for preventing us from feeling bombarded by visual input every day, but it can also risk life-or-death consequences when absolute precision is needed.

For example, radiologists examine hundreds of images in batches, seeing several related images one after the other. When looking at an X-ray, clinicians are typically asked to identify any abnormalities and then classify them.

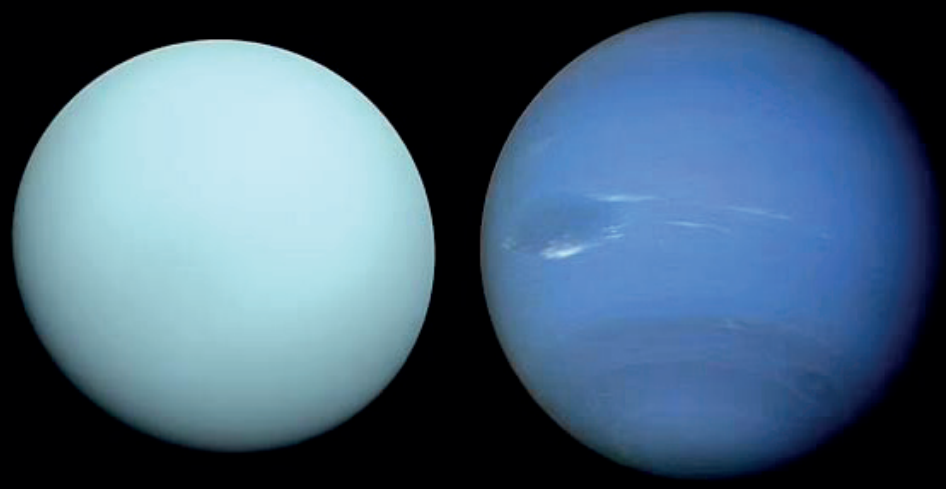
During this visual search and recognition task, researchers have found that radiologists' decisions were based not only on the present image, but also on images they had previously seen, which could have grave consequences for patients.

Our visual system's sluggishness to update can make us blind to immediate changes because it grabs on to our first impression and pulls us toward the past.

Ultimately, though, continuity fields promote our experience of a stable world. At the same time, it's important to remember that the judgments we make every day are not totally based on the present, but strongly depend on what we have seen in the past.

WHY THE 'ICY PLANETS' ARE DIFFERENT SHADES OF BLUE?

They are the far-away 'icy planets' of our solar system. However two of them glow a slightly different shade of blue.



The mystery of why Uranus (left) appears pale blue and Neptune (right) a deeper, cobalt hue may have finally been solved. The answer, scientists say, lies in the fact Uranus has a haze layer in its atmosphere that is roughly double the thickness of Neptune, giving it a paler colour.

Now the mystery of why Uranus appears paler than Neptune's deeper, cobalt hue may have finally been solved.

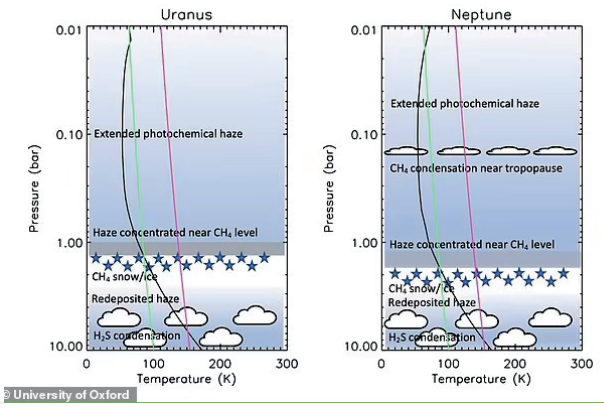
The answer, scientists say, lies in the fact Uranus has a haze layer in its atmosphere that is roughly double the thickness of Neptune, giving it the much lighter colour.

University of Oxford-led researchers termed this the Aerosol-2 layer, which they said would look whitish at visible wavelengths.

It acts to lighten the appearance of the seventh planet from the sun, in a similar way to how tracing paper over a picture makes vibrant colours seem more milky.

'This explains why Uranus is a paler blue colour than Neptune,' said the study's lead author Patrick Irwin, of the University of Oxford.

Both Uranus and Neptune have hydrogen, helium and methane in their skies, although hazes formed of other chemicals are also thought to exist at different altitudes, too.



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The thicker Aerosol-2 layer lightens the appearance of Uranus (shown in the diagram above), in a similar way to how tracing paper over a picture makes vibrant colours seem more milky.

The researchers believe these are likely created when methane is broken by ultraviolet radiation from the sun, before being remade into larger hydrocarbons.

It is this methane that also gives both Neptune and Uranus their blue appearance, according to the study's authors, because methane absorbs red light and leaves blue to be reflected back.

The researchers created models of the atmospheres of both worlds by using data from the Hubble Space Telescope and ground-based observatories, as well as information from the Voyager 2 spacecraft.

In their study, they wrote: 'The visible and near-infrared spectra of the solar system's 'ice giants', Uranus and Neptune, have fascinated planetary astronomers for many years.

'The atmospheres of the ice giants are observed to have similar atmospheres with similar tropospheric temperature profiles.'

They added: 'Both planets appear blue or bluish-green to the naked eye, in contrast to the more yellowish appearance of Jupiter and Saturn.

'We now know this blueness comes from a combination of this higher abundance of gaseous methane, which has strong absorption bands in the infrared and red portion of the visible spectrum.'

The researchers explained that their modelling found Uranus' atmosphere to be significantly thicker than that of Neptune.

This, they said, 'explains why Uranus appears to have a paler blue colour to the human eye than Neptune'.

Naomi Rowe-Gurney, who researches the atmospheres of Uranus and Neptune at NASA's Goddard Space Flight Center, told the New Scientist: 'Seeing both planets successfully compared directly in analysis is rare.

'The authors state that future observations will help to answer remaining questions and I am sure that the James Webb Space Telescope will help with this during the planned observations of both planets within the first year of operations.'

The research has been published in the journal Earth and Planetary Astrophysics.

HIBERNATING ANIMALS NEED MICROBES THROUGH WINTER TO SURVIVE

Microbes help hibernating animals, recycle nutrients and maintain muscle through winter. Discovery may help people with muscle wasting disorders and astronauts for their space voyages.

Thirteen–lined ground squirrels curled up for seasonal hibernation can slow their metabolic rates to as little as 1 percent of their waking activity. Credit: Photo courtesy Rob Streiffer

To get through a long winter without food, hibernating animals — like the 13–lined ground squirrel — can slow their metabolism by as much as 99 percent, but they still need important nutrients like proteins to maintain muscles while they hibernate. A new study from the University of Wisconsin–Madison shows that hibernating ground squirrels get help from microbes in their guts.

The discovery could help people with muscle–wasting disorders and even astronauts on extended space voyages.

"The longer any animal doesn't exercise, bones and muscles start to atrophy and lose mass and function," says Hannah Carey, an emeritus professor in the UW–Madison School of Veterinary Medicine and co–author of the new study, published on January 27, 2022, in the journal Science. "Without any dietary protein coming in, hibernators need another way to get what their muscles need."

One source of nitrogen, a vital building block for amino acids and proteins, accumulates in the bodies of all animals (including humans) as urea, a component of urine. The researchers knew that urea that moved into the squirrels' digestive tract could be broken down by some gut microbes, which also need nitrogen for their own proteins. But the researchers wanted to see if some of that urea nitrogen freed up by the microbes was also being incorporated into the squirrels' bodies.

They injected urea made with trackable isotopes of carbon and nitrogen into the blood of squirrels at three stages — during the active days of summer, early in winter hibernation, and late in winter. Some of the squirrels had also been treated with antibiotics to kill off the majority of the microbes in their intestines. As predicted, isotope–containing nitrogen was released by some of the gut microbes that degraded the injected urea.

"We followed that nitrogen to (the) livers (of the squirrels), primarily — where it is used to make many proteins — and some to muscles," says study co–investigator Fariba Assadi–Porter, an UW–Madison emeritus biochemist who specializes in tracking the isotopes. She is also a scientist in Integrative Biology and the university's Nuclear Magnetic Resonance Facility. "We believe we're seeing the isotope–labeled nitrogen molecules go from the host to the microbiome, then converted to usable molecules by the microbes before coming back to the host again, essentially being 'recycled' in the hibernating animal."

The researchers observed two differences that support this microbial path. The squirrels whose gut microbes were largely depleted by antibiotics had far less of the trackable nitrogen in their liver and muscles. And when the researchers sequenced the genomes of microbes found in the squirrels' guts, they found that as winter hibernation dragged on there was an increase in the presence of genes related to production of an enzyme called urease.

"Urease is not made by animals. Only microbes that express urease are able to split the urea molecule and release its nitrogen," says Carey, whose work is supported by the National Science Foundation. "As long as the right microbes are present, it's a transaction between them and the host — each get some of the nitrogen released to tide them over until hibernation ends."

Describing the keys to survival over the duration of hibernation could help people on low–nitrogen diets or with disorders that cause muscles to atrophy. It could also make it possible for humans to make lengthy trips to distant planets.

Putting space travelers into a hibernation–like state means they wouldn't need to take as much food, water, and oxygen, and would produce less waste and carbon dioxide, saving vast amounts of weight and fuel.

"This process could theoretically reduce rates of muscle loss in space, where microgravity exposure invariably leads to muscle atrophy," says Matthew Regan, a study co–author and former UW–Madison postdoctoral researcher who is now a professor of animal physiology at the University of Montreal. "And because characteristics of hibernation beyond this gut microbe–dependent process confer protection against other hazards of space flight such as ionizing radiation, it is theoretically possible that, if translated to humans, hibernation–like states could solve numerous challenges of human spaceflight simultaneously."

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