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COVID lessons from Japan: the right messaging empowers citizens

There's no perfect solution to suppress the pandemic, but careful study and communication are key.

[Hitoshi Oshitani](#)

Through six waves of COVID-19 in Japan, the number of cases and deaths per capita has been significantly lower than in other G7 countries. This is despite having the world's oldest population, and being densely packed. Yes, Japan has high vaccination rates, especially for older people, and masking is common. But neither of these is a full explanation. Deaths were low even before vaccines were available, and masks are common across Asia.

Japan has sought to understand the spread and risks of the disease and apply that to minimizing deaths and hospitalizations while maintaining social and economic activities. Trade-offs among these factors can be uneasy. Strong social pressure probably helped to boost protective measures, such as mask wearing, and minimized risky behaviours. Overall, the government quickly equipped its people with information to take protective action and avoided rigid prescriptions.

In 2003, I was the officer responsible for emerging diseases at the World Health Organization (WHO) Western Pacific regional office when the outbreak of severe acute respiratory syndrome (SARS) occurred: it was contained within eight months, with fewer than 1,000 deaths. When I first learnt of a similar coronavirus identified in China in people with pneumonia — SARS-CoV-2 — I thought perhaps the outbreak would follow a similar path.

I soon realized otherwise. With SARS, most people became severely ill. With COVID-19, many cases are mild or asymptomatic — and, unlike SARS, people can spread the disease without being sick. In other words, COVID-19 is far less 'visible' and so is harder

to contain.

Japan's constitution prohibits strict lockdowns, so another strategy was needed to suppress transmission. Heading into the pandemic, Japan had more than 8,000 public-health nurses across 400 public-health centres conducting 'retrospective' contact tracing for diseases, such as tuberculosis, to identify how people became infected — and that system was quickly adapted to COVID-19.

By the end of February 2020, scientists had identified many clusters of transmission and realized that most infected people did not infect anyone else, but a few infected many. From my past work, I knew that respiratory viruses are mainly transmitted through aerosols. My colleagues and I looked for common risk factors among superspreading events to come up with a more effective public-health message for the public. It incorporated early indications that SARS-CoV-2 could spread through aerosols.

This led us to warn against the '3Cs' (*sanmitsu*): closed environments, crowded conditions and close-contact settings. Even as other countries focused on disinfection, Japan promoted this concept extensively, by asking people to avoid high-risk activities such as karaoke bars, nightclubs and indoor dining. People largely complied. A panel of artists, academics and journalists named *sanmitsu* Japan's buzzword of the year in 2020.

Since the beginning of the pandemic, we've tracked how superspreading events differ. Other parts of the world have continued to flirt with 'going back to normal' by totally lifting restrictions, often in service of the economy, only to see cases soar again, with significant numbers of deaths. Simple solutions that help only the privileged and immunocompetent individuals cannot be accepted as a 'new normal' while vulnerable people bear the brunt of such policies. Current data suggest that Japanese citizens are adapting. In late April and early May, Japan celebrated its Golden Week holidays. This year, there were almost no special

restrictions on when restaurants had to close or whether they could serve alcohol. Crowds were up, but smaller than in the years before the pandemic, and precautions, such as finding ventilated spaces, were emphasized. In the earlier waves, people would relax as cases ebbed, prompting a subsequent wave. But behaviour after the surge earlier this year seems different, even with no restrictive measures in place.

The situation is becoming more complicated. People are reluctant to accept strict measures, even with the upsurge of cases, because vaccine coverage is high and Omicron fatality rates are lower. There are more interventions available, especially in a high-income country such as Japan: booster vaccinations, antivirals, better clinical care and public-health measures, such as CO₂ monitors to track ventilation in public buildings.

But there is no one silver bullet that can eliminate the virus. Certainly, Japan's response has not been perfect and has received criticism. It is true that the country's initial testing capacity was limited, but extensive testing is not enough to suppress transmission. Scientists and government advisers have to grapple with the fact that we do not yet know the right balance in the long term. They must understand that the behaviour of both the virus and people is subject to change — and adjust recommendations as such changes unfold.

Often, phrases such as 'exit strategy' or 'back to normal' are used by people longing for the days when we lived without the threat of this virus. But we are nowhere near back to normal. Nations must continue to seek the best balance between suppressing transmission and maintaining social and economic activities. How? By using all the tools at hand as they apply to cultures, traditions, legal frameworks and existing practices, to minimize suffering across the globe.

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Competing Interests H.O. has an unpaid consulting contract on COVID-19 with GlaxoSmithKline and has advisory roles for the government of Japan on COVID-19.

<https://bit.ly/3IP6ke7>

Ultrathin Fuel Cell Generates Electricity From Your Body's Own Sugar

Engineers have created a glucose power source that could fuel miniature implants and electronic sensors.

By Jennifer Chu, Massachusetts Institute of Technology

Glucose is a sugar we absorb from the foods we eat. It is the fuel that powers every cell in our bodies. Could glucose also power medical implants of the future?

Engineers at MIT and the [Technical University of Munich](#) think so. They have designed a new type of glucose fuel cell that converts glucose directly into electricity. The device is smaller than other proposed glucose fuel cells, measuring just 400 nanometers thick, or about 1/100 the width of a human hair. The sugary power source generates about 43 microwatts per square centimeter of electricity, achieving the highest power density of any glucose fuel cell under ambient conditions to date.



Silicon chip with 30 individual glucose micro fuel cells, seen as small silver squares inside each gray rectangle. Credit: Kent Dayton

The new device is also resilient, able to withstand temperatures up to 600 degrees Celsius (1,112 Fahrenheit). If incorporated into a medical implant, this high heat tolerance would allow the fuel cell to remain stable through the high-temperature sterilization process required for all implantable devices.

The core of the new device is made from ceramic, a material that retains its electrochemical properties even at high temperatures and miniature scales. The researchers envision the new design could be made into ultrathin films or coatings and wrapped around implants

to passively power electronics, using the body's ample glucose supply.

"Glucose is everywhere in the body, and the idea is to harvest this readily available energy and use it to power implantable devices," says Philipp Simons, who developed the design as part of his PhD thesis in MIT's Department of Materials Science and Engineering (DMSE). "In our work, we show a new glucose fuel cell electrochemistry."

"Instead of using a battery, which can take up 90 percent of an implant's volume, you could make a device with a thin film, and you'd have a power source with no volumetric footprint," says Jennifer L.M. Rupp, Simons' thesis supervisor and a DMSE visiting professor, who is also an associate professor of solid-state electrolyte chemistry at Technical University Munich in Germany.

Simons and his colleagues detailed their design recently in the journal *Advanced Materials*. Co-authors of the study include Rupp, Steven Schenk, Marco Gysel, and Lorenz Olbrich.

A "hard" separation

The inspiration for the new fuel cell came in 2016, when Rupp, who specializes in ceramics and electrochemical devices, went to take a routine glucose test toward the end of her pregnancy.

"In the doctor's office, I was a very bored electrochemist, thinking what you could do with sugar and electrochemistry," Rupp recalls.

"Then I realized, it would be good to have a glucose-powered solid state device. And Philipp and I met over coffee and wrote out on a napkin the first drawings."

The team is not the first to conceive of a glucose fuel cell, which was initially introduced in the 1960s and showed potential for converting glucose's chemical energy into electrical energy. But glucose fuel cells at the time were based on soft polymers and were quickly eclipsed by lithium-iodide batteries, which would become the standard power source for medical implants, most notably the

cardiac pacemaker.

However, batteries have a limit to how small they can be made, as their design requires the physical capacity to store energy.

"Fuel cells directly convert energy rather than storing it in a device, so you don't need all that volume that's required to store energy in a battery," Rupp says.

In recent years, scientists have taken another look at glucose fuel cells as potentially smaller power sources, fueled directly by the body's abundant glucose.

A glucose fuel cell's basic design consists of three layers: a top anode, a middle electrolyte, and a bottom cathode. The anode reacts with glucose in bodily fluids, transforming the sugar into gluconic acid. This electrochemical conversion releases a pair of protons and a pair of electrons. The middle electrolyte acts to separate the protons from the electrons, conducting the protons through the fuel cell, where they combine with air to form molecules of water — a harmless byproduct that flows away with the body's fluid. Meanwhile, the isolated electrons flow to an external circuit, where they can be used to power an electronic device.

The team looked to improve on existing materials and designs by modifying the electrolyte layer, which is often made from polymers. But polymer properties, along with their ability to conduct protons, easily degrade at high temperatures, are difficult to retain when scaled down to the dimension of nanometers, and are hard to sterilize. The researchers wondered if a ceramic — a heat-resistant material that can naturally conduct protons — could be made into an electrolyte for glucose fuel cells.

"When you think of ceramics for such a glucose fuel cell, they have the advantage of long-term stability, small scalability, and silicon chip integration," Rupp notes. "They're hard and robust."

Peak power

The researchers designed a glucose fuel cell with an electrolyte

made from ceria, a ceramic material that possesses high ion conductivity, is mechanically robust, and as such, is widely used as an electrolyte in hydrogen fuel cells. It has also been shown to be biocompatible. “Ceria is actively studied in the cancer research community,” Simons notes. “It’s also similar to zirconia, which is used in tooth implants, and is biocompatible and safe.”

The team sandwiched the electrolyte with an anode and cathode made of platinum, a stable material that readily reacts with glucose. They fabricated 150 individual glucose fuel cells on a chip, each about 400 nanometers thin, and about 300 micrometers wide (about the width of 30 human hairs). They patterned the cells onto silicon wafers, showing that the devices can be paired with a common semiconductor material. They then measured the current produced by each cell as they flowed a solution of glucose over each wafer in a custom-fabricated test station.

They found many cells produced a peak voltage of about 80 millivolts. Given the tiny size of each cell, this output is the highest power density of any existing glucose fuel cell design.

“Excitingly, we are able to draw power and current that’s sufficient to power implantable devices,” Simons says.

“It is the first time that proton conduction in electroceramic materials can be used for glucose-to-power conversion, defining a new type of electrochemistry,” Rupp says. “It extends the material use-cases from hydrogen fuel cells to new, exciting glucose-conversion modes.”

The researchers “have opened a new route to miniature power sources for implanted sensors and maybe other functions,” says Truls Norby, a professor of chemistry at the University of Oslo in Norway, who did not contribute to the work. “The ceramics used are nontoxic, cheap, and not least inert both to the conditions in the body and to conditions of sterilization prior to implantation. The concept and demonstration so far are promising indeed.”

Reference: “A Ceramic-Electrolyte Glucose Fuel Cell for Implantable Electronics” by Philipp Simons, Steven A. Schenk, Marco A. Gysel, Lorenz F. Olbrich and Jennifer L. M. Rupp, 5 April 2022, *Advanced Materials*. DOI: 10.1002/adma.202109075

<https://bit.ly/3GpD0V0>

Cancer Origin Identified by Scientists Through Cell “Surgery”

Research from the University of Warwick reveals new insights on a key cause of cancer formation during cell division (or mitosis), and points towards potential solutions for preventing it from occurring.

- When a cell divides abnormally, it does not share the correct number of chromosomes with the two new cells, which can lead to cancer.
- New research from Warwick Medical School has discovered why and how this happens, using “cell surgery.”
- Understanding the origin of abnormal cell division and cancer formation may lead to prevention.

When a cell divides normally, it makes a duplicate copy of every chromosome and then shares them equally between the two new cells. This function is carried out by a complex machine in the cell called the *mitotic spindle*.

If something goes wrong during this stage, the two new cells will be *aneuploid*, meaning that they will not have the correct number of chromosomes and will make mistakes when sharing genetic information.

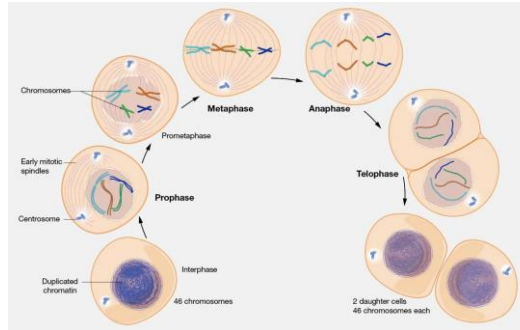
Cancer cells are *aneuploid*, so understanding how and why this happens is incredibly important in finding out how the disease originates. Professor Stephen Royle’s research team at Warwick Medical School has identified exactly this.

They found that some chromosomes can get lost and trapped in a tangle of membranes that exist in an area around the cell’s *spindle*, preventing the chromosomes from being shared properly and

leading to abnormal cell division that can cause cancer.

They made their discovery by performing a sort of ‘surgery’ on living cells. The researchers invented a way to remove the tangle of membranes in which chromosomes get trapped, and as a result, the chromosomes were rescued by the *spindle*, thus enabling normal healthy cell division.

This proved, for the first time, that chromosomes getting caught in these membranes is a direct risk factor for the formation of cancerous cells. Understanding this risk can lead to more effective cancer prevention.



Mitosis is the process through which a cell copies its chromosomes and then segregates them, producing two identical nuclei in preparation for cell division. Mitosis is generally followed by equal division of the cell's content into two genetically identical daughter cells. Credit: NIH

Stephen Royle, Professor of Cell Biology at Warwick Medical School, commented:

“Many scientists working on cell division focus on the spindle: how it works and why it makes mistakes in cancer. In this paper we shifted the spotlight and looked at membranes inside dividing cells.”

Dr. Nuria Ferrandiz, lead author of the study, said:

“We found that chromosomes can get trapped in membranes and this is a disaster for the dividing cell. It has the potential to change a normal cell into a cancer cell. Preventing this process may be a way to treat disease.”

Reference: “Endomembranes promote chromosome missegregation by ensheathing misaligned chromosomes” by Nuria Ferrandiz, Laura Downie, Georgina P. Starling and Stephen J. Royle, 28 April 2022, Journal of Cell Biology. DOI: [10.1083/jcb.202203021](https://doi.org/10.1083/jcb.202203021)

<https://nyti.ms/3LXOOHf>

Shards of the Planet Mercury May Be Hiding on Earth

New research explains how meteorites called aubrites may actually be shattered pieces of the planet closest to the sun from the early days of the solar system.

By [Jonathan O’Callaghan](#)

Mercury does not make sense. It is a bizarre hunk of rock with a composition that is unlike its neighboring rocky planets.

“It’s way too dense,” said David Rothery, a planetary scientist at the Open University in England.

Most of the planet, the closest to the sun, is taken up by its core. It lacks a thick mantle like Earth has, and no one is quite sure why. [One possibility](#) is that the planet used to be much bigger — perhaps twice its current bulk or more. Billions of years ago, this fledgling proto-Mercury, or super Mercury, could have been hit by a large object, stripping away its outer layers and leaving the remnant we see behind.

While a nice idea, there has never been direct evidence for it. But some researchers think they have found something. In work [presented at the Lunar and Planetary Science Conference](#) in Houston in March, Camille Cartier, a planetary scientist at the University of Lorraine in France, and colleagues said pieces of this proto-Mercury may be hiding in museums and other meteorite collections. Studying them could unlock the planet’s mysteries.

“We don’t have any samples of Mercury” at the moment, said Dr. Cartier. Gaining such specimens “would be a small revolution” in understanding the natural history of the solar system’s smallest planet.

According to [the Meteoritical Society](#), nearly 70,000 meteorites have been gathered around the world from places as remote as the Sahara and Antarctica, finding their way into museums and other collections. [Most are from asteroids](#) ejected from the belt between

Mars and Jupiter, while more than 500 come from the moon. More than 300 are from Mars.

Noticeably absent from these documented space rocks are confirmed meteorites from our solar system's innermost planets, Venus and Mercury. It is typically hypothesized that it is difficult, although not impossible, for detritus closer to the sun and its gravity to make their way farther out into the solar system.



The first aubrite to be discovered was found in France in 1836. It is now in a collection at the Natural History Museum in London. Credit...Jonathan O'Callaghan

Among a small number of meteorite collections are a rare type of space rock called aubrites. Named after the village Aubres in France, where [the first meteorite of this type was found in 1836](#), aubrites are pale in color and contain small amounts of metal. They are low in oxygen and seem to have formed in an ocean of magma. About 80 aubrite meteorites have been found on Earth.

For these reasons, they seem to match scientific models of conditions on the planet Mercury in earlier days of the solar system. "We have often said that aubrites are very good analogues for Mercury," Dr. Cartier said.

But scientists have stopped short of saying they are actually pieces of Mercury. Klaus Keil, a scientist at the University of Hawai'i at Manoa [who died in February](#), argued in 2010 that aubrites were more likely to have originated from other kinds of asteroids than something that was ejected from Mercury, with some scientists [favoring a group of asteroids in the belt](#) called E-type asteroids. Among his evidence were signs that aubrites had been blasted by the solar wind — something [Mercury's magnetic field](#) should have protected against.

Dr. Cartier, however, has another idea. What if aubrites originally came from Mercury?

Following from the hypothesis that a sizable object collided with a younger Mercury, Dr. Cartier said a large amount of material would have been thrown into space, about a third of the planet's mass. A small amount of that debris would have been pushed by the solar wind into what is now the asteroid belt, forming the E-type asteroids.

There, the asteroids would have remained for billions of years, occasionally smashing together and being continually blasted by the solar wind, explaining the solar wind fingerprint seen in aubrites. But eventually, she suggested, some pieces were pushed toward Earth and fell to our planet as aubritic meteorites.



An aubrite that fell in India in 1852, from the London Natural History Museum's collection, which has 10 total aubrites. Only a few dozen have been found on Earth. Credit...Jonathan O'Callaghan

Low levels of nickel and cobalt found in aubrites match what we would expect from the proto-Mercury, Dr. Cartier says, while data from [NASA's Messenger spacecraft that orbited Mercury](#) from 2011 to 2015 supports similarities between Mercury's composition and aubrites. "I think aubrites are the shallowest portions of the mantle of a large proto-Mercury," Dr. Cartier said. "This could resolve the origin of Mercury."

If true, it would mean that we have had pieces of Mercury — albeit a much more ancient version of the planet — hiding in drawers and display cases for more than 150 years.

"It would be fantastic," said Sara Russell, a meteorite expert at the Natural History Museum in London, who was not involved in Dr. Cartier's work. The museum has 10 aubrites in its collection.

Other experts have reservations about the hypothesis.

Jean-Alix Barrat, a geochemist at the University of Western Brittany in France and one of the few aubrite experts in the world, does not think there is enough aubritic material in meteorite collections to work out whether their contents match with models of the super Mercury. “The authors are a little bit optimistic,” he said. “The data they use is not sufficient to validate their conclusions.”

In response, Dr. Cartier said she removed possible contaminating rocks from her aubrite samples to get representative levels of nickel and cobalt, which she was “confident” are correct.

Jonti Horner, an expert in asteroid dynamics from the University of Southern Queensland in Australia, also was not sure whether material from Mercury could enter a stable orbit in the asteroid belt and hit Earth billions of years later. “It just doesn’t make sense to me from a dynamics point of view,” he said.

Christopher Spalding, an expert in planet formation at Princeton University and a co-author of Dr. Cartier’s study, says [his modeling shows](#) the solar wind can push material away from Mercury sufficiently to link it to E-type asteroids.

“The young sun was highly magnetic and spinning fast,” he said, turning the solar wind into a “whirlpool” that could send pieces of Mercury to the asteroid belt. Another possibility, yet to be modeled, is that the gravitational hefts of Venus and Earth scattered the material further out before some worked its way back to our planet.

Dr. Cartier’s proposal could be put to the test soon. A joint European-Japanese space mission called [BepiColombo is currently on its way to orbit Mercury](#) in December 2025. Dr. Cartier presented her idea to a group of BepiColombo scientists in early May.

“I was impressed by it,” said Dr. Rothery, a member of the BepiColombo science team. He said their mission could look for evidence of nickel in Mercury’s surface that would link the planet

more conclusively to collected aubrites.

It will not be “straightforward,” he notes, given that Mercury’s surface today will only resemble what is left behind from the proto-Mercury. But he said the results would “help feed into the modeling.”

Willy Benz, an astrophysicist from the University of Bern in Switzerland who first proposed the idea of a proto-Mercury, says that if aubrites do come from Mercury, they will add to evidence of an active and violent early solar system. “It will show that giant impacts are quite common,” he said, and that they “play an important role in shaping the architectures of planetary systems.”

Dr. Cartier is further testing her ideas by melting some aubrite samples under high pressure. If these experiments and the data from BepiColombo bolster her hypothesis, aubrites may suddenly be promoted from an oddity in our meteorite collections into some of the most remarkable meteorites ever collected — pieces of the solar system’s innermost world.

<https://bit.ly/3zjkBb5>

New Dinosaur Species Identified in Japan

A new genus and species of therizinosaurid dinosaur that lived during the Cretaceous period has been identified from the fossilized remains unearthed on Hokkaido, the northern island of Japan.

by [Enrico de Lazaro](#)

Dubbed *Paralitherizosaurus japonicus*, the newly-discovered dinosaur roamed our planet during the Upper Cretaceous epoch, some 72 million years ago.

The ancient beast belonged to [Therizinosauridae](#), a family of small to large, mainly herbivorous, theropod dinosaurs.

“Therizosaurs have been found mainly from the Cretaceous deposits in Mongolia and China,” said Hokkaido University Museum paleontologist [Yoshitsugu Kobayashi](#) and colleagues.

“All of the Early Cretaceous species, except *Falcarius*, have been named from China so far, and two species are recovered from northern (*Alxasaurus* from the Inner Mongolia) and northwestern (*Suzhousaurus* from Gansu Province) regions.”



Life reconstruction of Paralitherizinosaurus japonicus. Image credit: Masato Hattori.

“Other Chinese species (*Jianchangosaurus*, *Beipiaosaurus*, and *Lingyuanosaurus*) were recovered from the Jehol Group in the Liaoning Province of China, located in the eastern part of the country.”

“The Late Cretaceous therizinosaurs have been discovered from the Gobi Desert (Inner Mongolia of China and southern Mongolia) except for *Nanshiungosaurus* (Guangdong Province in the southeastern China along the Pacific).”

Fragmentary fossils of therizinosaurs are known from Japan, which was located at the eastern edge of the Asian continent during the Cretaceous period before the opening of the Japan Sea during the Miocene epoch.

One of these specimens, collected from the Osoushinai Formation in Nakagawa Town of Hokkaido Prefecture, was previously identified as a maniraptoran dinosaur, possibly therizinosaur, but its taxonomic status remained unresolved.

In the new study, Professor Kobayashi and co-authors re-examined the specimen and identified it as a new therizinosaurid species.

“*Paralitherizinosaurus japonicus* is the third therizinosaur specimen from Japan, following a single tooth from Honshu Island and a partial braincase, teeth, and humerus from Kyushu Island,” they said.

The species is also the youngest therizinosaur from Japan and the first recovered from the marine deposits in Asia.

“This suggests a long temporal existence of therizinosaurs at the eastern edge of the Asian continent and adaptation of therizinosaurs to coastal environments,” the authors concluded.

The [study](#) was published in the journal *Scientific Reports*.

Y. Kobayashi et al. 2022. New therizinosaurid dinosaur from the marine Osoushinai Formation (Upper Cretaceous, Japan) provides insight for function and evolution of therizinosaur claws. Sci Rep 12, 7207; doi: 10.1038/s41598-022-11063-5

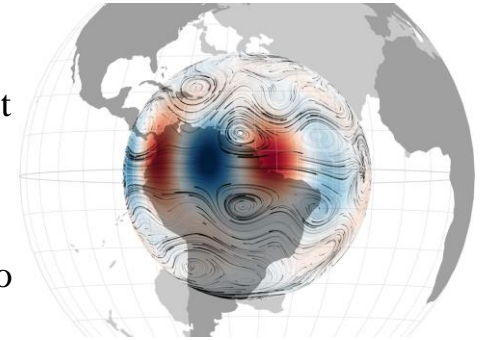
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Swarm satellites unveil magnetic waves that sweep the outermost part of Earth's outer core

Scientists have discovered a completely new type of magnetic wave that sweeps across the outermost part of Earth's outer core every seven years

by [European Space Agency](#)

While volcanic eruptions and earthquakes serve as immediate reminders that Earth's insides are anything but tranquil, there are also other, more elusive, dynamic processes happening deep down below the Earth. Using information from ESA's Swarm satellite mission, scientists have discovered a completely new type of magnetic wave that sweeps across the outermost part of Earth's outer core every seven years. This fascinating finding, presented at ESA's Living Planet Symposium, opens a new window into a world we can never see.



This mysterious wave oscillates every seven years and propagates westward at up to 1500 kilometres a year. These waves align in columns along Earth's axis of rotation. The motion and magnetic field changes associated with these waves are strongest near the equatorial region of the core. Credit:

University Université Grenoble Alpes

Earth's magnetic field is like a huge bubble protecting us from the onslaught of cosmic radiation and charged particles carried by powerful winds that escape the sun's gravitational pull and stream across the solar system. Without our magnetic field, life as we know it would not exist.

Understanding exactly how and where our magnetic field is generated, why it fluctuates constantly, how it interacts with [solar wind](#) and, indeed, why it is currently weakening, is not only of academic interest but also of benefit to society. For example, solar storms can damage [communication networks](#) and [navigation systems](#) and satellites, so while we can't do anything about changes in the magnetic field, understanding this invisible force helps to be prepared.

Most of the field is generated by an ocean of superheated, swirling liquid iron that makes up Earth's outer core 3,000 km under our feet. Acting like the spinning conductor in a bicycle dynamo, it generates electrical currents and the continuously changing electromagnetic field.

ESA's Swarm mission, which comprises three identical satellites, measures these magnetic signals that stem from Earth's core, as well as other signals that come from the crust, oceans, ionosphere and magnetosphere.

Since the trio of Swarm satellites were launched in 2013, scientists have been analyzing their data to gain new insight into many of Earth's natural processes, from space weather to the physics and dynamics of Earth's stormy heart.

Using information from ESA's Swarm satellite mission, scientists have discovered a completely new type of magnetic wave that sweeps across the outermost part of Earth's outer core every seven years. This fascinating finding opens a new window into a world we can never see. This mysterious wave oscillates every seven years and propagates westward at up to 1500 kilometres a year.

Credit: ESA/Planetary Visions

Measuring our magnetic field from space is the only real way of probing deep down to Earth's core. Seismology and mineral physics provide information about the material properties of the core, but they do not shed any light on the dynamo-generating motion of the liquid outer core.

But now, using data from the Swarm mission, scientists have unearthed a hidden secret.

A paper, published in the journal *Proceedings of the National Academy of Sciences*, describes how a team of scientists detected a new type of magnetic wave that sweeps across the "surface" of Earth's outer core, where the core meets the mantle. This mysterious wave oscillates every seven years and propagates westward at up to 1,500 kilometers a year.

Nicolas Gillet, from the University Université Grenoble Alpes and lead author of the paper, said, "Geophysicists have long theorized over the existence of such waves, but they were thought to take place over much longer time scales than our research has shown.

"Measurements of the magnetic field from instruments based on the surface of Earth suggested that there was some kind of wave action, but we needed the global coverage offered by measurements from space to reveal what is actually going on.

"We combined satellite measurements from Swarm, and also from the earlier German Champ mission and Danish Ørsted mission, with a computer model of the geodynamo to explain what the ground-based data had thrown up—and this led to our discovery."

Owing to Earth's rotation, these waves align in columns along the axis of rotation. The motion and magnetic field changes associated with these waves are strongest near the equatorial region of the core. While the research exhibits magneto-Coriolis waves near seven-year period, the question of the existence of such waves that would oscillate at different periods, however, remains.

Dr. Gillet added, "Magnetic waves are likely to be triggered by disturbances deep within the Earth's fluid core, possibly related to buoyancy plumes. Each wave is specified by its period and typical length-scale, and the period depends on characteristics of the forces at play. For magneto-Coriolis waves, the period is indicative of the intensity of the magnetic field within the core.

"Our research suggests that other such waves are likely to exist, probably with longer periods—but their discovery relies on more research."

ESA's Swarm mission scientist, Ilias Daras, noted, "This current research is certainly going to improve the scientific model of the [magnetic field](#) within Earth's outer core. It may also give us new insight into the electrical conductivity of the lowermost part of the mantle and also of Earth's thermal history."

More information: Nicolas Gillet et al, Satellite magnetic data reveal interannual waves in Earth's core, *Proceedings of the National Academy of Sciences* (2022). [DOI: 10.1073/pnas.2115258119](https://doi.org/10.1073/pnas.2115258119)

<https://go.nature.com/3PLvCHN>

‘Mind blowing’ ancient settlements uncovered in the Amazon

The urban centres are the first to be discovered in the region, challenging archaeological dogma.

[Freda Kreier](#)

Mysterious mounds in the southwest corner of the Amazon Basin were once the site of ancient urban settlements, scientists have discovered. Using a remote-sensing technology to map the terrain from the air, they found that, starting about 1,500 years ago, ancient Amazonians built and lived in densely populated centres, featuring 22-metre-tall earthen pyramids, that were encircled by kilometres of elevated roadways.

The complexity of these settlements is “mind blowing”, says team member Heiko Prümers, an archaeologist at the German

Archaeological Institute headquartered in Berlin.

“This is the first clear evidence that there were urban societies in this part of the Amazon Basin,” says Jonas Gregorio de Souza, an archaeologist at the Pompeu Fabra University in Barcelona, Spain.

The study adds to a [growing body of research](#) indicating that the Amazon

— long thought to have been pristine wilderness before the arrival of Europeans — was home to advanced societies well before that. The discovery was published on 25 May in *Nature*¹.



Researchers uncovered ancient urban centres on forested mounds in the Bolivian Amazon Basin. Credit: Roland Seitre/Nature Picture Library

A shift in thinking

Humans have lived in the Amazon Basin — a vast river-drainage system roughly the size of the continental United States — for around 10,000 years. Researchers thought that before the arrival of Europeans in the sixteenth century, all Amazonians lived in small, nomadic tribes that had little impact on the world around them. And although early European visitors described a landscape filled with towns and villages, later explorers were unable to find these sites.

By the twentieth century, archaeologists had yet to confirm the rumours, and argued that the Amazon’s nutrient-poor soil was unable to support large-scale agriculture, and that it would have prevented tropical civilizations — similar to those found in central America and southeast Asia — from arising in the Amazon. By the 2000s, however, archaeological opinion was beginning to shift. Some researchers suggested² that unusually high concentrations of domesticated plants, along with patches of unusually nutrient-rich soil that could have been created by people, might indicate that ancient Amazonians had indeed shaped their environment.

The hypothesis gained steam when, in 2018, archaeologists reported³ hundreds of large, geometric mounds that had been uncovered because of deforestation in the southern Amazon rainforest. These structures hinted at ancient organized societies capable of thriving in one location for years — but direct evidence of settlements was lacking.

In 1999, Prümers began studying a set of mounds in the Bolivian part of the Amazon Basin, outside the thick rainforest. There, a multitude of tree-covered mounds rise above a lowland area that floods during the rainy season.

Previous digs had revealed that these ‘forest islands’ contained traces of human habitation, including the remains of the mysterious Casarabe culture, which appeared around ad 500. During one excavation, Prümers and his colleagues realized that they had found what looked like a wall, indicating that a permanent settlement had once occupied the area. The researchers also found graves, platforms and other indications of a complex society. But dense vegetation made it difficult for them to use conventional methods to survey the site.

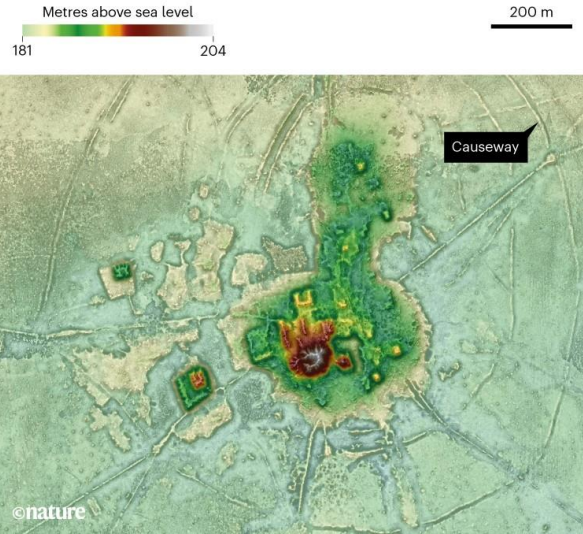
What lies beneath

By the 2010s, a technique called lidar — a remote-sensing technology that uses lasers to generate a 3D image of the ground

Name

THE SETTLEMENT BENEATH

Dense vegetation hid this ancient urban centre from view. Researchers unveiled it using a remote-sensing technique called lidar. The site in Bolivia, called Cotoca, had earthen pyramids (largest shown in red), terraces and elevated roads (causeways), and was occupied by the Casarabe culture between ad 500 and 1400.



Source: Ref. 1

Student number

below — had come into vogue with archaeologists. In 2012, a lidar survey of a valley in Honduras helped lead to the rediscovery of an ancient pre-Columbian city rumoured to exist in the area. The jungle had completely overtaken the settlement since it was abandoned in the fifteenth century, making it all but impossible to see from the air without lidar.

Prümers and his colleagues took advantage of lidar in 2019, when they flew a helicopter equipped with the technology over six areas near sites confirmed to have been occupied by the Casarabe people. The team got more than it bargained for, with lidar revealing the size and shape of 26 settlements, including 11 the researchers hadn't been looking for — a monumental task that would have taken 400 years to survey by conventional means, Prümers says.

Two of the urban centres each covered an area of more than 100 hectares — three times the size of Vatican City. The lidar images revealed walled compounds with broad terraces rising 6 metres above the ground. Conical pyramids made of earth towered above one end of the terraces (see ‘The settlement beneath’). People probably lived in the areas around the terraces and travelled along the causeways that connected the sites to one another.

“We have this image of Amazonia as a green desert — devoid of any type of culture,” Prümers says. But given that civilizations rose and thrived in other tropical areas, he notes, “Why shouldn't something like that exist here?”

Mysteries remain

Why these settlements were abandoned after 900 years is still a mystery. Radiocarbon dating has revealed that the Casarabe disappeared around 1400.

Prümers points out that lidar images revealed reservoirs in the settlements, perhaps indicating that this part of the world wasn't always wet — an environmental shift that might have driven people

away. However, consistent pollen records reveal⁴ that maize (corn) was grown in the area continuously for thousands of years, indicating sustainable agricultural practices.

At the very least, the discovery of long-lost Amazonian societies “changes the general perspective people have of Amazonian archaeology”, says Eduardo Neves, an archaeologist at the University of São Paulo in Brazil. Present-day logging and farming in the Amazon Basin are almost certainly destroying important archaeological sites that have yet to be discovered, he says, but a growing interest in Amazonian archaeology could lead to the protection of vulnerable places.

These discoveries also counter the narrative that Indigenous peoples were passive inhabitants of the Amazon Basin before the arrival of Europeans. “The people who lived there changed the landscape forever,” Neves says.

doi: <https://doi.org/10.1038/d41586-022-01458-9>

Updates & Corrections

Correction 26 May 2022: An earlier version of this story said that there are hundreds of tree-covered mounds rising above a lowland area in the Bolivian Amazon. Some estimates suggest there are many more than that.

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<https://bit.ly/38PbKTF>

How the Brain Links Memories

Our brains rarely record single memories—instead, they store memories into groups so that the recollection of one significant memory triggers the recall of others connected by time. As we age, however, our brains gradually lose this ability to link related memories.

[Elaine Schmidt](#)

Summary: Study reveals the CCR5 gene plays a critical role in linking memories in the brain. The HIV drug maraviroc suppresses the CCR5 gene and may be a potential new treatment to combat memory loss in older adults.

Now UCLA researchers have discovered a key molecular mechanism behind memory linking. They’ve also identified a way to restore this brain function in middle-aged mice – and an FDA-approved drug that achieves the same thing.

Published in *Nature*, the findings suggest a new method for strengthening human memory in middle age and a possible early intervention for dementia.

“Our memories are a huge part of who we are,” explained Alcino Silva, a distinguished professor of neurobiology and psychiatry at the David Geffen School of Medicine at UCLA. “The ability to link related experiences teaches how to stay safe and operate successfully in the world.”

A bit of Biology 101: cells are studded with receptors. To enter a cell, a molecule must latch onto its matching receptor, which operates like a doorknob to provide access inside.

The UCLA team focused on a gene called CCR5 that encodes the CCR5 receptor—the same one that HIV hitches a ride on to infect the brain cell and cause memory loss in AIDS patients.

Silva’s lab demonstrated in earlier research that CCR5 expression reduced memory recall.

In the current study, Silva and his colleagues discovered a central mechanism underlying mice’s ability to link their memories of two different cages. A tiny microscope opened a window into the animals’ brains, enabling the scientists to observe neurons firing and creating new memories.

Boosting CCR5 gene expression in the brains of middle-aged mice interfered with memory linking. The animals forgot the connection between the two cages.

When the scientists deleted the CCR5 gene in the animals, the mice

were able to link memories that normal mice could not.

Boosting CCR5 gene expression in the brains of middle-aged mice interfered with memory linking. The animals forgot the connection between the two cages. Image is in the public domain

Silva had previously studied the drug, maraviroc, which the U.S. Food and Drug Administration approved in 2007 for the treatment of HIV infection. His lab discovered that maraviroc also suppressed CCR5 in the brains of mice.

“When we gave maraviroc to older mice, the drug duplicated the effect of genetically deleting CCR5 from their DNA,” said Silva, a member of the UCLA Brain Research Institute. “The older animals were able to link memories again.”

The finding suggests that maraviroc could be used off-label to help restore middle-aged memory loss, as well as reverse the cognitive deficits caused by HIV infection.

“Our next step will be to organize a clinical trial to test maraviroc’s influence on early memory loss with the goal of early intervention,” said Silva. “Once we fully understand how memory declines, we possess the potential to slow down the process.”

Which begs the question: why does the brain need a gene that interferes with its ability to link memories?

“Life would be impossible if we remembered everything,” said Silva. “We suspect that CCR5 enables the brain to connect meaningful experiences by filtering out less significant details.”

The National Institute on Aging funded the research. UCLA postdoctoral researchers Yang Shen and Miou Zhou, now an assistant professor at Western University, coauthored the study.

Original Research: Closed access. “[CCR5 closes the temporal window for memory linking](#)” by Alcino Silva et al. *Nature*

Abstract

CCR5 closes the temporal window for memory linking

Real-world memories are formed in a particular context and are often not acquired or recalled in isolation. Time is a key variable in the organization of memories, as events that are experienced close in time are more likely to be

meaningfully associated, whereas those that are experienced with a longer interval are not. How the brain segregates events that are temporally distinct is unclear.

Here we show that a delayed (12–24 h) increase in the expression of C-C chemokine receptor type 5 (CCR5)—an immune receptor that is well known as a co-receptor for HIV infection—after the formation of a contextual memory determines the duration of the temporal window for associating or linking that memory with subsequent memories.

This delayed expression of CCR5 in mouse dorsal CA1 neurons results in a decrease in neuronal excitability, which in turn negatively regulates neuronal memory allocation, thus reducing the overlap between dorsal CA1 memory ensembles. Lowering this overlap affects the ability of one memory to trigger the recall of the other, and therefore closes the temporal window for memory linking.

Our findings also show that an age-related increase in the neuronal expression of CCR5 and its ligand CCL5 leads to impairments in memory linking in aged mice, which could be reversed with a *Ccr5* knockout and a drug approved by the US Food and Drug Administration (FDA) that inhibits this receptor, a result with clinical implications.

Altogether, the findings reported here provide insights into the molecular and cellular mechanisms that shape the temporal window for memory linking.

<https://bit.ly/3NIGkwK>

T. rex and its close relatives were warm-blooded like modern birds

Dinosaur blood ran hot and cold, scientists recently discovered.

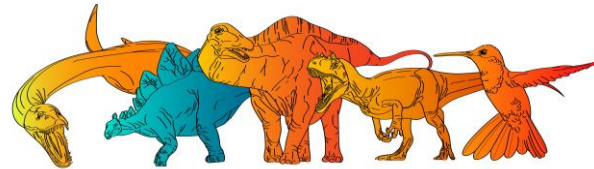
By [Cameron Duke](#)

Birds keep themselves warm with heat generated by some of the most hard-working metabolisms on the planet, while lizards rely on the sun to keep them toasty. Both of these groups are linked to [dinosaurs](#), and because of this, paleontologists have long wondered if dinosaurs had so-called cold-blooded [metabolisms](#) like their lizard cousins, or warm-blooded metabolisms like their avian relatives. Now scientists know the answer: It’s both.

An animal’s metabolism refers to how much energy its body uses to carry out normal functions. A higher metabolism — which requires

more energy to maintain — means that an animal can be more active, but the animal has to eat enough food and breathe enough oxygen to keep its metabolic engine running. As an added bonus, a high metabolism generates heat that keeps animals warm, hence the term warm-blooded, or endothermic. The opposite metabolic strategy requires less energy to maintain and is known as cold-blooded, or ectothermic. Cold-blooded animals need less oxygen and food than endothermic creatures but have to regulate their body temperatures with behavior.

Instead of generating their own heat, they maintain their internal temperature by basking in the sun or hiding in the shade.



Schematic drawing of a subset of the animals that were investigated as part of the study. Metabolic rates and resulting thermophysiological strategies are color-coded, orange hues characterize high metabolic rates coinciding with warm-bloodedness, and blue hues characterize low-metabolic rates coinciding with cold-bloodedness. From left to right: Plesiosaurus, Stegosaurus, Diplodocus, Allosaurus, Calypte (modern hummingbird).

Credit: J. Wiemann

"Birds inherited their exceptionally high metabolic rates from their dinosaur ancestors, which is pretty cool," Jasmina Wiemann, currently a postdoctoral researcher at CalTech and lead author on a new study about dinosaur metabolisms, told Live Science. In an analysis of 55 living and extinct species (many of them dinosaurs), Wiemann and co-authors found that warm-bloodedness, which is currently only seen in mammals and birds, was quite widespread among dinosaurs, but that not all dinosaurs were warm-blooded.

By analyzing species from various dinosaur groups, the team traced the evolution of warm-blooded and cold-blooded metabolisms through time. They found that dinosaurs descended from an ancestor were likely warm-blooded, but dinosaurs didn't all stay

that way. In the Triassic period, between 251.9 million and 201.3 million years ago, dinosaurs split into two major groups: the saurischians ("lizard-hipped" dinosaurs) and the ornithischians ("bird-hipped" dinosaurs). Evidence suggests that the saurischians, including meat-eating theropods like *Tyrannosaurus* and *Allosaurus* among many others, were warm-blooded creatures like their ancestors. Birds are descended from this lineage and have retained a warm-blooded metabolism.

The ornithischians, which include *Triceratops* and duck-billed *Hadrosaurus*, lost their fast metabolism over time and became cold-blooded species.



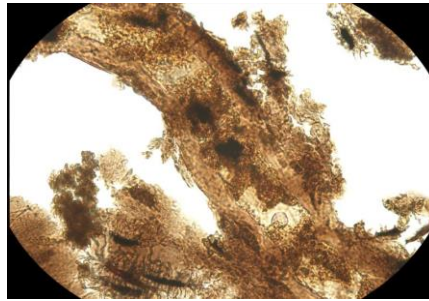
Though the ancestor of all dinosaurs was likely warm-blooded, only some lineages of dinosaurs, such as T. rex and other tyrannosaurs, retained that high-energy metabolism. (Image credit: Roger Harris/SPL)

This data backs up findings from prior research. For example, previous studies found that *Stegosaurus*, an ornithischian genus of armored plant-eaters, had an [exceptionally low growth rate](#) — a hallmark of a slow, cold-blooded metabolism. Another [study](#) found that hadrosaurs, a group of duck-billed plant eaters, seemed to have body temperatures that were far too variable for the animals to be warm-blooded. Other studies have pointed to warm-bloodedness, like the finding that some dinosaur species [lived year-round in the Arctic \(opens in new tab\)](#). This is the first study to show that dinosaurs had diverse metabolisms, and they follow an evolutionary pattern. "It's quite nice to get to the root of it and realize that these are true patterns, not just artifacts," Wiemann said.

According to Wiemann, studies that explored dinosaur metabolism had two big drawbacks. For one, they tended to infer metabolism indirectly by analyzing egg shell thickness, tooth structure, or isotopes — variations of an [element](#) with differing numbers of

neutrons — that are left over after fossilization. These are often used to determine growth rate or body temperature, which are proxies for metabolic rate. These proxies can give clues to an animal's metabolism, but don't measure the metabolism directly. Secondly, the methods used to conduct this research are often destructive and require that researchers damage fossils to tease out their secrets.

For the new study, instead of grinding priceless fossils to dust, Wiemann and her colleagues used a light-scattering microscope to determine the chemical makeup of dinosaur bones. Specifically, they looked for waste products from the metabolism itself (such as broken-down fats) which could hint at oxygen use in an animal's body — a direct measure of metabolic rate.



[Microscopic view of extracted soft tissues from the bones of one of the dinosaur specimens \(Allosaurus\) that were investigated for metabolic signals.](#)

(Image credit: Copyright J. Wiemann) (opens in new tab)

While this study supports findings from some previous work on dinosaur metabolisms, Wiemann's non-destructive sampling method might provide scientists with an unprecedented ability to explore metabolic evolution in other extinct lineages, not just dinosaurs.

This non-destructive method means paleontologists can delve into museum collections, "take a bone off the shelf and analyze it without any major preparation," Wiemann said. "For that reason, we could, for the first time, build one of these really large datasets that then actually connect the dots."

Deducing the patterns of metabolic evolution in dinosaurs has also raised questions about the metabolisms of living animals.

For example, birds are the only dinosaur group that survived the

mass extinction at the end of the Cretaceous period (approximately 145 million to 66 million years ago), so it might seem like their highly active metabolisms lent them an advantage. However, many other dinosaurs that seemed to have energy-hungry metabolic rates weren't so fortunate. Whether metabolism played much of a role in survival at this time is one question that Wiemann hopes might soon be answered.

The study also found that warm-blooded metabolisms appeared in three separate evolutionary lineages: in dinosaurs, in mammals, and in a group of extinct marine reptiles known as plesiosaurs. Not only did these lineages gain higher metabolisms independently of one another, they all did it around the same time, during the Triassic period. "I think it's quite fascinating to realize that it all happened around more or less the same time," said Wiemann.

Wiemann noted that future studies using the team's research method could expand scientists' knowledge of metabolic evolution. "They could eventually tell us what role mass extinctions and evolutionary bottlenecks actually play, in terms of creating the opportunity for different animal groups to expand and explore their metabolic capacities," said Wiemann. "I think there is something very exciting out there in the future."

The findings were published May 25 in the journal [Nature](#).

<https://bit.ly/3NIHx7u>

On your back? Side? Face-down? Mice show how we sleep may trigger or protect our brain from diseases like ALS

Recently, [we studied mice](#) and identified a new target in the fight against Amyotrophic lateral sclerosis: the brain's waste clearance system

Author David Wright¹

Amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease, is the [most common form](#) of motor neuron disease. People

with ALS progressively lose the ability to initiate and control muscle movements, including the ability to speak, swallow and breathe. There is no known cure. But recently, [we studied mice](#) and identified a new target in the fight against this devastating disease: the brain's waste clearance system.

[Neurodegenerative diseases](#) – including Parkinson's disease, Alzheimer's and multiple sclerosis – share many similarities, even though their clinical symptoms and disease progression may look very different. The incidence of these diseases increase with age. They are progressive and relentless, and result in gradual loss of brain tissue. We also see waste proteins accumulate in the brain.

Our new research looked at how the glymphatic system, which removes waste from the brain, could prevent ALS.

Protein chains, folds and misfolds

Inside our bodies, long protein chains fold to form functional shapes that allow them to perform [specific tasks](#) like creating antibodies to fight off infection, supporting cells or transporting molecules.

Sometimes this process goes awry, resulting in “misfolded” proteins that clump together to form aggregates. Misfolded protein can grow and fragment, creating seeds that spread throughout the brain to form new clusters.

The accumulation of waste proteins begins early in the neurodegenerative disease process – well before the onset of symptoms and brain loss. As researchers, we wanted to see if eliminating or slowing the spread of these waste proteins and their seeds could halt or slow the progression of disease.

Targeting waste removal

The [glymphatic system](#) removes waste, including toxic proteins, from the brain. This brain-wide network of fluid-filled spaces, known as [Virchow-Robin spaces](#), is mostly switched off while we're awake. But it kicks into gear during sleep to distribute

compounds essential to brain function and to get rid of toxic waste. This may explain why [all creatures](#), great and small ([even flies](#)), need sleep to survive. (Interestingly, whales and dolphins alternate their sleep between brain hemispheres, keeping the other hemisphere awake to watch for predators and alerting them to breathe!)

As we age, sleep quality [declines](#) and the risk of neurodegenerative disease, including ALS, increases.

Sleep disturbances are also a common symptom of ALS and research has shown a single night without sleep can result in [increased accumulation](#) of toxic waste protein in the brain. As such, we thought glymphatic function might be impaired in ALS.

Ageing mice

To investigate this, we looked to mice. The animals were genetically modified to express human TDP-43 – the protein implicated in ALS.

By feeding these mice food containing an antibiotic (doxycycline), we were able to turn the TDP-43 protein expression off and they aged normally. But when the mice are switched to normal food, TDP-43 expression is turned on and misfolded proteins begin to accumulate.

Over time, the mice display the classical signs of ALS including progressive muscle impairments and brain atrophy.

Using magnetic resonance imaging (MRI) to see brain structure, we investigated glymphatic function in these mice just three weeks after turning on TDP-43 expression.

As we watched the glymphatic system go to work, we saw the TDP-43 mice had worse glymphatic clearance than the control mice that had not been genetically modified. Importantly, these differences were seen very early in the disease process.

Our study provides the first evidence the glymphatic system might be a potential therapeutic target in the treatment of ALS.

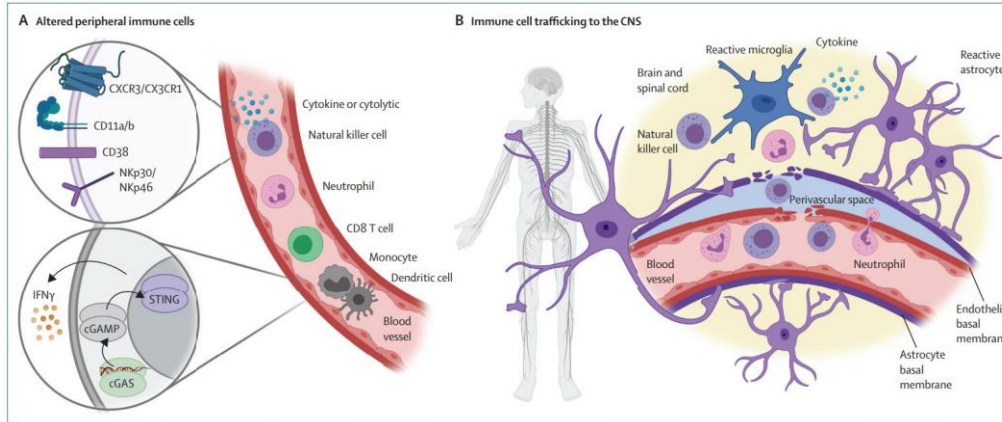


Figure 3: Inflammatory pathways in amyotrophic lateral sclerosis

(A) Various peripheral immune cell populations in blood have differential levels of expression in patients with amyotrophic lateral sclerosis, including innate (eg, neutrophils and natural killer cells) and adaptive (CD8 T cells) cells. In patients with amyotrophic lateral sclerosis, circulating natural killer cells over-express surface markers of cytotoxic function (eg, CD38, NKG2D, Nkp30, and Nkp46) and trafficking (eg, CD11a, CD11b, CXCR3, and CX3CR1). Circulating monocytes and dendritic cells expressing mutant TARDBP and C9orf72 repeat expansions increase IFN γ production. (B) Peripheral immune cells traffic to the CNS in patients with amyotrophic lateral sclerosis (eg, neutrophils and natural killer cells). This figure was created in BioRender. cGAMP= cyclic guanosine monophosphate-adenosine monophosphate. cGAS=cGAMP synthase. IFN γ =interferon γ . STING=stimulator of interferon genes protein.

How can we improve glymphatic function?

Not all sleep is equal. Sleep includes both rapid eye movement (REM) and non-REM sleep. This latter stage includes slow wave sleep – [when the glymphatic system is most active](#). Sleep therapies that enhance this phase may prove to be particularly beneficial for preventing diseases like ALS.

Sleep position is also thought to affect glymphatic clearance.

Research conducted in rodents has [demonstrated](#) glymphatic clearance is most efficient in the lateral (or side-sleeping) position, compared to either supine (on the back) or prone (front-lying) positions. The reasons for this are not yet fully understood but possibly relates to the effects of gravity, compression and stretching of tissue.

Lifestyle choices may be helpful in improving glymphatic function too. [Omega-3](#), found in marine-based fish, has long been considered to be beneficial to health and reduced risk of neurodegenerative diseases. New research shows these benefits may be partly due to the positive effect of [Omega-3 on glymphatic function](#).

Moderate consumption of alcohol has been shown to improve waste clearance. In mouse studies, both short and long-term exposure to [small amounts of alcohol were shown to boost glymphatic function](#) while high doses had the opposite effect.

[Exercise](#) has also been shown to be beneficial.

All these studies show small lifestyle changes can improve brain waste clearance to minimise the risk of neurodegenerative disease. Next, research needs to focus on therapies directly targeting the glymphatic system to help those already suffering from these debilitating diseases.

¹Associate Professor of Medical Imaging, Monash University

Disclosure statement David Wright receives funding from the NHMRC and FightMND. He has previously received funding from the Bethlehem Griffiths Research Foundation to investigate glymphatic function in ALS.

Partners [Monash University](#) provides funding as a founding partner of The Conversation AU. [View all partners](#)

<https://bit.ly/3lTgFpn>

Researcher describes how extraterrestrial civilizations could colonize the galaxy even if they don't have starships

Astronomers have searched for extraterrestrial civilizations in planetary systems for sixty years, to no avail.

In the paper published by *International Journal of Astrobiology*, Cambridge University Press, and titled "Migrating extraterrestrial civilizations and interstellar colonization: Implications for SETI and SETA," Irina K. Romanovskaya proposes that the search for extraterrestrial intelligence (SETI) may have more chances to become successful when including the search for migrating extraterrestrial civilizations.

For example, extraterrestrial civilizations may leave their home planetary systems when they face existential threats. One of the ways to do so is to ride free-floating planets. Free-floating planets can offer space and resources, as well as protection from space

radiation, for very large populations embarking on interstellar travel. It is most likely technically impossible that huge starships, also called world ships, can offer the same.

Extraterrestrial civilizations may also use free-floating planets to send biological or post-biological species to survey interstellar space, stars, and planetary systems, or to establish their colonies in several planetary systems to preserve and expand their civilizations even before they face existential threats at home.

In her paper, Romanovskaya discusses how extraterrestrial civilizations may hitch a ride on free-floating planets that are trespassing through their home planetary systems, or they may ride planet-like objects ejected from their planetary systems by dying host stars. Alternatively, extraterrestrial civilizations may use propulsion systems and gravity assist events to convert Sedna-type Oort-cloud objects of their planetary systems into free-floating planets and ride them among the stars.

Romanovskaya points out that with little starlight reaching free-floating planets, extraterrestrials could use controlled nuclear fusion as the source of energy, and they could inhabit subsurface habitats and oceans of the free-floating planets to be protected from space radiation. That would also prepare them for colonization of oceans in planetary systems.

Because free-floating planets cannot sustain their oceans forever and more exploration opportunities exist in planetary systems, extraterrestrial [civilizations](#) would ride free-floating planets to reach and colonize planets orbiting stars. Upon their close approach to planetary systems, the extraterrestrials could transfer from their free-floating planets to selected Oort-cloud objects of the planetary systems that would carry them inwards and towards the major planets of the planetary systems. Or, the planetary systems could capture such free-floating planets. Then, the extraterrestrials would colonize the planetary systems.

To discover extraterrestrials riding free-floating planets, Romanovskaya proposes to search for certain technosignatures—electromagnetic emissions produced by extraterrestrial technologies on the free-floating planets and in their vicinity—and in some cases, for matching signs of terraforming in a few planetary systems potentially indicating that one civilization riding free-floating planets could colonize them.

If astronomers detect technosignatures produced on a free-floating planet without detecting the free-floating planet itself, they could misinterpret the origin of the technosignatures. For example, on August 15, 1977, astronomers detected the famous Wow! signal in the constellation Sagittarius. Forty-five years later, scientists continue hypothesizing why the signal was detected only once.

According to Romanovskaya, if extraterrestrials sent the Wow! signal from an undetected free-floating planet and the planet moved away from the line of observations, then the Wow! signal would not be detected along that line of observations again. Thus, astronomers should search for free-floating planets along the lines of observations of unusual and potentially artificial signals coming from space.

Romanovskaya proposes there may be a very small chance that over the last few billions of years, free-floating planets with extraterrestrial intelligent species may have traveled in our stellar neighborhood, and she discusses different ways to look for their artifacts in the solar system and in the nearby planetary systems.

At present, somewhere in space, hundreds of light years away from Earth or closer than that, migrating intelligent biological species or post-biological beings with artificial intelligence may be riding free-floating planets and looking for a new home. Romanovskaya recommends that the search for such space travelers—the search for migrating [extraterrestrial intelligence](#) (SMETI)—should be part of our search for intelligent life in the universe.

More information: Irina K. Romanovskaya, Migrating extraterrestrial civilizations and interstellar colonization: implications for SETI and SETA, International Journal of Astrobiology (2022). DOI: [10.1017/S1473550422000143](https://doi.org/10.1017/S1473550422000143)

<https://bit.ly/3MZq5vs>

More Damaging Than Previously Thought: Glaciers Might Not Be Able To Recover From Climate Change

Ice shelves are floating extensions of glaciers. A new study, published in Nature Communications, found that if Greenland's second-largest ice shelf breaks up, it may not recover unless Earth's future climate cools considerably.

A group of researchers from [Stockholm University](#) and the [University of California, Irvine](#)

investigated whether the Petermann Ice Shelf in northern Greenland might recover from a future breakup caused by climate change. They employed a complex computer model to predict the ice shelf's potential recovery.



A crack in Petermann Ice Shelf was observed by an international team of scientists during the Oden expedition in 2019. These cracks can eventually grow across the entire ice shelf, leading to the release of large icebergs into the ocean and potentially breakup of the ice shelf. Credit: Martin Jakobsson

“Even if Earth’s climate stopped warming, it would be difficult to rebuild this ice shelf once it has fallen apart,” says Henning Åkesson, who led the study at Stockholm University.

“If Petermann’s ice shelf is lost, we would have to go ‘back in time’ towards a cooler climate reminiscent of the period before the industrial revolution to regrow Petermann,” Åkesson says.

Ice shelves reduce mass loss from our polar ice sheets. These gatekeepers thereby limit sea-level rise caused by climate warming.

“The rationale to avoid breakup of ice shelves in the first place should be clearer than ever”, Åkesson says.

Glaciers are rapidly melting

Petermann is one of Greenland’s few surviving ice shelves, and it is being closely monitored by experts throughout the globe after Manhattan-sized icebergs broke off from the ice shelf in 2010 and 2012, leading Petermann to lose 40% of its floating ice shelf. Scientists are afraid that additional ice shelf breakdown, or even collapse, may hasten ice flow from the interior ice sheet. In 2018, a new crack in the center of the ice shelf was found, raising additional concerns for Petermann’s health.

Ice-sheet experts are concerned

While this study focused on northwestern Greenland’s largest glacier, another grave concern is that the larger ice shelves found in Antarctica could be difficult to build back as well, should they break up too.

“This is just the first step, but chances are that our findings are not unique for Petermann Glacier and Greenland.” Åkesson says. “If they are not, near-future warming of the polar oceans may push the ice shelves protecting Earth’s ice sheets into a new retreated high-discharge state which may be exceedingly difficult to recover from.”

The ice-sheet experts stress that we need to pin down exactly how ice shelves break up, and how much more warming they now can withstand before they fall apart.

Reference: “Petermann ice shelf may not recover after a future breakup” by Henning Åkesson, Mathieu Morlighem, Johan Nilsson, Christian Stranne and Martin Jakobsson, 9 May 2022, Nature Communications. DOI: [10.1038/s41467-022-29529-5](https://doi.org/10.1038/s41467-022-29529-5)

<https://bit.ly/3N0LaFF>

Monkeypox may have been spreading in UK for years

This is one hypothesis to explain the monkeypox strain currently spreading.

By [Jeanna Bryner](#) published 1 day ago

The monkeypox virus may have been spreading at low levels in the United Kingdom for years now, only becoming detectable in the last month, according to health officials.

This is the first time the smallpox-related [virus](#) has spread locally outside of West and Central Africa, where it is endemic, as all known past cases outside Africa were related to foreign travel.



Monkeypox belongs to the Orthopoxvirus genus, which also includes variola virus (which causes smallpox), vaccinia virus (used in the smallpox vaccine) and cowpox virus. (Image credit: dotted zebra / Alamy)

As of May 25, more than 200 people across 20 countries are confirmed to have monkeypox, the [European Centre for Disease Prevention and Control \(opens in new tab\)](#) (ECDC) reported. Currently, about 106 cases are people in the U.K., according to the [U.K. Health Security Agency \(opens in new tab\)](#) (UKHSA). The majority of cases worldwide have been identified in men who have sex in men, and officials have tentatively traced the origin of the current outbreak to two raves, one in Spain and the other in Belgium, according to news reports.

Officials are now suggesting the possibility that local transmission of monkeypox has been occurring in the U.K. for two to three years. For instance, four monkeypox cases were reported in the U.K. between 2018 and 2019 in individuals who had traveled to Nigeria; another three cases from similar travel were confirmed there in 2021, [The Guardian reported \(opens in new tab\)](#).

"It could hypothetically be that the virus transmission amplified from this low level of transmission when by chance it entered the population that is at present amplifying transmission," Dr. David Heymann, an infectious disease epidemiologist and WHO advisor, told The Guardian. Heymann said further study is needed to confirm this hypothesis.

The genetic sequences of samples of the monkeypox virus in this outbreak show it is most similar to the monkeypox strain that was reported in the U.K., Israel and Singapore (from African travel) in

2018 and 2019, The Guardian said. Mutations to the current strain could have arisen over time as the virus spread at low levels in the U.K.

For the virus to have picked up these mutations, it must have been spreading in several individuals. "We know that chronic infection is not a plausible scenario, and that means there has been a chain of transmission events that apparently went unnoticed," Dr. Marc Van Ranst, a virologist at the University of Leuven in Belgium, told The Guardian.

Monkeypox infections show up first with flu-like symptoms along with swollen lymph nodes, according to the [Centers for Disease Control and Prevention \(opens in new tab\)](#) (CDC); one to three days after the fever begins, a person generally develops a rash that starts on the face and spreads across the body. That rash morphs into pus-filled "pimples" that scab over.

So how would such a visually apparent disease get overlooked?

"Between 2019 and 2020, if anybody came up with a rash in any part of Europe, you're not going to think of monkeypox, your thought would be other diseases that cause a rash," said Oyewale Tomori, a virologist and adviser to the Nigerian government, as reported by The Guardian.

If just a few cases are missed, those people can then spread the virus at a low rate to others, Tomori added.

Read the full story about monkeypox circulation in the U.K. at [The Guardian \(opens in new tab\)](#).