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NASA's Curiosity Rover Reports Back on "Most Chemically Diverse Part" of Gale Crater on Mars

ChemCam played a key role in analyzing new data.

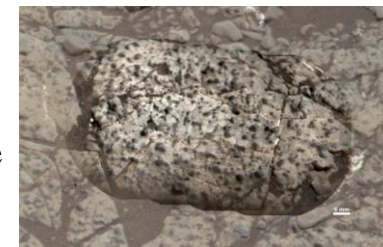
The first study of the Glen Torridon region in Mars' Gale crater reveals that groundwater altered the bedrock in the area during the planet's early history, which has crucial implications for understanding past habitability and the likelihood of finding past life on Mars. The findings, which were published in a special issue of the *Journal of Geophysical Research Planets*, reveal some of the early discoveries from the Glen Torridon region.

"The primary reason that the rover was sent to Mars was to investigate this region so we can understand the transition from an early, warm and wet Mars to a cold and dry one," said Patrick Gasda, of Los Alamos National Laboratory's Space and Remote Sensing group and lead author on the study. "This region probably represents the last stages of a wet Mars, and we want to understand the lake sediments in order to give us a baseline for what happened right before Mars' climate changed. It turns out this was a very active time in Mars' history."

The NASA Curiosity rover explored the ancient lakebed rocks within the Glen Torridon region from January 2019 to January 2021. During that time, the rover observed signs that the bedrock was changed by groundwater, especially in the higher elevations along the rover's path. The rover also discovered a surprisingly high number of nodules, veins, and other features related to water alteration of the bedrock.

The research team used data from the rover's ChemCam instrument, which was developed at Los Alamos and CNES (the French space agency), to record chemistry and images from the four cameras on the rover in order to look for physical and chemical changes to the rocks.

"First we saw a large number of dark-toned, rounded 'nodules' throughout the rock, and these features usually form in the soft sediments that are found in active lakes on Earth, so that's likely how they formed on Mars," Gasda said.



An image of a rock called "Ben Hee," taken with the ChemCam instrument. It shows bedrock filled with dark nodules, which usually form in soft sediments found in active lakes on Earth. Credit: NASA/JPL-Caltech/MSSS/LANL/IRAP-CNES

Then the rover observed large dark and white veins with strange chemistry, including high iron and manganese dark veins, and fluorine-rich lighter veins.

"These veins are very perplexing. We think, in the early stages of the crater, when the initial impact heated the rocks surrounding the crater, groundwater flowed through those rocks. We think this hot water likely extracted elements such as fluorine from these rocks," Gasda said. "High concentrations of fluorine are usually only found in hydrothermal systems on Earth. We did not expect to find veins with chemistry like this in Glen Torridon."

These hydrothermal systems could help researchers better understand habitability and prebiotic chemistry on Mars.

"If hydrothermal systems like these were active during the time of the lake, as we hypothesized in the paper, it would be very exciting," Gasda said.

These systems would bring redox elements (including iron, nickel, sulfur, and manganese) to the surface of Mars, and microbes use these elements to derive energy. On Earth, deep sea hydrothermal vents can produce hydrogen and methane gas, and some more complicated organic molecules; these are places that could have synthesized the basic building blocks of life on ancient Earth.

"The possibility of this existing on Mars is very cool," Gasda said.

These veins may be connected to other veins and nodules with enigmatic chemistry that have been found throughout the crater earlier in the mission. It could be that the crater was altered on a larger scale with groundwater that was related to the initial impact of the crater.

The rock beneath the crater likely remained warmer for longer than researchers initially thought, which would account for the higher concentration of elements such as fluorine in the groundwater. This groundwater could have circulated widely in the crater, forming other veins of varying chemistry for a long time after the crater initially formed.

Reference: Overview of the Morphology and Chemistry of Diagenetic Features in the Clay-Rich Glen Torridon Unit of Gale Crater, Mars by Patrick J. Gasda, J. Comellas, A. Essunfeld, D. Das, A. B. Bryk, E. Dehouck, S. P. Schwenzer, L. Crossey, K. Herkenhoff, J. R. Johnson, H. Newsom, N. L. Lanza, W. Rapin, W. Goetz, P.-Y. Meslin, J. C. Bridges, R. Anderson, G. David, S. M. R. Turner, M. T. Thorpe, L. Kah, J. Frydenvang, R. Kronyak, G. Caravaca, A. Ollila, S. Le Mouélic, M. Nellessen, M. Hoffman, D. Fey, A. Cousin, R. C. Wiens, S. M. Clegg, S. Maurice, O. Gasnault, D. Delapp and A. Reyes-Newell, 21 April 2022, *Journal of Geophysical Research Planets*. [DOI: 10.1029/2021JE007097](https://doi.org/10.1029/2021JE007097)
Funding: NASA Jet Propulsion Laboratory

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

When it comes to scorpions, it's the small ones you need to watch out for

Study confirms Indiana Jones line: Bigger scorpions are indeed less deadly

By [Elizabeth Pennisi](#)

Indiana Jones and the Kingdom of the Crystal Skull may not be the most beloved of the adventure series, but it did get at least one thing right: “When it comes to scorpions,” the titular adventurer quips, “the bigger, the better.” Now, Indy has the scientific evidence to back him up. Venom researchers have determined that larger scorpions are indeed less deadly, setting the stage for better treatments for scorpion stings.

“This is an excellent study,” says Bryan Fry, a venom researcher at

the University of Queensland, St. Lucia, who was not involved with the work. “It is a very rigorous interrogation of an age-old question.”

Scorpions sting more than 1 million people a year and kill more than 3000. Usually, the victims don't know what kind of scorpion nabbed them, so doctors have to guess about the best way to treat these stings.



This flat rock scorpion (Hadogenes granulatus), native to Mozambique, is such a gentle giant that that it is often sold as a pet. Piotr Naskrecki / Minden Pictures

A scorpion's toxin can cause everything from intense pain and numbness to muscle spasms, drooling, and an irregular heartbeat. Sedatives can help with muscle spasms, and medication can treat the pain. In some cases, doctors administer costly antivenom, but it can cause vomiting, fever, and rashes. And, despite treatment, some stings can still be deadly, especially if the victim has an allergic reaction. “Scorpions are a huge medical issue across the globe,” Fry says.

In the new study, Kevin Healy, an ecologist at the National University of Ireland, Galway, and colleagues combed the scientific literature for data on the body and claw size, claw and tail shape, and toxicity of as many of the 2500 species of scorpions as possible. Though in the end they analyzed only 36 species, those covered the gamut, from the walnut-size Mexican scorpion (*Centruroides noxius*) to the rock scorpion (*Hadogenes granulatus*), which is five times as big.

The rock scorpion's venom is a mild irritant, whereas venom from a few of [the tinier scorpions can send their victims into shock](#), the researchers found. Scorpions with slender pinchers were also on the deadlier side, they determined. The pattern of [smaller scorpions](#)

[being more dangerous](#) likely applies across all species, the team reported last month in *Toxins*.

The findings point to an evolutionary trade-off, Fry says. When they first appeared, scorpions relied on big, crablike claws to attack prey, he speculates. But once they evolved a deadly sting, they didn't need to grow big claws.

Spiders, another arachnid, seem to follow this trend, as well: Giant tarantulas have big fangs, but small venom glands, whereas slender black widows have tiny fangs and big venom glands. (Snakes, meanwhile, show no such pattern.)

Knowing that the size of a scorpion matters should give doctors a better handle on the best way to treat these stings, Healy says, such as whether antivenom is warranted.

And lest we give too much credit to *Crystal Skull*, Indy flubbed at least one fact about scorpions. Even though they only sting their victims, he tells a companion to watch out for their bites.

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A Tick Bite Made Them Allergic to Meat

And an organ-transplant company has an unexpected solution.

By [Sarah Zhang](#)

A few months ago, Candice Matthis and Debbie Nichols sat down with their husbands to have some bacon. It was an unremarkable scene, except for two details.

First, there were the EpiPens, which Matthis and Nichols both had ready in case of emergency. The two women can't eat red meat, not after they were each diagnosed with a dangerous red-meat allergy that develops, oddly enough, after tick bites. They had bonded as friends over their strange shared fate, where a strip of bacon could send them into anaphylactic shock. Matthis is so sensitive that even the airborne particles wafting off a pan of cooking meat typically make her sick.

But this time, nothing happened to her as the bacon sizzled. Her

EpiPen remained untouched. Nichols made herself a BLT. "It had been years," she told me. And for her, too, nothing happened, except that she remembered how good a BLT tasted.

Which brings us to the second remarkable thing about the meal. This bacon was not your regular bacon, or even your fancy pasture-raised, thick-cut bacon; this bacon was so exclusive that it's not available in stores. It came from Revivacor, a biotechnology company that genetically modifies pigs to create organs suitable for transplant into humans. (One of its pig hearts was experimentally transplanted into a human for the [first time this January](#).) It just so happens that the same molecule—a sugar called alpha-gal—that causes the human immune system to reject pig organs also causes the tick-associated red-meat allergy, known as alpha-gal syndrome. To make a pig whose organs could be harvested for transplant, Revivacor first had to make an alpha-gal-free pig. And when it did, the company realized that transplant surgeons weren't the only ones interested.

Since last fall, Revivacor has been quietly sending refrigerated packages of alpha-gal-free bacon, ham, ground pork, chops, and pork shoulders to people in the alpha-gal-syndrome community. These packages were free, but Revivacor has told the FDA it is exploring a [mail-order business](#). And so a biomedical company has found itself an accidental purveyor of specialty pork products.

Alpha-gal syndrome is an unusual allergy with an unusual history, even before genetically modified bacon entered the picture. It was considered a rare curiosity when it was first [discovered in 2008](#). Since then, the true prevalence of alpha-gal syndrome has begun to reveal itself; [tens of thousands of Americans](#) likely have it. And the tick species that causes this syndrome, the Lone Star tick, is spreading [across the United States too](#). Exactly how the bites of the Lone Star tick trigger this specific immune reaction to alpha-gal is still unknown. One hypothesis is that the tick's saliva [also contains](#)

[the sugar molecule.](#)

Although sometimes shorthanded as an allergy to red meat, alpha-gal syndrome is more accurately called an allergy to mammalian products. The molecule is found in the bodies of nearly all mammals [other than primates](#), where it likely functions as a molecular tag. It is in muscle and fat, which means steaks, bacon, and lamb chops are obvious no-no's for people with alpha-gal syndrome. But for people who are more sensitive to alpha-gal, dairy can also trigger a reaction. And for the small minority who are the most sensitive, avoiding alpha-gal means hunting for mammalian by-products hiding in the most unexpected places: drug capsules and [candy](#) (which can contain gelatin), face creams (collagen), and lip balm (lanolin). Even a wool sweater can make some people break out in hives.

To avoid alpha-gal, Matthis and Nichols—who blog about alpha-gal syndrome as the Two Alpha Gals—had to dramatically restructure their diets and their lives. “I was a huge Paleo person,” says Matthis, which obviously wasn't going to work anymore. She eventually went vegan.

Her entire family had to give up red meat at home because of her sensitivity to meat fumes. “They went through their own mourning,” she told me. It was hard, but they understood the danger; her teenage children have had to take her to the ER in anaphylactic shock. Eating in restaurants is a total minefield, so she packs a cooler of safe foods when she travels.

Nichols, for her part, went on a cruise a few months after she was first diagnosed, thinking she could just avoid beef, pork, and dairy. She woke up in the middle of the night in what she now understands to have been anaphylaxis. In retrospect, she must have accidentally eaten something of mammalian origin. She remembers pacing the top deck, trying desperately to breathe, and waking a nurse, who did not believe that she had such an allergy. “I'm never

going on a cruise again,” she told me. “Never!”

Skepticism from doctors and nurses is unfortunately not uncommon. Alpha-gal syndrome doesn't quite look like typical food allergies, says Scott Commins, an allergist at the University of North Carolina who originally helped discover the syndrome back in 2008. The symptoms usually appear hours after eating rather than immediately. “At 2 a.m., no one really in the ER thinks to ask what you had for dinner at 8 p.m.,” he told me. “The delay is a big issue.” And while some people have classic allergy symptoms such as hives and swelling of the lips and tongue, others tend to have [gastrointestinal issues](#), including abdominal pain and diarrhea. A diagnosis requires a test for antibodies against alpha-gal. Some patients told me they had a relatively easy time getting the test; others had to deal with doctors totally unfamiliar with alpha-gal. “Living in Nevada, nobody really has alpha-gal [syndrome] unless they moved here,” says Ilana Short, who lives in Las Vegas now but grew up in Tennessee. (Lone Star ticks are [currently found](#) in the eastern, southern, and midwestern United States, though they have been moving west.) She had unexplained hives for years before she was finally diagnosed.

Commins first got in touch with Revivacor years ago when he was looking into alpha-gal-free pigs as an experimental model to study the allergy. Revivacor, for its part, was not founded with niche food allergies in mind. It is and has always been focused on the goal of xenotransplantation, or animal-to-human organ transplants. Alpha-gal happens to be one of the biological obstacles to that goal. Because human bodies don't naturally produce this molecule, its presence on, say, a pig organ causes immune rejection. To get around this, Revivacor had to create a pig lacking a functional gene for alpha-gal. If this strategy to get around the immune system worked for transplants, it could work for food allergies too.

Again, Revivacor was focused on transplants. “We didn't at first

think there were enough patients with alpha-gal syndrome to really be a blip on their radar screen,” Commins told me. But over time, the community of people with the syndrome has grown larger and larger. They joined Facebook groups to swap information and tips and recipes. And some of them started reaching out to Revivacor about its alpha-gal-free pigs.

One of these people with alpha-gal syndrome happened to be Steve Troxler, who is, ironically enough, the agriculture commissioner of North Carolina, one of the top hog-producing states in the nation. “Part of my job as a commissioner of agriculture is to be able to eat more barbecue than any human being on the face of the Earth,” he says, which became rather awkward when he developed [the allergy in 2017](#). When Troxler heard about Revivacor, he saw the benefit both for people with alpha-gal syndrome and, potentially, for North Carolina. He sprang into action.

With his decades of agriculture-industry experience, Troxler knew which people at the FDA to introduce the company to and how to navigate the complex regulatory process. “It kind of became a part of my life’s work to try to help get this product to the market,” he told me.

The agency took [20 years](#) to approve the first genetically modified animal for food, the AquaBounty salmon. Troxler was proud to help get Revivacor’s pig—only the second genetically modified food animal—approved in a relatively speedy two years. In [December 2020](#), the FDA gave Revivacor’s GalSafe pig an official stamp of approval. (These pigs are not, by the way, the exact same pigs whose organs were used in the much-publicized pig-heart transplant or in two recent kidney transplants [into brain-dead patients](#). Xenotransplantation requires a [suite of additional genetic modifications](#) to minimize rejection and make the organs comparable in size to humans’.)

The original herd of GalSafe pigs at the time of approval was

small—reportedly numbering [just 25](#). And Revivacor still has a long road to travel to commercial availability. The pigs are currently raised at a [facility in Iowa](#), but Troxler hopes to set up a bigger production plant in, of course, North Carolina, with the alpha-gal-free pork hitting the market in 18 months. Revivacor has been very tight-lipped about its plans for commercializing GalSafe pork. The company, which rarely grants media interviews, declined to comment for this story.

Late last year, though, the company began offering free samples of GalSafe pork products in limited quantities. An order form began to circulate among the alpha-gal support groups on Facebook. Amber Shifflett received her order of four ham steaks and four packs of ground pork last fall. She had had to give up her beloved steaks and bacon breakfasts when she was diagnosed with alpha-gal syndrome earlier in the year. Now she has carefully rationed her precious stock of alpha-gal-free pork. She ate the ham steaks for Christmas. “That was my Christmas present to myself,” she told me. The ground pork is still in her freezer, waiting for a special occasion. “I’m so hesitant because they’re the last of my samples,” she said. Maybe she’ll have them for a cookout this summer, when everyone else is chowing down on red meat. She is still researching the right recipe.

The half-dozen people I talked with who tried the Revivacor meat all had good experiences. Troxler, in his expert opinion, said the pork tasted just like normal pork. No one had allergic reactions. “The only bad thing is it reminded me how delicious pork is,” says Sharon Forsyth, who has had the syndrome for three years and runs the site Alpha-gal Information. Scott Commins is about to begin a study, funded by Revivacor, to formally confirm the pork’s safety for people with alpha-gal syndrome, because the FDA approval was just for general consumption.

As nice as it was to taste pork again, those who tried Revivacor’s

pork told me, it didn't solve the challenges of living with alpha-gal. Some missed eating bacon more than others, but they all missed the carefreeness they hadn't known they'd once enjoyed. "I miss being able to have a normal life," Forsyth said. "I miss being able to travel. I miss being able to eat out without it always being an ordeal." One of her good friends lives in Madagascar, but she can't fathom traveling to a country where she doesn't speak the language and where she would have to ask about the presence of meat and dairy and hidden mammalian ingredients such as gelatin in everything she used or ate.

It's not just food and personal care products she worries about. [Mammalian by-products](#) are also used [widely in medicine](#): Replacement heart valves come from pigs or cows; vaccines can contain additives such as glycerin or bovine extract; gelatin is in drug capsules; sutures can have collagen; and monoclonal antibodies can be derived from mammals or mammalian cell lines. In fact, [one of the first pieces of evidence](#) that clued scientists in to alpha-gal syndrome was when cancer patients in areas with ticks started reacting to a mouse-derived monoclonal-antibody treatment. Most people with alpha-gal syndrome are not so sensitive that they have to avoid all of these medical products, but some are. Imagine that you're sick in a hospital, Forsyth said, and you have to worry about reacting to not just the food you eat but the drugs you're given.

But Revivacor's pigs could offer a safer alternative here, too. "Having pork is great," Commins said. "But to me it's really the medical uses of these animals that can be really helpful for patients." They might not be as sci-fi as transplanting whole pig organs, but alpha-gal-free sutures and heart valves would matter to these patients. The genetically modified pigs that were created for xenotransplant research and then turned into niche pork products might become medical products again.

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Calcium Supplements Linked to Earlier Death in Older People With Heart Valve Disease

Calcium supplements are linked to an increased risk of death among those with aortic valve stenosis

Calcium supplements, which are frequently given to older people to lessen the risk of brittle bones (osteoporosis) and fractures, are linked to an increased risk of death among those with aortic valve stenosis, a progressive and potentially fatal condition, according to new research published online in the journal *Heart*.

What's more, the findings show these supplements, whether or not they are coupled with vitamin D, seem to worsen the condition, which is the most common form of heart valve disease in adults in the developed world.

Aortic stenosis occurs when the aortic valve, the main outflow valve of the heart, stiffens and narrows. This means it can no longer open fully, reducing or blocking blood flow from the heart into the main artery (aorta) and the rest of the body.

The only effective treatment is the replacement of the faulty valve, a procedure known as AVR (aortic valve replacement).

The association between dietary and supplemental calcium or vitamin D with cardiovascular disease risk and death is hotly contested. Yet evidence on their safety is mostly derived from animal studies, and the prescription of both these supplements has risen sharply in recent years, particularly among postmenopausal women, point out the researchers.

The researchers therefore wanted to see what potential impact these supplements might have on death from any cause and from cardiovascular disease, the need for AVR, as well as progression of aortic stenosis among older people. They therefore tracked the heart health of 2657 patients (average age 74;42% women) with mild to moderate aortic stenosis between 2008 and 2018: the average

monitoring period was more than 5.5 years.

Participants were divided into those not taking any supplements (1292;49%), those supplemented with vitamin D alone (332;12%), and those given calcium plus or minus vitamin D supplements (1033;39%), 115 of whom took just a calcium supplement.

Those taking supplements had significantly more diabetes and coronary artery disease than those not taking supplements. They were also more likely to be taking statins, warfarin, and phosphate binders (to limit phosphorus absorption), to have had a coronary artery bypass graft and to need kidney dialysis.

During the monitoring period, 540 (20.5%) people died: 150 died of cardiovascular disease; 155 died of other causes; and 235 died of unknown causes. And 774 (29%) people had their aortic valve replaced. More than a third of people in each of the groups developed severe aortic stenosis after 5 years.

Supplemental vitamin D alone didn't seem to affect survival. But supplemental calcium plus vitamin D was associated with a significantly higher (31%) risk of death from any cause and a doubling in the risk of a cardiovascular death. And it was associated with a 48% heightened risk of AVR compared with those not taking supplements.

Supplemental calcium alone was also associated with a heightened risk of death from any cause (24%) and a near tripling in the risk of AVR. And the risks of death from any cause and from cardiovascular disease were also higher among those taking calcium supplements who didn't have their aortic valve replaced.

This is an observational study, and therefore can't establish cause. Those taking supplements also had more risk factors for heart disease and death than those who weren't and the quantities of calcium intake from diet and supplements weren't assessed.

But the researchers nevertheless conclude: "Strengthened by its large sample size and extended follow-up period, our study

suggests that calcium supplementation does not confer any [cardiovascular] benefit, and instead may reflect an elevated overall risk of AVR and mortality, especially in those not undergoing AVR."

In a linked editorial, Professor Jutta Bergler-Klein, of the Medical University of Vienna, points out that billions of dollars are spent every year on vitamin and mineral supplements for older people in the belief that these benefit health.

But we may need a rethink—at least when it comes to calcium supplements—she suggests, adding that the study findings should give doctors treating osteoporosis in people with heart disease, pause for thought.

"In patients with calcific [aortic stenosis] and high-risk [cardiovascular disease], the present study strongly adds to the evidence that long-term continuous calcium supplementation should be avoided if not mandatory," she writes.

References:

"Supplemental calcium and vitamin D and long-term mortality in aortic stenosis" by Nicholas Kassis, Essa H Hariri, Antonette K Karrthik, Keerat R Ahuja, Habib Layoun, Anas M Saad, Mohamed M Gad, Manpreet Kaur, Najdat Bazarbashi, Brian P Griffin, Zoran B Popovic, Serge C Harb, Milind Y Desai and Samir R Kapadia, 25 April 2022, *Heart*. DOI:10.1136/heartjnl-2021-320215

"Calcium, vitamin D and aortic valve calcification: to the bone or to the heart?" by Jutta Bergler-Klein, 25 April 2022, *Heart*. DOI:10.1136/heartjnl-2021-320672

<https://bit.ly/3Kswz3U>

Edible, fluorescent silk tags could help stem tide of counterfeit medicines

Edible matrix code made of silk that can be attached to tablets or added to liquids as an anticounterfeiting measure

By Helen Albert

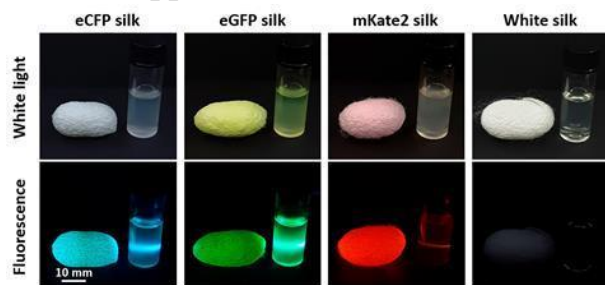
A group of researchers based in the US and Korea have developed and tested an edible matrix code made of silk that can be attached to tablets or added to liquids as an anticounterfeiting measure. The tag is made of silk and is invisible to the eye, but can be picked up by

specific optical filters on a smartphone camera that can pick up fluorescence.

Drug counterfeiting is an increasing problem. Every year it causes thousands of deaths and poisonings, and recent increases in online sales have only made the problem harder to manage.

‘There are approximately 40,000 online pharmacies that one can access via the Internet. Only three to four percent of them are operated legally,’ explains [Young Kim](#), a researcher at Purdue University who co-led the research.

Most anti-counterfeit measures are applied to medicine boxes, but some other ‘on-dose’ tags do exist, such as [DNA tags](#). The problem with these is they mostly require skilled personnel and expensive machinery to process.



Photographs and fluorescence images of the silk tag technology, compared with a non-transgenic white silk cocoon Source: © 2022 [Jung Woo Leem et al](#)

Kim and colleagues [previously developed](#) transgenic silk worms in South Korea that produce silk proteins in three distinct fluorescing colours to create anti-counterfeit tags. In the [new study](#), they tested the technology more broadly, including adding tags to tablets and high-alcohol liquids, and training a smart phone application to read them.

Several factors need to be addressed before the system can be rolled out, however. ‘We need to scale up in terms of production,’ says Kim, who is currently discussing the best way to do this with several pharmaceutical companies. He says estimated material costs are low, at 1-2 cents per pack, but adds that future labour costs are harder to estimate. A possible scale-up approach includes adding tags directly during manufacturing. ‘That’s definitely the best case,’

says Kim, but adds that some kind of ‘sticker’ including the tag could also be attached to the medicines.

The ingestible nature of the tags, means FDA approval will have to be sought. But Kim is confident that this will not be a problem. ‘The good thing is silk proteins are now “generally recognised as safe”,’ he explains, an official FDA designation for non-toxic food materials.

[Natalja Genina](#), a pharmacist at the University of Copenhagen focused on anticounterfeiting materials, applauds the innovative nature of the technology. However, she says ‘making sure that they can generate and store the data, and that everyone has access to this data, could be a challenge’.

[Tim Mackey](#), a professor at the University of California, San Diego specialising in drug counterfeiting research, says lack of knowledge could also be a problem. ‘A lot of consumers aren’t aware of the counterfeiting medicines issue,’ he explains.

Kim concedes that more work is needed before patients can directly check their own medicines. Initially he and his colleagues plan to work with health care professionals to trial the anti-counterfeiting technology further.

An additional proposed application of the technology is monitoring patient adherence in clinical trials. The team also thinks the tags could help monitor counterfeiting of drinks such as whisky, as a high alcohol content is needed for the tags to maintain structural integrity.

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

All of the bases in DNA and RNA have now been found in meteorites

The discovery adds to evidence that suggests life’s precursors came from space

By [Liz Kruesi](#)

More of the ingredients for life have been found in meteorites.

Space rocks that fell to Earth within the last century [contain the five bases that store information in DNA and RNA](#), scientists report April 26 in *Nature Communications*.



A 2-gram chunk from this rock — a piece of the meteorite that fell near Murchison, Australia, in 1969 — contains two crucial components of DNA and RNA now identified for the first time in an extraterrestrial source, researchers say. NASA

These “nucleobases” — adenine, guanine, cytosine, thymine and uracil — combine with sugars and phosphates to make up the genetic code of all life on Earth. Whether these basic ingredients for life first came from space or instead formed [in a warm soup of earthly chemistry](#) is still not known (SN: 9/24/20). But the discovery adds to evidence that suggests life’s precursors originally came from space, the researchers say.

Scientists have detected bits of [adenine, guanine](#) and other organic compounds in meteorites [since the 1960s](#) (SN: 8/10/11, SN: 12/4/20). Researchers have also seen hints of uracil, but cytosine and thymine remained elusive, until now.

“We’ve completed the set of all the bases found in DNA and RNA and life on Earth, and they’re present in meteorites,” says astrochemist Daniel Glavin of NASA’s Goddard Space Flight Center in Greenbelt, Md.

A few years ago, geochemist Yasuhiro Oba of Hokkaido University in Sapporo, Japan, and colleagues came up with a technique to gently extract and separate different chemical compounds in liquified meteorite dust and then analyze them.

“Our detection method has orders of magnitude higher sensitivity than that applied in previous studies,” Oba says. Three years ago,

the researchers used this same technique to [discover ribose, a sugar needed for life, in three meteorites](#) (SN: 11/22/19).

In the new study, Oba and colleagues combined forces with astrochemists at NASA to analyze one of those three meteorite samples and three additional ones, looking for another type of crucial ingredient for life: nucleobases.

The researchers think their milder extraction technique, which uses cold water instead of the usual acid, keeps the compounds intact. “We’re finding this extraction approach is very amenable for these fragile nucleobases,” Glavin says. “It’s more like a cold brew, rather than making hot tea.”

With this technique, Glavin, Oba and their colleagues measured the abundances of the bases and other compounds related to life in four samples from meteorites that fell decades ago in Australia, Kentucky and British Columbia. In all four, the team detected and measured adenine, guanine, cytosine, uracil, thymine, several compounds related to those bases and a few amino acids.

Using the same technique, the team also measured chemical abundances within soil collected from the Australia site and then compared the measured meteorite values with that of the soil. For some detected compounds, the meteorite values were greater than the surrounding soil, which suggests that the compounds came to Earth in these rocks.

But for other detected compounds, including cytosine and uracil, the soil abundances are as much as 20 times as high as in the meteorites. That could point to earthly contamination, says cosmochemist Michael Callahan of Boise State University in Idaho. “I think [the researchers] positively identified these compounds,” Callahan says. But “they didn’t present enough compelling data to convince me that they’re truly extraterrestrial.” Callahan previously worked at NASA and collaborated with Glavin and others to measure organic materials in meteorites.

But Glavin and his colleagues point to a few specific detected chemicals to support the hypothesis of an interplanetary origin. In the new analysis, the researchers measured more than a dozen other life-related compounds, including isomers of the nucleobases, Glavin says. Isomers have the same chemical formulas as their associated bases, but their ingredients are organized differently. The team found some of those isomers in the meteorites but not in the soil. “If there had been contamination from the soil, we should have seen those isomers in the soil as well. And we didn’t,” he says.

Going directly to the source of such meteorites — pristine asteroids — could clear up the matter. Oba and colleagues are already using their extraction technique on pieces from the surface of the asteroid Ryugu, which Japan’s Hayabusa2 mission [brought to Earth in late 2020](#) (SN: 12/7/20). NASA’s OSIRIS-REx mission is expected to return in September 2023 with similar samples from the asteroid [Bennu](#) (SN: 1/15/19). “We’re really excited about what stories those materials have to tell,” Glavin says.

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

Anticipating a side effect makes it more likely you’ll experience it – this could contribute to vaccine hesitancy

2/3 of common side effects people experience after vaccination could be due to a nocebo response

Hamish Wilson*

The COVID pandemic has highlighted several interesting features of modern medical practice – most recently the “nocebo” response, which may account for a significant number of side effects people experience following vaccination.

Nocebo responses (from Latin *noci*: to harm) are the opposite of the better known [placebo](#). While the latter describes [improvements in symptoms](#) following inert medication, the nocebo response heightens symptoms if a person anticipates them. It can increase

pain if someone expects something will hurt.

A fascinating [meta-analysis](#) examined data from 12 clinical trials of COVID vaccines, involving over 45,000 participants, and found about two-thirds of common side effects people experience after vaccination could be due to a nocebo response, rather than the vaccine itself.

Nocebo responses can be troublesome and significant. They include headaches, fatigue, muscle pains, nausea or diarrhoea. Such symptoms may be related to anxiety or negative expectations, or day-to-day sensations being [incorrectly attributed to a treatment](#).

While [previous analysis](#) in other fields had already confirmed the presence of nocebo responses in randomised trials, COVID vaccine research dramatically highlights its frequency.

The latest study found up to 35% of patients in the placebo arm of vaccine trials had adverse events such as headaches and fatigue. Mathematical analysis showed 50-75% of patient symptoms after the real vaccination (not placebo) may have been caused by those nocebo responses.

A different group of researchers from Italy reviewed other COVID vaccine trials and [confirmed these conclusions](#). These findings are potentially significant, as [vaccine hesitancy and refusal](#) have been linked to patient concerns about side effects or major adverse events. Knowing how frequently self-limiting nocebo responses happen may reduce vaccine hesitancy.

The ‘meaning response’

Together, the placebo and nocebo effects are better understood as two aspects of what medical practitioners call a “meaning response”. Both occur in relation to the importance and [meaning patients place on their illness](#), their relationship with their healthcare providers, and their thoughts and beliefs about proposed treatments.

Nocebo responses are now being recognised as potentially important contributors to patient outcomes. For example, if a doctor

or nurse give pessimistic or negative information about pain, various studies have demonstrated the [patient's pain can worsen](#), regardless of the degree of tissue damage.

Not feeling validated or respected by the doctor may also [inhibit the efficacy of medications](#) and increase side effects.

Previous research in New Zealand has also illustrated how negative media coverage may increase patients' experiences of adverse events after compulsory changes to their medication regimes. For example, [brand switches of thyroxine](#) in 2007 and of an [antidepressant](#) in 2018 were followed by increased reporting of side effects and adverse events.

Acknowledging and publicising the potential contribution of nocebo responses may be useful for further [generic substitutions](#).

Implications for COVID vaccinations

Vaccinators need to avoid inadvertently contributing to nocebo responses when advising their patients. They could use [positive framing](#) about the very low risk of serious adverse events. They could also briefly explain that nocebo responses are common and self-limiting.

However, my own experience as a patient receiving three COVID vaccinations was disconcerting. No one in the various vaccinating teams said anything positive about the vaccine or its efficacy in preventing me or my family from catching the virus, or reducing the severity of the illness if we did.

And just after receiving the third injection, I was further disquieted by warnings about chest pain and reminders I should seek immediate medical attention if I experienced any. This extra information on heart problems as a potential adverse event followed recent concerns about [rare cases of myocarditis after vaccination](#).

All the vaccinating staff were conscientious and kind, but it seemed odd they hadn't been instructed to discuss the benefits of vaccination. It might have been a useful approach to country-wide

vaccine hesitancy.

While well intended, it is possible their emphasis on serious side effects from the vaccine may increase the incidence of nocebo responses in a population already [primed](#) for them. This could mean more patients will present to their doctors or emergency departments with symptoms unrelated to the vaccine itself.

How to improve awareness

Anecdotally, advice from vaccinators appears to be quite variable. It may be helpful if they incorporated an understanding of potential placebo and nocebo responses into their [vaccination advice to each patient](#).

Health authorities and health professionals need to understand meaning responses and their [role in clinical practice](#). Incorporating those insights into healthcare communication may [prevent unnecessary patient anxiety](#), worrisome symptoms and considerable healthcare expenditure.

Respecting autonomy means [patients need to be asked](#) if they want to receive information about side effects or adverse events. The juggle is how to inform patients about the very low risk of serious harm while not increasing their apprehension.

Pandemic research is now also [exploring potential parallels](#) between long COVID and other chronic conditions such as Myalgic Encephalitis/Chronic Fatigue Syndrome as well as tentative associations between [adverse childhood experiences](#) and vaccine hesitancy.

Without intending to minimise the pandemic's devastating impact, it is providing us with useful insights into wider current medical and sociological issues.

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<https://bit.ly/3vRvE7U>

Genome of girl with severe lupus pins down genetic target for treatments

Protein that senses viruses becomes overactive in autoimmune disease

By [Jocelyn Kaiser](#)

There is no cure for lupus, a disease that causes the body's immune system to attack itself. But researchers are now closer to a genetic explanation for the puzzling condition, thanks to the genome of a child with a rare inherited form of the disease.

A new study [fingers a gene called *TLR7* that helps fight off viruses](#); when overactive, it unleashes the immune system on the body's organs and tissues. Although *TLR7* is not the only gene implicated in lupus, targeting its activity or protein could help many patients. “*TLR7* is likely to be a central hub, if not the central signaling pathway in lupus,” says Carola Vinuesa, an immunogeneticist at the Francis Crick Institute who led the work, published today in *Nature*. “It’s a great paper,” says Betty Tsao of the Medical University of South Carolina, who studies lupus genetics but was not involved with the research.

At least 200,000 people in the United States have systemic lupus erythematosus (SLE), the most common form of the autoimmune disease. Patients can develop skin rashes, joint pain, fatigue, blood clots, kidney failure, heart disease, and psychiatric problems. Lupus is thought to involve both genetics—it runs in families—along with environmental triggers. Patients usually receive immune-suppressing drugs, but these can make them vulnerable to infections. In 2016, Vinuesa, then at Australian National University, and collaborators came across a 7-year-old Spanish girl named Gabriela who had symptoms of SLE, which is unusual in children. Sequencing Gabriela's genome revealed a single-base change in the gene for *TLR7*, which encodes a pathogen-detecting protein called

toll-like receptor 7 on the surface of multiple types of immune cells, including antibody-making B cells. A *TLR7* mutation had never been implicated in lupus before, but the researchers subsequently found several other lupus patients with similar mutations. Mice that were gene edited to carry Gabriela's *TLR7* mutation developed lupus symptoms such as low platelets and kidney damage.

The *TLR7* protein's job is to spot RNA viruses. When the receptor is triggered, cells carrying it produce biochemicals called interferons that block the virus from replicating in other, infected cells; *TLR7* also tells B cells to produce antibodies to the virus. (People who lack a functioning *TLR7* are prone to severe COVID-19 from SARS-CoV-2, an RNA virus.)

But Gabriela's *TLR7* mutation makes the receptor it encodes much more sensitive, Vinuesa's team found. Studies of the gene-edited mice showed their *TLR7* protein is activated [simply by encountering the molecule guanosine](#), which is present in the DNA and RNA of healthy human cells, her team reports today. “Basically, any nucleic acid component triggers a signal,” Vinuesa says.

The resulting overproduction of interferon leads to an immune attack on normal cells. But an even more important effect was that the mutant *TLR7* protein promotes the survival of B cells that recognize normal cell proteins, leading to the production of self-reactive antibodies to those proteins that harm human tissues. Normally those traitorous B cells are weeded out by the immune system.

Researchers already knew mice with extra copies of *TLR7* develop a mild lupuslike disorder, and that lupus patients often carry mutations near the gene that slightly alter its activity. But “this is definitive proof” of *TLR7*'s role, Vinuesa says. Because the *TLR7* pathway is often overactivated in people with lupus, even if they don't have mutations in the gene, her team thinks blocking this pathway with drugs—either targeting the receptor or downstream

signals, “is a reasonable therapeutic strategy.”

A role for *TLR7* also helps explain why most people with lupus are women: The gene is on the X chromosome in a section where, unlike with most genes, both copies of a gene are often expressed. Men, with their X and Y chromosome pair, have just one copy so they make less of the immune receptor overall, even if they carry the *TLR7* mutation.

Tsao says the team makes “a very convincing” case that *TLR7* is “a pivotal pathway” in lupus. Rheumatologist Amr Sawalha of the University of Pittsburgh notes that an interferon-blocking drug approved last year called anifrolumab has already been used to treat lupus. The new study, he says, “reinforces targeting *TLR7* as a potential treatment.”

Gabriela, now a teenager, takes a cocktail of immunosuppressants to control her disease; the drugs have had the side effect of stunting her growth. She said in a press release that she hopes the new research will lead to better treatments for “so many lupus warriors who suffer from this disease.”

<https://bit.ly/3F2CBqK>

Over 100 brain tumors linked to NJ high school: Is it a cancer cluster?

How will officials determine if a true cancer cluster exists?

By [Donavyn Coffey](#)

More than 100 graduates of a New Jersey high school have been diagnosed with brain tumors over the past 30 years, prompting concern that there might be a connection between the school and the tumor cases.

Now, an investigation is underway to determine if the school — Colonia High School in Woodbridge, New Jersey — is linked with a [cancer](#) cluster. But how will officials figure out if a true cancer cluster exists or if the cases are simply a coincidence?

Colonia graduate Al Lupiano, an environmental scientist, was the

first to sound the alarm about the potential cluster. In 1999, at age 27, he was diagnosed with a large, benign [brain](#) tumor called an acoustic neuroma. His condition was rare, but he was successfully treated. But in 2021, his wife and sister, also graduates of Colonia, were both diagnosed with rare brain tumors, according to [NJ Spotlight News](#). His wife was diagnosed with an acoustic neuroma, and his sister was diagnosed with glioblastoma, an aggressive brain cancer. That's when Lupiano started looking into the connection.

Initially, he found 15 people who attended the high school and were diagnosed with a primary brain tumor, meaning a tumor that originates in the brain, according to [NBC Today](#). And in March 2022, a few weeks after his sister's death due to her malignant tumor, Lupiano posted his findings to Facebook in search of more patients. Since the initial post, Lupiano has published a list of 115 people who attended or worked at Colonia and were diagnosed with a primary brain tumor, according to news reports.

The City of Woodbridge has hired experts to conduct radiation tests inside school buildings and on school grounds, according to [NJ Spotlight News](#). (Exposure to certain types of radiation can increase the risk of cancer, according to the [National Cancer Institute](#).) If no link is found with the high school specifically, Woodbridge Mayor John McCormac, said other potential points of connection in the township will be explored, according to [NBC Today](#).

"It needs to be investigated, no questions asked," said Elizabeth A. Platz, a professor of epidemiology at the Johns Hopkins Bloomberg School of Public Health and Sidney Kimmel Comprehensive Cancer Center. But just because there is an investigation does not necessarily mean there's a cancer cluster, Platz told [Live Science](#).

According to the [National Cancer Institute](#), "cases of cancer can appear to cluster even when there is no connection among them." A 2012 study in the journal [Critical Reviews in Toxicology](#) demonstrates how tricky it can be to confirm a cancer cluster. The

review article looked at 567 cancer cluster investigations over 20 years. Only 72 of the suspected cancer clusters were confirmed to have an increased incidence of cancer within the cluster. Just three of these clusters were linked to a possible exposure, and only one had a clear cause.

It may be that once someone is diagnosed with cancer, they are more likely to take note of other cancer diagnoses or more likely to have conversations about cancer and realize their connections to other cancer patients, Platz said. It can seem connected, when in reality, cancer is quite common and people are simply noticing this fact.

To confirm a true cancer cluster, epidemiologists must establish that there's a greater number of cancer cases than would be expected in a given population, based on their specific characteristics such as age, sex and geography, at a given time, Platz said. In other words, they will need to prove by statistical analysis that more Colonia staff and graduates developed brain cancer than people with their same characteristics (age, sex, location) over the same time. Working that out takes time, Platz said.

The investigation will consider very granular data on graduates, like their occupations, family history and other activities that could affect their exposures. Notably, brain cancer is rarer than other cancers. And we don't have the same major risk factors for brain cancer as we do for common cancer types, Platz said. (For example, smoking increases a person's risk of lung cancer.)

Public health experts will look at the rate of brain cancer cases and investigate potential causes. Without analyzing the data herself, Platz said she's not able to estimate how many of the 15,000 people who have gone through Colonia High in the past 30 years would need to have developed cancer for it to be considered a cluster. In the United States, the rate of new cases of brain cancer or other

[nervous system](#) cancer is 6.3 cases per 100,000 people per year, according to the [National Institutes of Health](#).

Platz expects that public health officials will look for specific overlaps in timing and tumor type. "If there's a unique exposure, we would expect a unique cancer type," Platz said. Rather than looking at all central nervous system cancers over 30 years, investigators will likely look at rates of specific types of brain tumors and how long after high school these tumors developed, she said.

Because cancer clusters are often suspected in very small subpopulations — like neighborhoods, apartment buildings or homes on the same side of the street — they can be very difficult to establish, Platz said. The number of people is so small that we don't know how many cancers you'd expect, she said. Unlike lab experiments, which can be tightly controlled, epidemiology and public health studies are often based on observations; as such, the answers can be incomplete or unsatisfying, Platz said.

According to [NJ Spotlight News](#), McCormac has been contacted by at least five agencies, including the U.S. Centers for Disease Control and Prevention and the New Jersey Department of Health. All are awaiting results from the radiation testing at the school before deciding how to get involved and proceed with the investigation.

<https://bit.ly/376Oo3c>

1st human case of H3N8 bird flu reported in 4-year-old boy in China

A 4-year-old boy in China has become the first human case of the H3N8 strain of bird flu, according to news reports.

By [Jeanna Bryner](#)

The boy, who lives in Henan province, was exposed to chickens and crows at his home, which could have transmitted the virus, according to news reports. The boy was infected with an avian version of the H3N8 virus, though strains of this virus can also

infect horses (known as equine influenza virus) and dogs (known as canine influenza virus). And now it has made the leap to humans, though the risk of it spreading from human to human is low, according to a [Reuters report](#).

Though avian flu viruses originated in birds and don't easily spread to other animals, in rare cases, strains have adapted to infect other animals — such as dogs and horses — as well as humans, [Live Science previously reported](#). Bird flu strains that have hopped to humans include: H5N1, H7N9, H5N6, H5N8 and now H3N8.

A genetic analysis of the Henan province case suggests the variant came about through a shuffling of genes from more than one avian flu virus, making it a reassortant. This type of mixed-up virus "can have unpredictable capacity in terms of transmission and virulence in human population," said Marius Gilbert, an epidemiologist at the Université Libre de Bruxelles in Belgium, as reported by [The Guardian](#). This particular case of H3N8 holds genes from viruses previously found in poultry and wild birds, Reuters reported.

The fact that this variety of H3N8 has hopped to a human does not mean it can spread easily between humans, experts say. "We often see a virus spread to a human and then not spread any further so a single case is not a cause of great concern," said Sir Peter Horby, professor of emerging infectious diseases and global health at the University of Oxford, [The Guardian](#) reported.

In June of last year, China also reported the first human case of another bird flu, called H10N3, [Live Science reported](#) at the time. The 41-year-old man in the city of Zhenjiang was hospitalized but ultimately discharged.

Because avian influenza has the potential to trigger outbreaks in humans, health organizations closely monitor new variants. In 2016 and 2017, for instance, an outbreak of H7N9 in China led to the deaths of more than 300 people, according to [Science Magazine](#). And the H2N2 strain of bird flu caused a pandemic in 1957 after it

swapped genes with human flu viruses; the death toll from it reached 1.1 million worldwide, including 116,000 deaths in the United States, [the CDC reported](#). The virus behind the 1918 pandemic, called H1N1, likely also came from birds, [Live Science reported](#).

In February of 2021, Russia reported the first case of avian influenza strain H5N8 passing from poultry to humans, [Live Science reported](#). Though there was no evidence of human-to-human spread, seven poultry plant workers were infected with the strain. There is no information about the health status of the young boy infected with the H3N8 strain of bird flu.

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

The world's largest ichthyosaur may have just been discovered in the Swiss Alps

The Triassic sea monster may be one of the largest animals that ever lived.

By [Brandon Specktor](#)

Researchers have found the broken tooth of one of the largest carnivores ever to stalk the Earth.

No, it isn't *T. rex*. It isn't even a dinosaur. Rather, the tooth belongs to a rare and mysterious species of giant ichthyosaur — a flesh-eating marine reptile that patrolled the world's seas during the late [Triassic period](#), about 205 million years ago.

Though the crown of the tooth is partially missing, the fossil fang's root is twice as wide as any other ichthyosaur tooth known, according to a new study published April 28 in the [Journal of Vertebrate Paleontology](#). The previous record holder for largest tooth was an ichthyosaur measuring nearly 50 feet (15 meters) long, the study authors said — possibly making the owner of this newly described tooth one of the largest animals ever to live on land or sea. However, because scientists only have half a tooth to base their research on, it's impossible to tell whether the ancient marine reptile

was a true leviathan, or simply one of many similarly sized sea monsters that ruled the Triassic seas, the researchers said.

"It is hard to say if the tooth is from a large ichthyosaur with giant teeth or from a giant ichthyosaur with average-sized teeth," lead study author P. Martin Sander, of the University of Bonn in Germany, said in a statement.



An illustration of an enormous ichthyosaur hunting in the Triassic seas
(Image credit: Dr Heinz Furrer)

Monsters of the deep

Ichthyosaurs, whose name translates to "fish lizards," emerged during the middle Triassic period (about 252 million to 201 million years ago) not long after the end-[Permian](#) extinction wiped out roughly 95% of life in [Earth's](#) oceans. The aquatic reptiles did very well for themselves in these changing seas; within about 5 million years of their first appearance, ichthyosaurs ballooned to enormous sizes and dominated all the world's oceans, the study authors wrote. The largest known ichthyosaur is the *Shastasaurus sikanniensis* — a whale-like creature that measured up to 69 feet (21 m) long, and possibly longer. For comparison, modern [blue whales](#) generally measure between 80 and 100 feet (24 and 30 m) long, while the carnivore king *T. rex* measured an average of 40 feet (12 m) long, according to the [American Museum of Natural History](#).

Many large ichthyosaurs, including the gargantuan *Shastasaurus*, seem to have become top predators without ever evolving teeth, according to the researchers. Only one species of giant ichthyosaur — the 50-foot-long *Himalayasaurus*, discovered in Tibet — is known to have had a mouth full of teeth. So, when scientists discovered a single large fossil ichthyosaur tooth in the Kössen

Formation of the Swiss Alps — a 9,200-foot-high (2,800 m) rock formation that existed at the bottom of a Triassic sea — the team had a bit of a mystery on their hands.

In the new study, the researchers analyzed that fossil tooth in detail, along with some large ichthyosaur ribs and vertebrae, all discovered in the same Alpine formation between 1976 and 1990. The team compared the sampling of bones to other giant ichthyosaur fossils with more complete skeletons, in order to estimate the size and species of the new specimens.



The ichthyosaur tooth is 4 inches long (100 mm), and missing part of its crown. The beast that bore it may be one of the alrgeest sea monsters ever.

(Image credit: Dr Martin Sander/ Dr Heinz Furrer)

Measuring about 2.3 inches (60 mm) wide at the root and 4 inches (100 mm) tall from the root to the broken end of the crown, the fossil tooth is twice as wide as any known *Himalayasaurus* tooth, the researchers said. The unique pattern of dentin — the hard tissue that makes up the bulk of reptile and mammal teeth — proves that the tooth belonged to an ichthyosaur, but the fossil's extraordinary size doesn't fit with any known species. If the creature's body was significantly larger than *Himalayasaurus*, as the tooth seems to suggest, then researchers could be looking at the largest ichthyosaur ever discovered.

Similarly, the ribs and vertebrae from the Kössen Formation are some of the largest ichthyosaur fossils of their kind ever discovered in Europe, the researchers said. The tooth, ribs and vertebrae appear to belong to three different ichthyosaur specimens — all of them gargantuan.

"These late Triassic giant ichthyosaurs clearly were among the largest animals to ever inhabit our planet," the researchers wrote. However, given that only a few bones remain of each specimen, it's

impossible to reliably categorize them as a particular species. Measurements of the bones may also be slightly skewed, as several of the fossils appear to have been squashed by the movement of tectonic plates that raised the Alps out of the sea over hundreds of millions of years, the team said.

For now, the researchers have assigned the three specimens to the family Shastasauridae — the same family of the giants *Shastasaurus*, *Shonisaurus* and *Himalayasaurus*. Whether or not the specimens dwarf those other goliath sea monsters is a question that cannot be answered without more fossil evidence.

<https://bit.ly/39vOwKn>

Scientists Discover New Electrical Function Performed by Nearly Half of Brain Cells

Surprising research findings in mice could lead to new insights and treatments for a wide range of brain and neurological diseases, from epilepsy to Alzheimer's.

Researchers at Tufts University School of Medicine have discovered a previously unknown function performed by astrocytes, a type of cell that comprises nearly half of all cells in the brain.

According to the researchers, the discovery in mice of a novel function by cells known as astrocytes opens up a whole new avenue for neuroscience study that could lead to treatments for a variety of conditions ranging from epilepsy to Alzheimer's to traumatic brain injury.

It all boils down to how astrocytes interact with neurons, which are fundamental cells of the brain and nervous system that receive input from the outside world. Through a complex set of electrical and chemical signaling, neurons transmit information between different areas of the brain and between the brain and the rest of the nervous system.

Astrocytes, also known collectively as astroglia, are star-shaped glial cells found in the brain and spinal cord. They perform a

variety of functions, including biochemical control of endothelial cells that form the blood–brain barrier, provision of nutrients to the nervous tissue, maintenance of extracellular ion balance, cerebral blood flow regulation, and a role in the repair and scarring process of the brain and spinal cord following infection and traumatic injuries.

Until now, scientists believed astrocytes were important, but lesser cast members in this activity. Astrocytes guide the growth of axons, the long, slender projection of a neuron that conducts electrical impulses. They also control neurotransmitters, chemicals that enable the transfer of electrical signals throughout the brain and nervous system. In addition, astrocytes build the blood-brain barrier and react to injury. But they did not seem to be electrically active like the all-important neurons—until now.

“The electrical activity of astrocytes changes how neurons function,” says Chris Dulla, associate professor of neuroscience at the School of Medicine and Graduate School of Biomedical Sciences, and corresponding author on a paper published today (April 28, 2022) by *Nature Neuroscience*. “We have discovered a new way that two of the most important cells in the brain talk to each other. Because there is so much unknown about how the brain works, discovering new fundamental processes that control brain function is key to developing novel treatments for neurological diseases.”

In addition to Dulla and lead author Moritz Armbruster, the study's other authors include Saptarnab Naskar, Mary Sommer, Elliot Kim, and Philip G. Haydon from Tufts University School of Medicine; Jacqueline P. Garcia from the Cell, Molecular and Developmental Biology program at Tufts Graduate School of Biomedical Sciences; and researchers from other institutions.

To make the discovery, the team used brand new technology to devise a technique that enables them to see and study the electrical

properties of brain cell interactions, which could not be observed previously.

“With these new tools, we’ve essentially uncovered completely novel aspects of the biology,” says Armbruster, research assistant professor of neuroscience at the School of Medicine. “As better tools come along—for example, new fluorescent sensors are being developed constantly—we’ll get a better understanding of things we didn’t even think about before.”

“The new technology images electrical activity with light,” Dulla explains. “Neurons are very electrically active, and the new technology allows us to see that astrocytes are electrically active, as well.”

Dulla describes astrocytes as “making sure everything is copacetic in the brain, and if something goes wrong, if there’s an injury or viral infection, they detect it, try to respond, and then try to protect the brain from insult. What we want to do next is determine how astrocytes change when these insults happen.”

Neuron-to-neuron communication occurs through the release of packets of chemicals called neurotransmitters. Scientists knew that astrocytes control neurotransmitters, helping to make sure that neurons stay healthy and active. But the new study reveals that neurons also release potassium ions, which change the electrical activity of the astrocyte and how it controls the neurotransmitters.

“So the neuron is controlling what the astrocyte is doing, and they are communicating back and forth. Neurons and astrocytes talk with each other in a way that has not been known about before,” he says.

The Impact on Future Research

The discovery of astrocyte-neuron crosstalk raises numerous questions as to how the interactions work in brain pathology and in the development of learning and memory. “It makes us rethink everything astrocytes do, and how the fact that astrocytes are

electrically active may be influencing a wide range of neurological diseases,” he says.

For example, in Alzheimer’s disease, astrocytes don’t control neurotransmitters, even though that is their fundamental job, Dulla explains. Similar problems occur with traumatic brain injury and epilepsy. For years scientists have thought perhaps the problem is caused by a protein being absent, or a mutation that causes a protein not to work.

“Build-up of extracellular potassium in the brain, has been hypothesized to contribute to epilepsy and migraine pathologies,” says Armbruster. “This new study gives us a better understanding of how astrocytes clear this buildup and help maintain a balance of excitation.”

The researchers are now screening existing drugs to see if they can manipulate the neuron-astrocyte interactions. “By doing so, can we one day help people learn faster or better? Can we repair a brain injury when it occurs?” Dulla asks.

The new technology used to make this discovery not only opens up new ways to think about astrocyte activity, it also provides new approaches for imaging activity through the brain. Before now, there was no way to image potassium activity in the brain, for example, or study how potassium is involved in sleep, metabolism, or injury and infection in the brain.

“We are giving these tools to other labs so they can use the same assays and techniques to study the questions they are interested in,” he says. “Scientists are getting the tools to study headache, breathing, developmental disorders, and a wide range of different neurological diseases.”

Reference: “Neuronal activity drives pathway-specific depolarization of peripheral astrocyte processes” by Moritz Armbruster, Saptarnab Naskar, Jacqueline P. Garcia, Mary Sommer, Elliot Kim, Yoav Adam, Philip G. Haydon, Edward S. Boyden, Adam E. Cohen and Chris G. Dulla, 28 April 2022, Nature Neuroscience. [DOI: 10.1038/s41593-022-01049-x](https://doi.org/10.1038/s41593-022-01049-x)

<https://bit.ly/3y2cnU1>

Antibiotics Tied to Lower Effectiveness of Childhood Vaccines

Use of the drugs in children under the age of two was associated with lower antibody levels after the jabs—perhaps, researchers suggest, due to microbiome alterations.

Natalia Mesa

A study published yesterday (April 27) in *Pediatrics* finds that children who received a course of antibiotics during the first two years of life had diminished immune responses to four common vaccines. Researchers tell *Science News* that the findings are a cautionary tale about overusing antibiotics.

Babies are typically immunized against various diseases in the first six months of life and get boosters in their second year. From 2000 to 2016, the study's authors collected blood samples from 560 children ages 6 to 24 months during routine visits with their pediatricians, measuring antibody levels after the children received polio, diphtheria-tetanus-pertussis, *Haemophilus influenzae* type b, and pneumococcal vaccines.

Of these children, 342 had collectively been prescribed close to 1,700 courses of antibiotics. The other 218 children had not received antibiotics. The team analyzed whether antibody levels induced by the four vaccines met the threshold of what is considered protective and found that at 9 and 12 months old, children who had received a course of antibiotics were significantly more likely to have subpar levels of antibodies than those who had not. The immune response was lower among children who'd had multiple courses of antibiotics than for those who'd had one, with each antibiotics dose associated with 5 to 11 percent lower antibody levels after initial vaccinations and 12 to 21 percent lower antibodies after booster shots.

The study did not assess the children's actual rates of disease, and

some [studies](#) have noted that antibody levels are sometimes imperfect predictors of immune protection against disease.

"If anyone needed yet another reason why overprescription of antibiotics is not a good thing, this paper offers that reason," immunologist Bali Pulendran of Stanford University School of Medicine, who was not involved in the study, tells *Science News*.

The association varied with the type and length of antibiotic treatment. Broad spectrum drugs, which target a wide array of bacteria, were associated with antibody levels below what is protective, while more targeted antibiotics were not. Ten-day courses, but not five-day courses, were associated with reduced vaccine-induced antibody levels.

Antibiotics are known to affect the [gut microbiome](#), which in turn influences a wide array of bodily systems, including the [immune system](#). The study's authors suggest that antibiotics might negatively affecting children's gut health by decreasing the diversity of bacteria in the gut, which may in turn decrease vaccine effectiveness. *Science News* reports that this new study adds to existing evidence that gut health may affect response to vaccination. According to *Science News*, study coauthor Michael Pichichero, a pediatric infectious diseases specialist at the Rochester General Hospital Research Institute in New York, and colleagues are beginning a study with a new group of children to see what kinds of changes are occurring in the gut bacteria. The researchers plan to collect stool samples along with blood draws and antibiotic use records. They'd like to follow the children past age 5, beyond the time kids receive another round of booster shots, to learn whether antibiotics also interfere with this next opportunity to develop antibodies.

"Antibiotics are miracle medicines," Pichichero tells *Science News*. "In no way does this study imply that children who need an antibiotic shouldn't get it."

<https://bit.ly/3y4b8U6>

Dog breed is a surprisingly poor predictor of individual behavior

Our canine companions, it turns out, are as individual as people

By [Anna Gibbs](#)

Turns out we may be unfairly stereotyping dogs.

Modern breeds are shaped around aesthetics: Chihuahuas' batlike ears, poodles' curly fur, dachshunds' hot dog shape. But breeds are frequently associated with certain behaviors, too. For instance, the American Kennel Club describes border collies as "affectionate, smart, energetic" and beagles as "friendly, curious, merry."

Now, genetic information from more than 2,000 dogs, paired with self-reported surveys from dog owners, indicates that a dog's breed is a poor predictor of its behavior. On average, [breed explains only 9 percent of the behavioral differences](#) between individual dogs, researchers report April 28 in *Science*.

"Everybody was assuming that breed was predictive of behavior in dogs," geneticist Elinor Karlsson of the University of Massachusetts Chan Medical School in Worcester said in an April 26 news briefing. But "that had never really been asked particularly well."

Geneticists had asked the question before in different ways. One study in 2019 looked at whether [genetics might explain collective variation between breeds](#) and found that genes could explain some of the differences between, say, poodles and chihuahuas (*SN*: 10/1/19). But Karlsson and her colleagues wanted to learn how much breed can predict variation in individual dogs' behavior.

To study variation at the individual level, the team needed genetic and behavior data from a lot of dogs. So they developed [Darwin's Ark](#), an open-source database where more than 18,000 pet owners responded to surveys about their dog's traits and behavior. The survey asked over 100 questions about observable behaviors, which

the researchers grouped into eight "behavioral factors," including human sociability (how comfortable a dog is around humans) and biddability (how responsive it is to commands).

The researchers also collected genetic data from 2,155 purebred and mixed-breed dogs, including 1,715 dogs from Darwin's Ark whose owners sent in dog saliva swabs. The inclusion of mixed-breed dogs, or mutts, shed light on how ancestry affects behavior while removing the purebred stereotypes that could affect the way the dog is treated — and thus behaves.

Studying mutts also makes it easier to decouple traits from one another, says Kathleen Morrill, a geneticist in Karlsson's lab. "And that means on an individual basis, you're going to have a better shot at mapping a gene that is actually tied to the question you're asking."

Then the team combined the genetic and survey data for the individual dogs to identify genes associated with particular traits. The new study revealed that the most heritable behavioral factor for dogs is human sociability, and that motor patterns — such as howling and retrieving — are generally more heritable than other behaviors.

That makes sense, Kathryn Lord, an evolutionary canine biologist in Karlsson's lab, said during the briefing. Before modern breeding started within the last couple hundred years or so, dogs were [selected for the functional roles](#) they could provide, such as hunting or herding (*SN*: 4/26/17). Today, these selections still show up in breed groups. For instance, herding dogs on average tend to be more biddable and interested in toys. It also follows that, within breed groups, individual breeds are more likely to display certain motor patterns: Retrievers, unsurprisingly, are more likely to retrieve.

Still, even though breed was associated with certain behaviors, it was not a reliable predictor of individual behavior. While retrievers

are less likely to howl, some owners reported that their retrievers howled often; greyhounds rarely bury toys, except some do.

The research solidifies what people have observed: Dog breeds differ on average in behavior, but there's a lot of variation within breeds, says Adam Boyko, a canine geneticist at Cornell University who was not involved in the study.

Surprisingly, size had even less of an effect — as in, virtually none — on an individual's behavior, despite the yappiness commonly associated with small dogs. Boyko points out that small dogs may often behave worse than large dogs, but rather than that being built into their genetics, "I think it's that we typically tolerate poor behavior more in small dogs than we do in big dogs."

As a dog trainer, Curtis Kelley of Pet Parent Allies in Philadelphia says that he meets a dog where it's at. "Dogs are as individual as people are," he says. Breed gives a loose guideline for what kind of behaviors to expect, "but it's certainly not a hard-and-fast rule."

If a person is looking to buy a dog, he says, they shouldn't put too much stock in the dog's breed. Even within a litter, dogs can show very different personalities. "A puppy will show you who they are at eight weeks old," Kelley says. "It's just our job to believe them."

Citations K. Morrill et al. [Ancestry-inclusive dog genomics challenges popular breed stereotypes](https://doi.org/10.1126/science.abk0639). *Science*. Published online April 28, 2022. doi: 10.1126/science.abk0639.

<https://bit.ly/3s0fqbd>

One Disease Has Already Surged 80% This Year, And We're in a 'Perfect Storm' For More

"Canary in a coal mine" illness indicates that outbreaks of other diseases are likely

Daniel Lawler, AFP

Measles cases have surged by nearly 80 percent worldwide this year, the UN said Wednesday, warning that the rise of the "canary in a coal mine" illness indicates that outbreaks of other diseases are likely on the way.

The [coronavirus pandemic](#) has interrupted vaccination campaigns for non-COVID diseases around the world, creating a "perfect storm" that could put millions of children's lives at risk, the UN's children's agency UNICEF and the [World Health Organization said in a statement](#).

More than 17,300 measles cases were reported globally in January and February, compared to around 9,600 during those months last year, according to new data from the UN agencies.

There have been 21 large and disruptive measles outbreaks in the last 12 months to April, most of them in Africa and the eastern Mediterranean, the data showed.

Christopher Gregory, senior health adviser in UNICEF's immunization section, told AFP that because measles is the "most contagious vaccine-preventable disease" it often serves as a warning sign. "Measles is what we call the tracer, or the canary in the coal mine, that really shows us where those weaknesses in the immunization system are," he said.

He said [yellow fever](#) was among the diseases that could surge next, after rising cases were reported in West Africa.

"We're particularly worried about those countries that are most fragile, where the healthcare systems are already really struggling, where they're still trying to deal with the impacts of COVID on top of these outbreaks," he said.

Somalia recorded by far the most measles cases in the last 12 months with more than 9,000, the UN data showed, followed by Yemen, Afghanistan, Nigeria and Ethiopia – all countries battling some form of conflict. There are also fears that the war in Ukraine could spark a resurgence in the country after it recorded Europe's highest rate of measles between 2017 and 2019.

Gregory said that it had been very difficult to keep track of any disease in Ukraine since the war began, adding that the biggest concern was "what we could be missing".

Impact 'felt for decades'

More than 23 million children missed out on routine vaccinations in 2020 as the COVID pandemic descended, the largest number in more than a decade.

The UN agencies said that 57 vaccination campaigns in 43 countries postponed at the start of the pandemic had still not been completed, affecting 203 million people – most of them children.

COVID also continues to pile pressure on healthcare facilities and drag staffing and attention away from vaccination for long-standing deadly diseases.

"The impact of these disruptions to immunization services will be felt for decades to come," WHO chief Tedros Adhanom Ghebreyesus said in the statement.

"Now is the moment to get essential immunization back on track and launch catch-up campaigns so that everybody can have access to these life-saving vaccines."

Gregory said it was time to put childhood immunization on "at least the same level of priority as finishing COVID vaccination".

Measles is a disease caused by a [virus](#) that attacks mainly children. The most serious complications include blindness, brain swelling, diarrhea, and severe respiratory infections.

Vaccination uptake of at least 95 percent is the best way to avoid it spreading, though many countries fall far short of that goal – Somalia is at just 46 percent, according to the UN data.

<https://nyti.ms/3vVTGP3>

The 'Ultimate Bird' Once Prowled the Seas of a Young Japan

Researchers described Annakacygna, a family of flightless ancient swans that were filter-feeders.

By [Asher Elbein](#)

It's not unusual today to find swans on rivers and lakes, splitting their time between pulling up water plants and punishing the

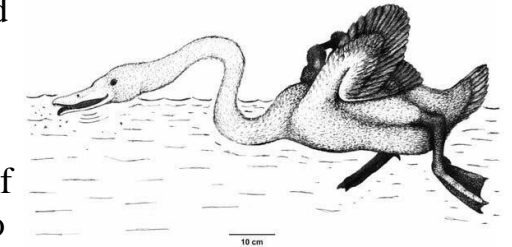
unwise with powerful blows of their bony-elbowed wings.

Eleven million years ago, however, swans in what is today called Japan did something unexpected: They took to the oceans.

In a [paper published](#) this week in The Bulletin of Gunma Museum of Natural History, Japanese

paleontologists formally described this family or genus of swans,

Annakacygna, which had long, filter-feeding heads, small wings and seriously strange hips — all of which have led the researchers to call it the “ultimate bird.”



An artist's reconstruction of Annakacygna hajime, an 11 million-year-old relative to modern-day swans. Credit...Gunma Museum of Natural History

The first set of remains of Annakacygna — a nearly articulated skeleton in a stone slab from a riverbed in Japan's Gunma Prefecture — were excavated by a Japanese fossil hunter in 2000. After the fossil hunter donated the remains to the Gunma Museum of Natural History, the museum director, Hasegawa Yoshikazu, called in Hiroshige Matsuoka, a paleontologist, to examine them.

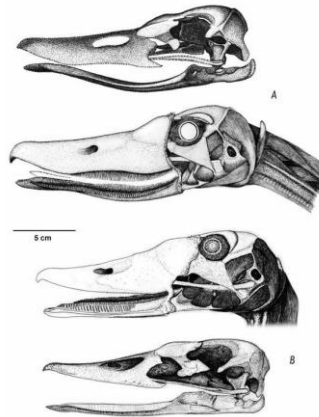
Initially Dr. Matsuoka thought he was looking at a strange duck, perhaps an animal that dove in the oceans just offshore of the then-newly risen Japanese Archipelago. But as bones were cleared from the slab, he concluded that the short-winged skeleton belonged to a flightless swan.

The species, which he and his co-author Dr. Yoshikazu named Annakacygna hajime, was about four feet long, as large as the modern black swan. Another set of remains from a related species, which they named A. yoshiiensis, suggested a bird as long as the largest living swan species, the 5½-foot trumpeter swan.

Both birds were “fatter and heavier than these modern swans,” Dr. Matsuoka said. Comparing their remains to the dissected body of a

common extant swan, he found that the birds differed in other ways as well. Their tails were highly mobile. Their hips were unusually broad and strong, and their bones were thicker than usual for a water bird, helping them ride low in the water.

Oddest of all were the wings. Flightless birds usually lose some of the utility of their wings, Dr. Matsuoka said, a process called degeneration. But in *Annakacygna*, the shoulder joints and muscle attachments that pull the arms backward were unexpectedly well-developed, with uniquely shaped wrists that kept the digits — and with them, the wings — permanently bent.



A comparison of the musculoskeletal systems of the head of Annakacygna hajimei, top, and the present-day whooper, or common, swan. Credit...Gunma Museum of Natural History

At first, these wings puzzled the team. But while watching a video of a mute swan holding a chick on her back, Dr. Matsuoka had a brainwave. Many modern swans habitually carry their young piggyback, he said, with their wings held back and up to shield the chicks. That posture in *Annakacygna*'s modern relatives suggested a new possibility: that the flightless swans might have enshrined this behavior into their anatomy, converting their bent wings and broad hips into specially adapted cradles to carry chicks safely across the briny deep.

The swans were well adapted to a coastal lifestyle in another way as well: long, filter-feeding beaks that resembled those of shoveler ducks, allowing them to dabble for plankton in the cool, rich seas off the Japanese coast. Modern swans, by contrast, have straight, vegetation-nibbling beaks.

Flightlessness isn't unusual in water birds; modern steamer ducks, a

few species of teal and several extinct varieties of geese ditched the skies for the water. Some of these waterfowl hit remarkable sizes: The Pleistocene giant swan of Malta, which some researchers have suggested was land-bound, was 30 percent larger than a living mute swan.

Annakacygna hajimei's full, reconstructed skeleton, including its puzzling, bent wings. Credit...Gunma Museum of Natural History.

But while it's smaller, Dr. Matsuoka said, *Annakacygna* is in a league all of its own. "I think all wild animals live for two purposes," he said, namely maintaining the self (by eating) and the species (by breeding.) Judged by that rubric, the barge-like, baby-cradling, filter-feeding sea swan is something special.

"It's the best survival form as an animal," he said. "That's why we call it the 'ultimate bird.'"

