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## From spinal cord injury to recovery

### *An essential role for neuronal feedback from below the site of injury*

Spinal cord injury disconnects communication between the brain and the spinal cord, disrupting control over part of the body. Studying the mechanisms of recovery, Leuven researcher Aya Takeoka (NERF) found that a specific type of neuronal feedback from sites below the injury plays a crucial role during early recovery and for maintaining regained motor functions. These new basic research findings implicate the importance of continued use of affected body parts for rehabilitative success in spinal cord injury patients.

"Following spinal cord injury, disrupted neuronal pathways can no longer provide sufficiently strong signals to the spinal networks below the injury, often leading to permanent and devastating motor impairment," explains prof. Aya Takeoka from NERF (NeuroElectronics Research Flanders), an interdisciplinary research center empowered by VIB, KU Leuven and imec. Her lab studies the mechanisms of motor learning and control, including how motor functions recover after injury.

"Incomplete injuries, where only part of the neuronal connections are damaged, frequently recover spontaneously," adds Takeoka. "We know that activating a very specific type of sensory feedback pathway plays a crucial role during rehabilitative training, promoting the formation of detour circuits. Understanding this process in more detail can help us design rehabilitation strategies with maximal benefit for spinal cord injury patients."

#### **Early and maintained feedback for maximal success**

One type of so-called somatosensory feedback is proprioception, which entails the unconscious perception of self-movement and

body position through nerve cells that are located in close proximity of the spinal cord and can detect muscle stretch.

To learn more about where and when proprioceptive feedback affects locomotor recovery after injury, Takeoka devised a conditional genetic approach to eliminate this type of feedback at different locations and time points in mice. Using these models, she showed that proprioceptive feedback below but not above the site of injury is critical for naturally occurring circuit rearrangement and locomotor recovery.

"We found a central role for so-called proprioceptive afferents, nerve fibers which signal proprioceptive information back to the spinal cord," says Takeoka. "Afferents below the lesion undergo specific rearrangements soon after injury, and without them regained motor function cannot be maintained, even if detour circuits have formed."

In short, proprioceptive feedback is not only essential to initiate locomotor recovery but it is also permanently required to maintain any regained motor function. According to Takeoka, these findings can inform rehabilitation practices for patients as well: "The fact that proprioceptive feedback, specifically from below the site of injury, is so important, suggests that task-specific rehabilitative training that emphasizes such feedback is likely to maximize functional outcomes in rehabilitation clinics."

[Functional local proprioceptive feedback circuits initiate and maintain locomotor recovery after spinal cord injury](http://bit.ly/2UrBLA3), Takeoka & Arber, Cell Reports 2019

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## **Poisons flow in toxic levels through the veins of great white sharks, new study shows**

*One of the ocean's most fearsome predators—thrive with toxic levels of poisons flowing in their veins*

by Mark Price

Great white sharks—one of the ocean's most fearsome apex predators—thrive with toxic levels of poisons flowing in their veins, according to a new study by OCEARCH.

Researchers recently came to that conclusion after taking blood samples from 40 white sharks off South Africa, according to an April 3 report on OCEARCH.org.

The samples revealed "alarmingly high levels of poisonous heavy metals, like arsenic and mercury, in sharks' blood," says the report. "Despite levels of heavy metals that would be toxic to most other species, white sharks seem to show no ill effects," says OCEARCH, a nonprofit devoted to collecting "previously unattainable" ocean data.

The fact that white sharks flourish with poison in their veins is one of the "tricks" the species has used to survive millions of years, OCEARCH says. "White sharks are incredibly tolerant to what would essentially be poison to other species," said the report.

In an interview with The South African, Liza Merly of the Rosenstiel School of Marine and Atmospheric Science said the research could benefit humans, when researchers figure out the "protective mechanism" in sharks that protects them from the toxins. However, for now the report warns that humans should worry about how white sharks are being poisoned to such extremes.

"Basically, if the sharks have high levels of toxins in their tissues, it is likely that species they eat below them will also have toxins, including fishes that humans eat," said study co-author Neil Hammerschlag in a release from OCEARCH.

What the study doesn't show is whether toxins in white sharks are going up, says OCEARCH. That's because this is "the first published account of high heavy metal concentrations in white shark blood," said researchers.

"Researchers can monitor the heavy metal levels and compare them back to this study to see if they are increasing or decreasing," said

the report. "This study also opens up new opportunities to research the mechanisms that might be helping these apex predators survive."

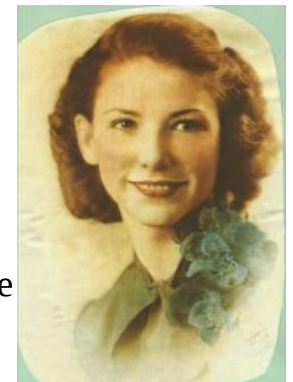
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## **Med School Cadaver's Heart Was In the Right Place (But Her Other Organs Weren't)**

***A woman's body that was recently donated to a medical school in Oregon provided an anatomy lesson that was much stranger than instructors expected.***

By [Mindy Weisberger, Senior Writer](#)

When students at the Oregon Health and Science University (OHSU) in Portland dissected the cadaver of the 99-year-old woman, they found that her liver and abdominal organs were transposed — as if flipped across a vertical axis — though her heart was oriented normally, on the left side, OHSU representatives said in a statement.



***The donated body of deceased Rose Marie Bentley recently led medical students to a startling discovery. Courtesy of the Bentley family***

This is known as "situs inversus with levocardia," and it affects about 1 in 22,000 births, according to OHSU. But unlike most who have this rare condition, the woman experienced no ill effects during her lifetime — in fact, she was completely unaware that some of her organs weren't where they were supposed to be, her family told OHSU.

The donated remains belonged to Rose Marie Bentley, who died in October 2017. Her unusual case was presented today (April 8) in a poster at the 2019 American Association of Anatomists Annual Meeting at Experimental Biology, in Orlando, Florida.

The instructors had never seen this type of organ inversion in an anatomy lab before, "and it's so rare, I'm not sure I'll ever see

another one," co-author Cameron Walker, an assistant professor of anatomy in the OHSU Anatomical Services Center, told Live Science.

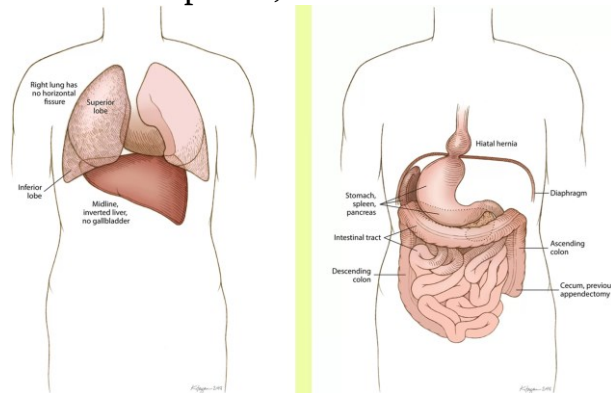
### "Transposed from right to left"

Bentley's body arrived at OHSU in the spring of 2018, bound for an anatomy class, according to Walker.

When the students working on Bentley's body opened up her chest cavity, "they found blood vessels around the heart that were different in orientation," Walker said. He and his colleagues checked the heart, but it didn't seem to have any defects.

"The real enlightenment came when we got to the abdominal cavity," Walker said. "When that was opened, we could see that her organs had been

transposed." The liver, instead of being on the body's right side, was situated along the midline, with a larger left lobe. The stomach and [the spleen](#), typically on the left, were on the right.



*The donor's liver was oriented*

*centrally, with an enlarged left lobe; her stomach, spleen and pancreas were located on the right. Courtesy of OHSU*

Information provided by the donor and her family suggested that Bentley experienced "robust health" well into her 90s, according to the authors. Over the years, she had undergone several surgeries: doctors removed her appendix, her [gallbladder](#) and her uterus. Indeed, the surgeon who performed the appendectomy told her at the time that the organ was on her left side, instead of on the right.

But the other two surgeons did not mention any anomalies in Bentley's anatomy, and her family said that neither she nor any of

her relatives suspected that anything was amiss, the researchers said in the presentation.

Aside from the organs' flipped positions, they "did not appear unusual in any way, and she enjoyed normal function," the scientists said.

[Genetic factors](#) that cause situs inversus with levocardia are complex, and it's unknown what precisely take place during fetal development that directs certain organs to grow in a reverse position, according to the [National Institutes of Health](#) (NIH).

In many cases of situs inversus, all of the organs — including the heart — are transposed, and people typically experience no associated health problems, the NIH says. However, if most of the organs are reversed but the heart is not, this can cause a growing fetus to develop defects along the midline of the heart, "and those make the heart dramatically less efficient and can lead to very early onset of congestive heart failure early in life," Walker said.

When that happens, survival to adulthood is exceptionally rare — about 1 in 50 million, the researchers wrote in their presentation. Yet Bentley lived to be 99 years old and had no history of heart trouble, making her case even more incredible, the scientists concluded.

### Atypical anatomy

Anomalies such as Bentley's are rare in [medical school cadavers](#), but it's not unheard of for donated bodies to contain anatomical surprises, said Dale Ritter, the lead human anatomy instructor for Alpert Medical School (AMS) at Brown University in Rhode Island. AMS receives about 55 donated cadavers each year, "and 1 out of 10 will have some significant departure from what is considered typical anatomy," Ritter told Live Science.

For example, certain small muscles in the forearm and the lower leg sometimes aren't there at all, Ritter said. [Branching patterns in arteries](#) can also show tremendous variation, which can be

confusing and frustrating for students trying to reconcile what they've seen in textbook illustrations with what's on the table in front of them, according to Ritter.

"We encourage students during the dissections to walk around and look at other tables and other donors for exactly that reason — the anatomy can look completely different," he explained.

In the end, Bentley's highly unusual organ alignment proved to be an important reminder to OHSU students that every patient is unique, and that medical professionals need to see their patients as individuals, Walker said.

"There isn't a one-size-fits-all practice where you can always use the same steps and the same treatments to help everyone in exactly the same way," he added.

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## How a New Cancer 'Vaccine' Fights Tumors Throughout the Body

*A new cancer "vaccine" that's injected directly into a single tumor can trigger the [immune system](#) to attack cancer cells throughout the body, a small new study suggests.*

By [Rachael Rettner, Senior Writer](#)

The researchers say that the experimental therapy essentially turns tumors into "cancer vaccine factories," where immune cells learn to recognize the cancer before seeking it out and destroying it in other parts of the body. "[We're] seeing tumors all throughout the body melting away" after injecting just one tumor, said lead study author Dr. Joshua Brody, director of the Lymphoma Immunotherapy Program at the Icahn School of Medicine at Mount Sinai in New York.

Still, the research, published today (April 8) in the journal [Nature Medicine](#), is very preliminary. The therapy has only been tested in 11 patients with non-Hodgkin's lymphoma (a cancer of immune system cells), and not all of these patients responded to the

treatment. But some patients did have remission for relatively long periods, and the results were promising enough that the therapy is now also being tested in patients with breast and head and neck cancers, the authors said.

What's more, the "vaccine" appears to substantially boost the effectiveness of another type of immunotherapy called "checkpoint blockade" — the same therapy that former President [Jimmy Carter received to treat his metastatic melanoma](#) in 2015. ("Immunotherapy" refers to treatments that harness the immune system to fight cancer.)

The two therapies "are remarkably synergistic," Brody told Live Science. So far, the researchers have only tested the combined therapies in mice, but they are optimistic that the combined therapies could benefit cancer patients, particularly those that aren't getting much benefit from current immunotherapy treatments.

### Cancer "vaccine"

To be clear, the new treatment is not technically a vaccine — a term used for substances that provide long-lasting immunity against disease. (Still, the term "cancer vaccine" can be used to refer to therapies that train the immune system to fight cancer, according to the [American Cancer Society](#).)

Instead, the new treatment is a type of [immunotherapy](#). It involves giving patients a series of injections with two types of immune stimulants.

The therapy has three steps. First, patients are given an injection that contains a small molecule that recruits immune cells, called dendritic cells, into the tumor. Dendritic cells act like generals in an army, telling the immune system "soldiers" — known as T cells — what to do, Brody said.

Next, patients are given a low dose of radiotherapy, which kills a few tumor cells so that they spill out "antigens," or proteins, that the

immune system can learn to recognize, Brody said. Dendritic cells then take up these antigens and show them to the T cells.

Then, patients are given a second injection that contains a molecule that activates the dendritic cells.

"The dendritic cells are learning the lesson ... and telling it to the T cells," which then can search the body for other cancer cells, Brody said.

### **Synergistic therapies?**

In the new study, many of the 11 lymphoma patients saw a regression of their tumors that lasted for months to years. But several patients didn't benefit from the therapy.

The researchers were also interested to see how their therapy worked with [checkpoint blockade](#) drugs, which essentially take the "brakes" off T cells so they better attack cancer cells. While this therapy can work well for some types of cancer (indeed, President Carter had complete remission after his checkpoint blockade treatment), it doesn't work well for others, including non-Hodgkin's lymphoma.

When the researchers gave checkpoint blockade drugs to mice with non-Hodgkin's [lymphoma](#), the treatment, not surprisingly, had no effect. But when they gave it in combination with their vaccine, about 75% of the mice went into long-term remission.

The type of therapy tested in the new study is known as "in situ vaccination," because it involves injections directly into tumor cells. It isn't the first experimental "in situ" cancer vaccine — in 2018, researchers reported promising results of another [in situ vaccine in mice](#). But the new treatment is different because it focuses on dendritic cells rather than T cells.

The authors think "this could be ... effective for many cancer types that are so far not benefiting much from cancer immunotherapy," Brody said.

Dr. Mark Mulligan, director of the NYU Langone Vaccine Center, who wasn't involved with the study, said the new findings appear promising. Figuring out how to harness checkpoint blockade drugs for more cancer types "is an important area of ongoing research," Mulligan told Live Science. The data presented in mice, and early data from the human trial, "appear promising" in terms of enhancing the effect of checkpoint blockade treatments, he said.

Still, Mulligan cautioned that the new study is the "earliest phase" of human testing, and that larger, more rigorous studies will now be needed to confirm the methods' safety and effectiveness.

Dr. Pallawi Torka, an assistant professor of oncology at Roswell Park Comprehensive Cancer Center in Buffalo, New York, who specializes in lymphoma, agreed the results are "preliminary yet promising."

New immunotherapy approaches for treating non-Hodgkin's lymphomas are "sorely needed," said Torka, who was not involved with the new research. The effectiveness of the study approach is "welcome news," especially given the dramatic improvement seen in the mouse study when the treatment was combined with checkpoint blockade, she told Live Science.

But Torka noted that the treatment approach used in the study is "quite cumbersome." Patients received nine daily injections of the first immune stimulant, followed by two doses of radiotherapy, and then eight injections of the second immune stimulant.

"The next set of experiments will need to focus on simplifying, combining and reducing the number of steps needed" so that the approach could be tested at a number of medical sites, rather than a few specialized cancer centers, Torka said.

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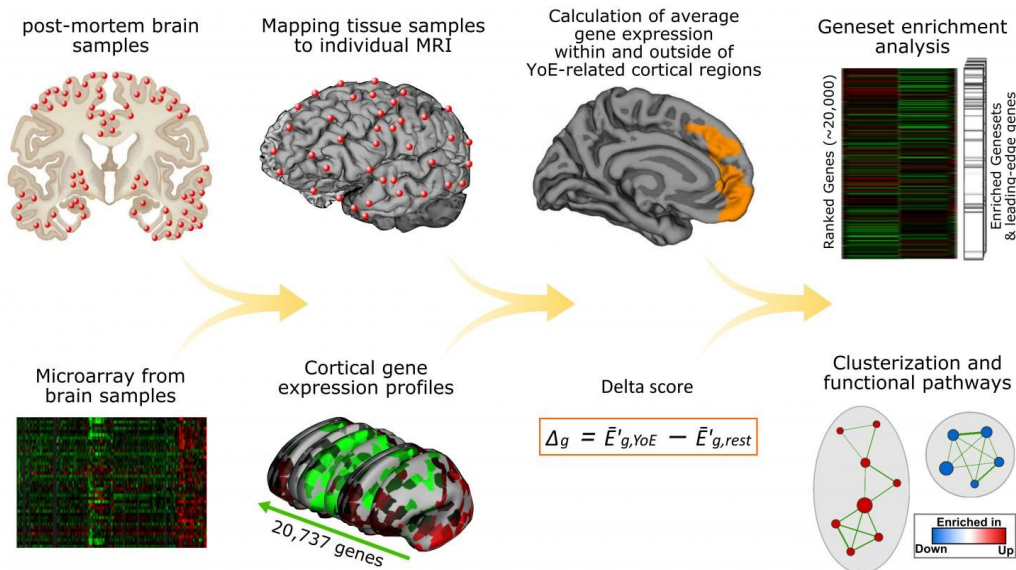
## Researchers find brain molecular features associated with years of education

*May explain how high levels of education are associated with the preserved cognitive function in the elderly*

A study led by a team from the Institute of Neurosciences of the UB identified greater cortical thickness in the frontal lobe in a group of old people with high levels of education (15 or more years of education).

Afterwards, the study of the molecular architecture of these regions revealed these areas feature a relative overexpression of gene families involved in the synaptic transmission and the activation of the immune response.

Results provide new data on humans regarding potential molecular mechanisms that may explain how high levels of education are associated with the preserved cognitive function in the elderly.



*Schematic depiction of the research. D. Bartrés-Faz et al.*

The total number of years of education is the most common proxy measure of cognitive reserve, a psychological construct that reflects the capacity of the adult brain to counteract or minimize the cognitive impact of the typical effects of ageing (i.e. brain atrophy) and even of the initial stages of neurodegenerative conditions such as Alzheimer's disease.

This is stated in a study [published in The Journal of Neuroscience](#), led by David Bartrés-Faz, adjunct lecturer at the Faculty of Medicine and Health Sciences and researcher at the Institute of Neurosciences of the UB (UBNeuro) and the August Pi i Sunyer Biomedical Research Institute (IDIBAPS), together with the team led by Dr. Michel J. Grothe, from the German Center for Neurodegenerative Diseases (DZNE) and published in *The Journal of Neuroscience*.

The researchers, using magnetic resonance data, analysed the brain regions that differ in cortical thickness among older adults with high figures of years of education (15 or more years) compared to a group of individuals with a lower number of years of education.

"This analysis suggested the group of people with more years of education presented greater cortical thickness in the frontal lobe, particularly in the prefrontal areas of the anterior cingulate cortex and the orbital cortex", says David Bartrés-Faz.

In a second part of the study, researchers analysed whether these regions were featured, at a molecular level, by a different genetic expression profile than the other areas in the brain.

To do so, researchers used data from the Allen Institute Human Brain Atlas, which contains information on the cerebral cortex' human transcriptome.

"What we saw -notes Bartrés-Faz is that, compared to the other regions of the cerebral cortex, the areas where people with higher levels of education show a major cortical thickness are characterized by an overexpression of gene families involved in

synaptic transmission-, and therefore, in brain plasticity mechanisms, as well as in gene families involved in immune responses".

"The results are relevant because they reflect -for the first time- the molecular features of brain areas in humans that vary in thickness depending on the education these people received. More specifically, these data are relevant because they conciliate previous studies which suggested education modulates brain plasticity mechanisms. According to Bartrés-Faz, "the identified molecular evidence regarding the overexpression of gene families linked to neurotransmission systems suggest this effect", says the researcher.

Previous studies on neuroimaging had already shown that prefrontal regions such as the anterior cingulate and orbital cortex increased metabolism and functional connectivity in old people with high levels of cognitive reserve. These results had been understood as reflecting greater neural efficiency or higher compensatory capacity to counteract brain atrophy and damage in these elderly. The new study is compatible with these interpretations, while providing new directions for future molecular studies on brain health in ageing.

The study has been carried out analysing neuroimaging data 122 cognitively normal older adults (87 women and 35 men, average age of 68.2), including participants from the study Walnuts and Healthy Ageing (WAHA), coordinated by Dr. Emili Ros, from the Service of Endocrinology and Nutrition at Hospital Clinic de Barcelona-IDIBAPS and the Physiopathology of Obesity and Nutrition Networking Biomedical Research Centre (CIBERObn).

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## **Zapping elderly brains with electricity improves short-term memory—for almost an hour**

*Jolting specific brain areas with a periodic burst of electricity might reverse faltering short-term memory*

By Giorgia Guglielmi

To read this sentence, you hold the words in your mind for a few seconds until you reach the period. As you do, neurons in your brain fire in coordinated bursts, generating electrical waves that let you hold information for as long as it is needed. But as we age, these brain waves start to get out of sync, causing short-term memory to falter. A new study finds that jolting specific brain areas with a periodic burst of electricity might reverse the deficit—temporarily, at least.

The work makes “a strong case” for the idea that out-of-sync brain waves in specific regions can drive cognitive aging, says Vincent Clark, a neuroscientist at the University of New Mexico in Albuquerque, who was not involved in the research. He adds that the brain stimulation approach in the study may result in a new treatment for age-related deficits in working memory.

Working memory is “the sketchpad of the mind,” allowing us to hold information in our minds over a period of seconds. This short-term memory is critical to accomplishing everyday tasks such as planning and counting, says Robert Reinhart, a neuroscientist at Boston University who led the study. Scientists think that when we use this type of memory, millions of neurons in different brain areas communicate through coupled bursts of activity. “Cells that fire together, wire together,” Reinhart says.

But despite its critical role, working memory is a fragile cognitive resource that declines with age, Reinhart says. Previous studies had suggested that reduced working-memory performance in the elderly is linked to uncoupled activity in different brain areas. So Reinhart and his team set out to test whether recoupling brain waves in older adults could boost the brain’s ability to temporarily store information.

To do so, the researchers used jolts of weak electrical current to synchronize waves in the prefrontal and temporal cortex—two brain areas critical for cognition—and applied the current to the

scalps of 42 healthy people in their 60s and 70s who showed no signs of decline in mental ability. Before their brains were zapped, participants looked at a series of images: an everyday object, followed briefly by a blank screen, and then either an identical or a modified version of the same object. The goal was to spot whether the two images were different.

Then the participants took the test again, while their brains were stimulated with a current. After about 25 minutes of applying electricity, participants were on average more accurate at identifying changes in the images than they were before the stimulation.

Following stimulation, their performance in the test was indistinguishable from that of a group of 42 people in their 20s. And the waves in the prefrontal and temporal cortex, which had previously been out of sync in most of the participants, started to fire in sync, the researchers report today in *Nature Neuroscience*. No such effects occurred in a second group of older people who received jolts of current that didn't synchronize waves in the prefrontal and temporal cortex.

By using bursts of current to knock brain waves out of sync, the researchers also modulated the brain chatter in healthy people in their 20s, making them slower and less accurate at spotting differences in the image test.

"This is a very nice and clear demonstration of how functional connections underlie memory in younger adults and how alterations ... can lead to memory reductions in older adults," says Cheryl Grady, a cognitive neuroscientist at the Rotman Research Institute at Baycrest in Toronto, Canada. It's also the first time that transcranial stimulation has been shown to restore working memory in older people, says Michael O'Sullivan, a neuroscientist at the University of Queensland in Brisbane, Australia.

But whether brain zapping could turbocharge the cognitive abilities of seniors or help improve the memories of people with diseases like Alzheimer's is still unclear: In the study, the positive effects on working memory lasted for just under an hour—though Reinhart says that's as far as they recorded in the experiment. The team didn't see the improvements decline toward the end, so he suspects that the cognitive boost may last for longer. Still, researchers say much more work has to be done to better understand how the stimulation works.

Clark is optimistic. "No pill yet developed can produce these sorts of effects safely and reliably," he says. "Helping people is the ultimate goal of all of our research, and it's encouraging to see that progress is being made."

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### **NIH researchers make progress toward Epstein-Barr virus vaccine**

*Novel vaccine candidates that, in animals, elicited potent anti-EBV antibody responses that blocked infection of cell types involved in EBV-associated cancers*

**WHAT:** A research team led by scientists from NIH's National Institute of Allergy and Infectious Diseases (NIAID) has determined how several antibodies induced by Epstein-Barr virus (EBV), a herpesvirus that causes infectious mononucleosis and is associated with certain cancers, block infection of cells grown in the laboratory.

They then used this information to develop novel vaccine candidates that, in animals, elicited potent anti-EBV antibody responses that blocked infection of cell types involved in EBV-associated cancers.

Currently, there is no licensed vaccine for EBV. The virus is associated with certain cancers (nasopharyngeal and gastric) of epithelial cells, which form the lining of the body's surfaces, as well



as Burkitt and Hodgkin lymphomas, which are cancers of the immune system's B cells. Worldwide, about 200,000 cases of EBV-associated cancers occur annually, resulting in 140,000 deaths.

Jeffrey I. Cohen, M.D., and Wei Bu, Ph.D., both of NIAID, led the investigation. Prior efforts to develop an EBV vaccine focused on a viral surface protein, gp350, that the virus uses to enter B cells. However, EBV infects not only B cells, but also epithelial cells that line the mouth and upper throat.

These cells are usually infected after contact with saliva from an EBV-infected individual.

The new research helps define the contributions of virus-neutralizing antibodies other than those directed at gp350 on B cells. Among other findings, the team determined that antibodies to viral proteins called the gH/gL complex play a major role in inhibiting EBV fusion with epithelial cells.

The scientists developed two vaccine candidates, one designed to elicit antibodies to gH/gL on epithelial cells and another that included gH/gL and another viral protein, gp42. The team tested the vaccines in a series of experiments in mice and monkeys.

In both animal models, each of the experimental vaccines induced antibodies that potently inhibited epithelial cell fusion. The vaccine containing gp42 induced stronger B cell fusion inhibitory antibodies than the one containing gH/gL alone.

Unlike the gp350 candidate EBV vaccine, which protects only B cells from infection, the candidate vaccines described in the new paper elicited antibodies that could prevent EBV from fusing with both epithelial cells and B cells and thus may provide protection independent of cell type, the authors note.

The team is planning to further develop one of the vaccine constructs with an eye toward human trials.

**ARTICLE:** *W Bu et al. Immunization with components of the viral fusion apparatus elicits antibodies that neutralize Epstein-Barr virus in B cells and epithelial cells.* [Immunity](https://doi.org/10.1016/j.immuni.2019.03.010) DOI: [10.1016/j.immuni.2019.03.010](https://doi.org/10.1016/j.immuni.2019.03.010) (2019).

<http://bit.ly/2GkEPoM>

## The return of Cthulhu -- the small sea critter

### 430 million-year-old fossil as a new species related to living sea cucumbers

New Haven, Conn. - Cthulhu is calling from the ancient depths -- and this time, researchers are only too happy to speak its name.

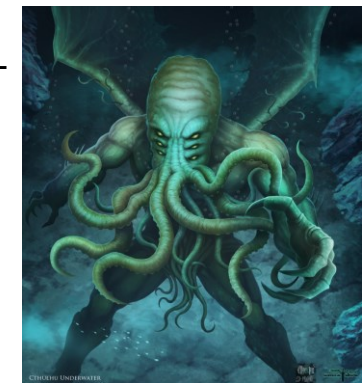
Researchers at Yale, Oxford, the University of Leicester, Imperial College London, and University College London have identified a 430 million-year-old fossil as a new species related to living sea cucumbers. They named the creature *Sollasina cthulhu*, after H.P. Lovecraft's tentacled monster, Cthulhu.



*This is a life reconstruction of Sollasina cthulhu.* Credit: Elissa Martin/Yale Peabody Museum of Natural History

A study announcing the discovery appears April 10 in the journal *Proceedings of the Royal Society B*.

The new cthulhu, *Sollasina*, had 45 tentacle-like tube feet, which it used to crawl along the ocean floor and capture food. The creature was small, about the size of a large spider. It was found in the Herefordshire Lagerstätte in the United Kingdom, a site that has proven to be a trove of fossilized ancient sea animals.



*Cthulhu Underwater* by Serathus

"In this paper, we report a new echinoderm -- the group that includes sea urchins, sea cucumbers, and sea stars -- with soft-tissue preservation," said Yale paleontologist Derek Briggs, a co-author of the study. "This new species belongs to an extinct group called the ophiocistioids. With the aid of high-resolution physical-optical

tomography, we describe the species in 3D, revealing internal elements of the water vascular system that were previously unknown in this group and, indeed, in nearly all fossil echinoderms."

The 3D reconstruction process involves grinding a fossil away, layer by layer, and taking photographs at each stage. This results in hundreds of slice images, which are digitally reconstructed into a "virtual fossil."

That's how the researchers were able to discern *Sollasina*'s internal water vascular system and determine it is more closely related to sea cucumbers rather than to sea urchins.

"The water vascular system operates the tentacle-like structures that they used for locomotion and food capture," Briggs said. "The tube feet of living echinoderms are naked, but in the ophiocistioids they were plated. Our analysis strongly suggests that ophiocistioids diverged from the line leading to modern sea cucumbers."

The researchers said *Sollasina*'s existence demonstrates that the sea cucumber skeleton was modified gradually during the assembly of its body plan.

*The lead author of the study is Imran Rahman, deputy head of research at the Oxford University Museum of Natural History. Other authors are Jeffrey Thompson of University College London, David Siveter of the University of Leicester, Derek Siveter of Oxford, and Mark Sutton of Imperial College London.*

*The Yale Peabody Museum of Natural History Invertebrate Paleontology Division, the Oxford University Museum of Natural History, the John Fell Oxford University Press Research Fund, the Natural Environment Research Council, and the Leverhulme Trust supported the research.*

<https://bbc.in/2UXYJxZ>

## **Homo luzonensis: New human species found in Philippines**

***There's a new addition to the family tree: an extinct species of human that's been found in the Philippines.***

It's known as *Homo luzonensis*, after the site of its discovery on the country's largest island Luzon.

Its physical features are a mixture of those found in very ancient human ancestors and in more recent people. That could mean primitive human relatives left Africa and made it all the way to South-East Asia, something not previously thought possible. The find shows that human evolution in the region may have been a highly complicated affair, with three or more human species in the region at around the time our ancestors arrive.

One of these species was the diminutive "Hobbit" - *Homo floresiensis* - which survived on the Indonesian island of Flores until 50,000 years ago.



***The teeth of Homo luzonensis are consistent with the remains being assigned to a new species*** Florent detroit

Prof Chris Stringer, from London's Natural History Museum, commented: "After the remarkable finds of the diminutive *Homo floresiensis* were published in 2004, I said that the experiment in human evolution conducted on Flores could have been repeated on many of the other islands in the region. "That speculation has seemingly been confirmed on the island of Luzon... nearly 3,000km away."

The new specimens from Callao Cave, in the north of Luzon, are described in the journal Nature. They have been dated to between 67,000 years and 50,000 years ago. They consist of thirteen remains - teeth, hand and foot bones, as well as part of a femur - that belong to at least three adult and juvenile individuals. They have been recovered in excavations at the cave since 2007.



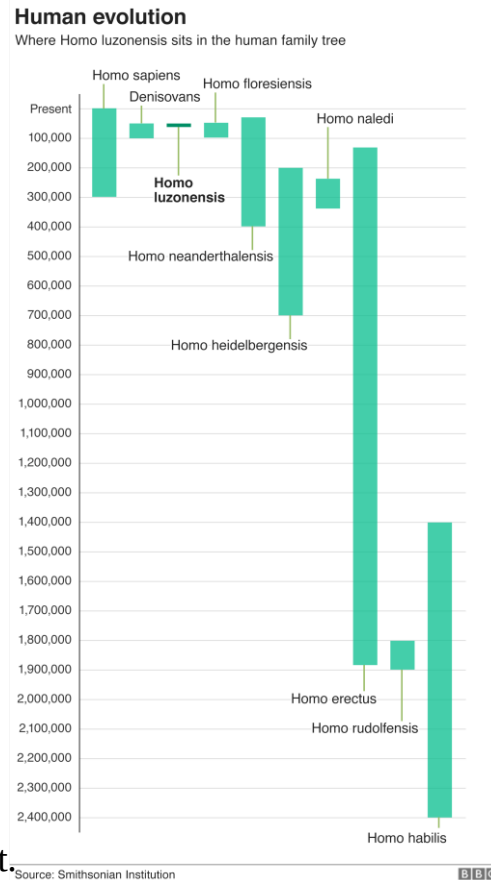
***The finger and toe bones are curved, suggesting climbing was still an important activity for this species*** Florent Detroit

*Homo luzonensis* has some physical similarities to recent humans, but in other features hark back to the australopithecines, upright-walking ape-like creatures that lived in Africa between two and four million years ago, as well as very early members of the genus *Homo*.

The finger and toe bones are curved, suggesting climbing was still an important activity for this species. This also seems to have been the case for some australopithecines. If australopithecine-like species were able to reach South-East Asia, it would change the way our ideas about who in our human family tree left Africa first.

*Homo erectus* has long thought to have been the first member of our direct line to leave the African homeland - around 1.9 million years ago. And given that Luzon was only ever accessible by sea, the find raises questions about how pre-human species might have reached the island.

In addition to *Homo luzonensis*, island South-East Asia also appears to have been home to another human species called the Denisovans, who appear to have interbred with early modern humans (*Homo sapiens*) when they arrived in the region. This evidence comes from analysis of DNA, as no known Denisovan fossils have been found in the region.



The Indonesian island of Flores was home to a species called *Homo floresiensis*, nicknamed The Hobbits because of their small stature. They are thought to have survived there from at least 100,000 years ago until 50,000 years ago - potentially overlapping with the arrival of modern humans.

Interestingly, scientists have also argued that *Homo floresiensis* shows physical features that are reminiscent of those found in australopithecines. But other researchers have argued that the Hobbits were descended from *Homo erectus* but that some of their anatomy reverted to a more primitive state.

In an article published in *Nature*, Matthew Tocheri from Lakehead University in Canada, who was not involved with the research, commented: "Explaining the many similarities that *H. floresiensis* and *H. luzonensis* share with early *Homo* species and australopithecines as independently acquired reversals to a more ancestral-like hominin anatomy, owing to evolution in isolated island settings, seems like a stretch of coincidence too far."

<https://bbc.in/2v2GJnt>

## Taiwan doctor finds four sweat bees living inside woman's eye

***A Taiwanese woman was found by doctors to have four small sweat bees living inside her eye, the first such incident on the island.***

The 28-year-old woman, identified only as Ms He, was pulling out weeds when the insects flew into her eyes.



***Sweat bees sometimes land on people to imbibe perspiration*** Getty Images  
Dr Hong Chi Ting of the Fooyin University Hospital told the BBC he was "shocked" when he pulled the 4mm insects out by their legs. Ms He has now been discharged and is expected to make a full recovery.

Sweat bees, also known as Halictidae, are attracted to sweat and sometimes land on people to imbibe perspiration. [They also drink tears](#) for their high protein content, according to a study by the Kansas Entomological Society.

### 'They were all alive'

Ms He was weeding around her relatives' graves when the insects flew into her left eye.

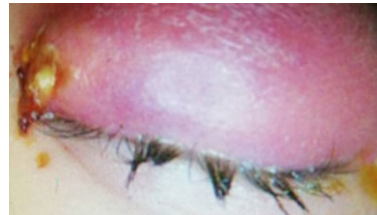
She was visiting the grave as part of the annual Chinese Qing Ming tomb-sweeping festival, which is traditionally observed by sprucing up loved ones' graves. When a gust of wind blew into her eyes she assumed it was dirt that had entered, she told reporters.



*The tiny sweat bees were found inside her left eye* Hong Chi Ting

But hours later, her eyes were still swollen and in pain, leading her to seek medical help at the hospital in southern Taiwan.

"She couldn't completely close her eyes. I looked into the gap with a microscope and saw something black that looked like an insect leg," Dr Hong, an ophthalmology professor at the hospital told the BBC.



*The woman's eye was badly swollen when she went to seek medical treatment*

Hong Chi Ting

"I grabbed the leg and very slowly took one out, then I saw another one, and another and another. They were still intact and all alive."

Dr Hong added that the bees could have been blown inside her eye by a gust of wind and found themselves stuck inside.

"These bees don't usually attack people but they like drinking sweat, hence their name," he said.

Dr Hong added that Ms He was "lucky" that she did not rub her eyes while the bees were inside.

"She was wearing contact lenses so she didn't dare to rub her eyes in case she broke the lens. If she did she could have induced the bees to produce venom... she could have gone blind."

But what's happened to the bees?

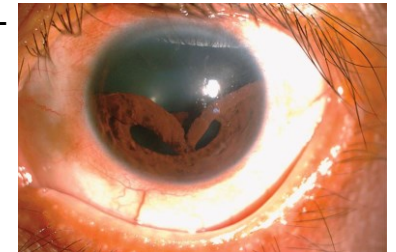
"They are still alive, they've been sent as specimens to another organisation and will be studied," said Dr Hong. "This is the first time in Taiwan we've seen something like this."

<http://bit.ly/2X6C6Vt>

## An Odd Eye Injury Caused a Man's Iris to 'Collapse' Diagnosed with "traumatic iridodialysis"

By [Rachael Rettner, Senior Writer](#)

The man's eye looks like a cloudy fishbowl, or perhaps a terrarium: A dark orb with a layer of a brown, sandy-looking substance at the bottom. But this isn't some kind of special [contact lens](#). It's the result of a painful eye injury that caused the man's iris to tear from its normal place and "droop" down.



*A man in Taiwan was diagnosed with a painful eye injury called "traumatic iridodialysis," in which the iris detaches from its normal place. In this case, the iris detached at the top, and appears to be sagging downward.*

The New England Journal of Medicine ©2019

The man, a 48-year-old living in Taiwan, went to an eye clinic after being struck in his left eye with a bungee cord, according to a new report of the case, published today (April 10) in [The New England Journal of Medicine](#).

He told doctors that the mishap occurred when he attempted to secure goods to a motorcycle using a bungee cord, and the cord snapped back and hit him in the eye.

By the time he went to the clinic, he reported pain and blurry and double vision in the affected eye.

An exam revealed that the man had a bruised left eyelid and a distorted pupil. An eye test showed his vision was 20/200 in his left eye — the threshold for being "[legally blind](#)" in the United States.

Further tests showed the man had a deformed [iris](#) that was detached "from the 9 o'clock position to the 3 o'clock position" and "sagging downward," the report said.

The man was diagnosed with "traumatic iridodialysis." This type of [eye injury](#) happens when blunt trauma causes the iris — the colored part of the eye — to detach from the circular structure behind it, known as the ciliary body, according to the report, from researchers at National Taiwan University Hospital.

The eye is "a complicated, delicate and fragile structure," said Dr. Andrew Iwach, a clinical spokesperson for the American Academy of Ophthalmology (AAO) and an ophthalmologist in San Francisco, who wasn't involved with the case.

"When something strikes the front of the eye, the iris can get 'disinserted,' that is, ripped away from the...inner wall of the eye," leading to iridodialysis, Iwach told Live Science.

In this case, the iris appears to have collapsed — it tore at the top and "kind of came down" due to gravity, Iwach said. But the appearance of iridodialysis can take many forms depending on the angle of the injury and how the shock wave of energy transmits through the eye. "You can get a variety of different patterns of appearance to the eye after injury," Iwach said.

Such injuries can have a number of harmful effects, including bleeding inside the eye, injury to the lens or retinal detachment, Iwach said. It can also cause a "[traumatic cataract](#)," or clouding of the lens, to develop.

Fortunately, in the man's case, he didn't have any signs of these other problems. But he will need to be monitored regularly for the rest of his life, because these injuries can cause eye problems to show up years later, including [glaucoma](#), Iwach said.

The AAO recommends [wearing protective eyewear](#), such as safety glasses, when doing home improvement projects or other activities that could increase the risk of eye injuries.

The man had a surgery known as "iridoplasty" to try to reposition his iris. Afterward, he had restoration of his pupil shape and improved eyesight. One year later, the man's iris remained attached with only "mild deformity" and no signs of glaucoma, the report said.

<http://bit.ly/2UF26uB>

### **Monkeys Genetically Edited to Mimic Human Brain Development**

*Rhesus monkeys engineered to express a human gene reportedly show delayed brain development and better short-term memory.*

*Fellow scientists are raising ethical red flags.*

**Chia-Yi Hou**

Researchers from Kunming Institute of Zoology, Chinese Academy of Sciences, and the University of North Carolina have reported successfully editing a human gene into rhesus monkeys in a study published on March 27 in [National Science Review](#). The gene is said to be important for human brain development and the treated monkeys subsequently showed human-like brain development, reports [China Daily](#).

The human gene, *microcephalin* or *MCPH1*, is expressed during the fetal stage of brain development and is linked to brain size, according to the study. Researchers exposed monkey embryos to viruses containing the gene, which led to the differentiation of neural cells that resembled human development, they described in their study.

Human brains take much longer to develop in comparison to other primates in a process called neoteny, where the period of neural plasticity is extended through childhood. The researchers report that

their study may be evidence that engineered primates can develop in a similar pattern.

The monkeys in the study also showed signs of better short-term memory, report the authors.

A number of scientists, even one involved with the study, have criticized the experiments. Unnamed scientists called the experiments “reckless” and “questioned the ethics of genetically modifying primates,” reports [MIT Technology Review](#). “The use of transgenic monkeys to study human genes linked to brain evolution is a very risky road to take,” James Sikela of the University of Colorado who was not involved with the study tells [MIT Technology Review](#). “It is a classic slippery slope issue and one that we can expect to recur as this type of research is pursued.”

Research using genetic modification of primates is active at Chinese institutions. A research group at the Institute of Neuroscience in Shanghai published results in January 2019 on disabling a gene necessary for the sleep-wake cycle, reports [Nature](#).

<http://bit.ly/2Pb7tLI>

## Our Closest Neighboring Exoplanets Could Be Habitable After All

*Study finds UV radiation should not be a limiting factor for habitability of planets orbiting M-type stars and closest alien worlds remain intriguing targets for the search for extrasolar life*

[Proxima b](#), [TRAPPIST-1e](#), [Ross-128b](#) and [LHS-1140b](#) — the closest potentially habitable exoplanets — orbit a different kind of star than our Sun: M-type stars (red dwarfs). Such stars can flare frequently, bombarding the planets with biologically damaging ultraviolet (UV) radiation, placing their atmospheres at risk of erosion and bringing the [habitability of these worlds](#) into question. A new study, however, finds that UV radiation should not be a limiting factor for the habitability of planets orbiting M-type stars

and that the closest alien worlds remain intriguing targets for the search for life beyond our Solar System.

All life on Earth today evolved from creatures that thrived during an even greater UV radiation assault than Proxima-b and other nearby exoplanets currently endure.

“The [early Earth](#) was a chaotic, irradiated, hot place. Yet in spite of this, life somehow [gained](#) a toehold and then expanded,” said Cornell University astobiologists [Professor Lisa Kaltenegger](#) and [Jack O’Malley-James](#).

“The same thing could be happening at this very moment on some of the nearest exoplanets.”

The astronomers modeled the surface UV environments of Proxima-b, TRAPPIST-1e, Ross-128b and LHS-1140b.

They modeled various atmospheric compositions, from ones similar to present-day Earth to eroded and anoxic atmospheres — those with very thin atmospheres that don’t block UV radiation well and those without the protection of ozone, respectively.

The models show that as atmospheres thin and ozone levels decrease, more high-energy UV radiation reaches the ground.

The team compared the models to Earth’s history, from nearly 4 billion years ago to today.

Although the modeled planets receive higher UV radiation than that emitted by our own Sun today, this is significantly lower than what Earth received 3.9 billion years ago.

An opposite question arises for planets orbiting inactive M-type stars on which the radiation flux is particularly low: does the evolution of life require the high levels of radiation of early Earth?

To judge the potential habitability of worlds with varying rates of radiation influx, the researchers assessed the mortality rates at different UV wavelengths of the extremophile [Deinococcus radiodurans](#), one of the most radiation-resistant organisms known.

“Not all wavelengths of UV radiation are equally damaging to biological molecules,” the scientists said.

“For example, a dosage of UV radiation at 360 nm would need to be three orders of magnitude higher than a dosage of radiation at 260 nm to produce similar mortality rates in a population of this organism.”

“Many organisms on Earth employ survival strategies to cope with high levels of radiation that could be imitated by life on other worlds. Subsurface life would be more difficult to find on distant planets without the kind of atmospheric biosignatures telescopes can detect.”

“The history of life on Earth provides us with a wealth of information about how biology can overcome the challenges of environments we would think of as hostile,” O’Malley-James said.

“Our research demonstrates that in the quest for life on other worlds, our closest worlds are fascinating targets to explore,” Professor Kaltenegger said.

The [study](#) was published in the *Monthly Notices of the Royal Astronomical Society*.

Jack T. O’Malley-James & L. Kaltenegger. 2019. *Lessons from early Earth: UV surface radiation should not limit the habitability of active M star systems*. MNRAS 485 (4): 5598-5603; doi: 10.1093/mnras/stz724

<http://bit.ly/2Zciml1>

## UBC researchers say eggs for breakfast benefits those with diabetes

### *Low-carb breakfast improves control of blood glucose levels*

While some cereals may be the breakfast of champions, a UBC professor suggests people with Type 2 Diabetes (T2D) should be reaching for something else.

Associate Professor Jonathan Little, who teaches in UBC Okanagan's School of Health and Exercise Sciences, published a study this week demonstrating that a high-fat, low-carb breakfast

(LCBF) can help those with T2D control blood sugar levels throughout the day.

"The large blood sugar spike that follows breakfast is due to the combination of pronounced insulin resistance in the morning in people with T2D and because typical Western breakfast foods--cereal, oatmeal, toast and fruit--are high in carbohydrates," says Little.

Breakfast, he says, is consistently the "problem" meal that leads to the largest blood sugar spikes for people with T2D. His research shows that by eating a low-carb and high-fat meal first thing in the morning is a simple way to prevent this large spike, improve glycemic control throughout the day, and perhaps also reduce other diabetes complications.

Study participants, with well-controlled T2D, completed two experimental feeding days. On one day, they ate an omelette for breakfast and on another day, they ate oatmeal and some fruit. An identical lunch and dinner were provided on both days. A continuous glucose monitor--a small device that attaches to your abdomen and measures glucose every five minutes--was used to measure blood sugar spikes across the entire day. Participants also reported ratings of hunger, fullness and a desire to eat something sweet or savory.

Little's study determined that consuming a very low-carbohydrate high-fat breakfast completely prevented the blood sugar spike after breakfast and this had enough of an effect to lower overall glucose exposure and improve the stability of glucose readings for the next 24 hours.

"We expected that limiting carbohydrates to less than 10 per cent at breakfast would help prevent the spike after this meal," he says.

"But we were a bit surprised that this had enough of an effect and that the overall glucose control and stability were improved. We know that large swings in blood sugar are damaging to our blood

vessels, eyes, and kidneys. The inclusion of a very low-carbohydrate high-fat breakfast meal in T2D patients may be a practical and easy way to target the large morning glucose spike and reduce associated complications."

He does note that there was no difference in blood sugar levels in both groups later in the day, suggesting that the effect for reducing overall post-meal glucose spikes can be attributed to the breakfast responses with no evidence that a low-carb breakfast worsened glucose responses to lunch or dinner.

"The results of our study suggest potential benefits of altering macronutrient distribution throughout the day so that carbohydrates are restricted at breakfast with a balanced lunch and dinner rather than consuming an even distribution and moderate amount of carbohydrates throughout the day."

As another interesting aspect of the research, participants noted that pre-meal hunger and their cravings for sweet foods later in the day tended to be lower if they ate the low-carb breakfast. Little suggests this change in diet maybe a healthy step for anybody, even those who are not living with diabetes.

*Little's study was published this week in the American Journal of Clinical Nutrition. His research is funded by the Canadian Institutes of Health Research and a Michael Smith Foundation for Health Research Scholar Award.*

<http://bit.ly/2PbW9PO>

## **Lots of patients with cancer, cancer survivors use but don't report complementary/alternative medicine therapies**

**Participants didn't disclose their CAM use because physicians didn't ask or they didn't think their physicians needed to know**

**Bottom Line:** This study used data from a nationwide survey to estimate how many patients with cancer and cancer survivors use complementary and alternative medicines (CAMs) in addition to or instead of conventional therapies, and how many don't disclose that

to their physicians. Among about 3,100 survey participants reporting a history of cancer, 33.3 percent used CAMs in the past 12 months and the most commonly used were herbal supplements (35.8 percent), followed by other modalities that include chiropractic or osteopathic manipulation (25.4 percent); massage (14.1 percent); yoga/tai chi/qigong (7.6 percent); mantra/mindfulness/spiritual meditation (6.9 percent); special diets (2.9 percent); and acupuncture (2.0 percent). Among the 1,023 participants who reported using CAM, 288 (29.3 percent) didn't disclose that to their physicians. Many participants said they didn't disclose their CAM use because physicians didn't ask or they didn't think their physicians needed to know. Considering the high proportion of patients with cancer and cancer survivors using CAM, there needs to be more study of its use on cancer outcomes.

*Authors: Nina N. Sanford, M.D., of University of Texas Southwestern, Dallas, and coauthors ([doi:10.1001/jamaoncol.2019.0349](https://doi.org/10.1001/jamaoncol.2019.0349))*

<http://bit.ly/2Doo36v>

## **Multiple Denisovan-related ancestries in Papuans DNA sequences from Indonesia and New Guinea reveal new branches of the Denisovan family tree**

The [findings are based on a new study](#) led by Murray Cox from Massey University in New Zealand and made possible by sampling efforts led by Herawati Sudoyo from the Eijkman Institute for Molecular Biology in Jakarta, Indonesia. The data were collected and analyzed by an international team of researchers, including Mark Stoneking from the Max Planck Institute for Evolutionary Anthropology. Taken together with previous work - which has pointed to a third Denisovan lineage in the genomes of modern Siberians, Native Americans, and East Asians - the evidence "suggests that modern humans interbred with multiple Denisovan populations, which were geographically isolated from each other over deep evolutionary time," the researchers write.



The new evidence also unexpectedly shows extra mixing between Papuans and one of the two Denisovan groups, suggesting that this group actually lived in New Guinea or its adjacent islands. Moreover, Denisovans may have lived in the area until as recently as 30,000 years ago, making them one of the last surviving groups of archaic hominins. "People used to think that Denisovans lived on the Asian mainland and far to the north," says Cox. "Our work instead shows that the center of archaic diversity was not in Europe or the frozen north, but instead in tropical Asia." Stoneking adds, "Moreover, this archaic diversity seems to have persisted much longer in Island Southeast Asia and New Guinea than elsewhere in the world."

It had already been clear that Island Southeast Asia and New Guinea was a special place, with individuals there carrying more archaic hominin DNA than anywhere else on Earth. The region was also recognized as key to the early evolution of *Homo sapiens* outside Africa. But there were gaps in the story.

#### Divergent Denisovan lineages

To help fill those gaps, the team identified stretches of archaic DNA from 161 new genomes spanning 14 island groups in Island Southeast Asia and New Guinea. Their analyses uncovered large stretches of DNA that did not jibe with a single introgression of genes from Denisovans into humans in the region. Instead, they report, modern Papuans carry hundreds of gene variants from two deeply divergent Denisovan lineages. In fact, they estimate that those two groups of Denisovans had been separated from one another for 350,000 years.

The new findings highlight how "incredibly understudied" this part of the world has been, the researchers say. To put it in context, many of the study's participants live in Indonesia, a country the size of Europe that is the 4th largest country in the world based on population size. And yet, apart from a handful of genome sequences

reported in a global survey of genomic diversity in 2016, the new paper reports the first Indonesian genome sequences. There also has been a strong bias in studies of archaic hominins toward Europe and northern Eurasia, because DNA collected from ancient bones survives best in the cold north.

#### Missing data bias scientific interpretation

This lack of global representation in both ancient and modern genome data is well noted, the researchers say. "However, we don't think that people have really grasped just how much of a bias this puts on scientific interpretations - such as, here, the geographical distribution of archaic hominin populations," Cox says.

As fascinating as these new findings are, the researchers say their primary aim is to use this new genomic data to help improve healthcare for people in Island Southeast Asia. They say this first genome survey in the region now offers the baseline information needed to set that work in motion.

<http://bit.ly/2V1OGbq>

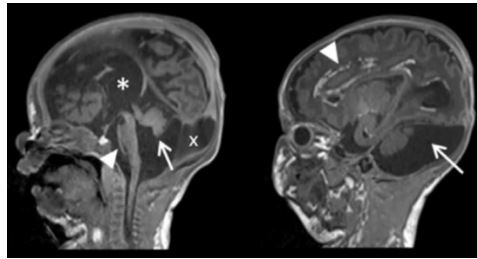
### **The Boy Missing an Entire Type of Brain Cell**

***Microglia make up 10 percent of the brain, and an extremely rare case shows just how important they are.***

Even before he was born, it was clear that the boy's brain was unusual—so much so that his expecting parents flew from rural Alaska to Seattle, where specialists could attend to their son from birth. That is how [James Bennett](#) first met the boy, then a days-old infant struggling to breathe. The baby's head was too big. The structures in his brain looked wrong. Bennett, a pediatric geneticist at Seattle Children's, was tasked with figuring out why.

The answer was ultimately stranger than doctors could have imagined: The boy's brain was [missing an entire type of cell, called microglia](#), the result of mutations in a single gene, called CSF1R. Doctors had never seen anything like it.

Microglia make up 10 percent of the brain's cells, but they are not neurons and therefore have long been overlooked. The boy's case makes their importance unmistakable. In the absence of microglia, the boy's neurons still grew to fill his skull, but they ended up in the wrong places and made the wrong connections. Microglia, scientists have started to realize, guide the development of the brain.



***MRIs of the boy's brain showed structural abnormalities.*** Oosterhof et al / American Journal of Human Genetics

“There wasn't any part of the brain that wasn't involved and affected in this child,” Bennett says. A part of the baby's cerebellum jutted at an odd angle. His ventricles, normally small fluid-filled cavities in the brain, were too large. And a dense bundle of nerves that is supposed to connect the brain's left and right hemispheres, called the corpus callosum, had entirely failed to develop.

In petri dishes and in animals, scientists had previously observed how microglia guide developing neurons to the right locations, creating the highly organized layers that make up the brain. They also prune connections between neurons. “Things get off track pretty quickly when you start manipulating the functions of microglia,” says [Stephen Noctor](#), a developmental neurobiologist at the University of California at Davis who was not involved in examining the boy. To better understand the CSF1R gene, Bennett teamed up with zebra-fish biologists. In fish, turning off the gene disrupts a cellular pathway necessary for corpus-callosum neurons to grow in humans.

[Kim Green](#), a neurobiologist at the University of California at Irvine, notes that mutant mice lacking microglia have broadly similar patterns of disorganization in their brains. These mice

models essentially predicted what would happen in a human. Green had just never expected to see a person without microglia. “It's absolutely remarkable,” he says.

The boy's brain helped unlock these scientific mysteries. But he was ultimately still a boy, a very sick one with worried young parents. Their son's condition was so severe, it turns out, because he had inherited two faulty copies of the CSF1R gene—one from each parent. His parents happened to carry the same rare mutation because they are cousins.

In adults, just one copy of a CSF1R mutation can lead to a brain disorder called [adult-onset leukoencephalopathy with axonal spheroids and pigmented glia](#), which causes memory loss and eventually dementia beginning in one's 40s. When the boy's DNA-sequencing results came back, Bennett realized that he had to explain to the parents their own CSF1R mutation and their risks of developing the disorder. They were relieved, he says, to understand what was wrong with their child, but perhaps too overwhelmed to fully take in what it meant for their lives. The couple spoke with a genetic counselor before their son's DNA sequencing, and Bennett says he arranged to have them meet with another genetic counselor back in Alaska, where they returned home.

This story has no miracle cure or happy ending. The boy died in Alaska at 10 months old of likely related causes, and Bennett says the family agreed to an autopsy. They have since lost touch. The phone numbers he has for them no longer work. He told me that he recently got hold of the mother's sister, in an attempt to tell the family about the research made possible by their child. It's a delicate balance: He feels a duty to inform, but he understands that the parents might not want to be reminded of their dead son.

A pediatric geneticist's job, Bennett said, is often to diagnose extremely rare conditions, which push up against the limits of the

human body. "On any day, you can find a patient you spend the rest of your career thinking about," he said. The boy is one of them.

<http://bit.ly/2DckmRd>

**Earliest life may have arisen in ponds, not oceans**  
***Study finds shallow bodies of water were probably more suitable for Earth's first life forms***  
 by Jennifer Chu, MIT News Office

Primitive ponds may have provided a suitable environment for brewing up Earth's first life forms, more so than oceans, a new MIT study finds.

Researchers report that shallow bodies of water, on the order of 10 centimeters deep, could have held high concentrations of what many scientists believe to be a key ingredient for jump-starting life on Earth: nitrogen.

In shallow ponds, nitrogen, in the form of nitrogenous oxides, would have had a good chance of accumulating enough to react with other compounds and give rise to the first living organisms. In much deeper oceans, nitrogen would have had a harder time establishing a significant, life-catalyzing presence, the researchers say.

"Our overall message is, if you think the origin of life required fixed nitrogen, as many people do, then it's tough to have the origin of life happen in the ocean," says lead author Sukrit Ranjan, a postdoc in MIT's Department of Earth, Atmospheric and Planetary Sciences (EAPS). "It's much easier to have that happen in a pond."

Ranjan and his colleagues have [published their results](#) today in the journal *Geochemistry, Geophysics, Geosystems*. The paper's co-authors are Andrew Babbin, the Doherty Assistant Professor in Ocean Utilization in EAPS, along with Zoe Todd and Dimitar Sasselov of Harvard University, and Paul Rimmer at Cambridge University.

**Breaking a bond**

If primitive life indeed sprang from a key reaction involving nitrogen, there are two ways in which scientists believe this could have happened. The first hypothesis involves the deep ocean, where nitrogen, in the form of nitrogenous oxides, could have reacted with carbon dioxide bubbling forth from hydrothermal vents, to form life's first molecular building blocks.

The second nitrogen-based hypothesis for the origin of life involves RNA -- ribonucleic acid, a molecule that today helps encode our genetic information. In its primitive form, RNA was likely a free-floating molecule. When in contact with nitrogenous oxides, some scientists believe, RNA could have been chemically induced to form the first molecular chains of life. This process of RNA formation could have occurred in either the oceans or in shallow lakes and ponds.

Nitrogenous oxides were likely deposited in bodies of water, including oceans and ponds, as remnants of the breakdown of nitrogen in Earth's atmosphere. Atmospheric nitrogen consists of two nitrogen molecules, linked via a strong triple bond, that can only be broken by an extremely energetic event -- namely, lightning. "Lightning is like a really intense bomb going off," Ranjan says. "It produces enough energy that it breaks that triple bond in our atmospheric nitrogen gas, to produce nitrogenous oxides that can then rain down into water bodies."

Scientists believe that there could have been enough lightning crackling through the early atmosphere to produce an abundance of nitrogenous oxides to fuel the origin of life in the ocean. Ranjan says scientists have assumed that this supply of lightning-generated nitrogenous oxides was relatively stable once the compounds entered the oceans.

However, in this new study, he identifies two significant "sinks," or effects that could have destroyed a significant portion of nitrogenous oxides, particularly in the oceans. He and his

colleagues looked through the scientific literature and found that nitrogenous oxides in water can be broken down via interactions with the sun's ultraviolet light, and also with dissolved iron sloughed off from primitive oceanic rocks.

Ranjan says both ultraviolet light and dissolved iron could have destroyed a significant portion of nitrogenous oxides in the ocean, sending the compounds back into the atmosphere as gaseous nitrogen.

"We showed that if you include these two new sinks that people hadn't thought about before, that suppresses the concentrations of nitrogenous oxides in the ocean by a factor of 1,000, relative to what people calculated before," Ranjan says.

### "Building a cathedral"

In the ocean, ultraviolet light and dissolved iron would have made nitrogenous oxides far less available for synthesizing living organisms. In shallow ponds, however, life would have had a better chance to take hold. That's mainly because ponds have much less volume over which compounds can be diluted. As a result, nitrogenous oxides would have built up to much higher concentrations in ponds. Any "sinks," such as UV light and dissolved iron, would have had less of an effect on the compound's overall concentrations.

Ranjan says the more shallow the pond, the greater the chance nitrogenous oxides would have had to interact with other molecules, and particularly RNA, to catalyze the first living organisms.

"These ponds could have been from 10 to 100 centimeters deep, with a surface area of tens of square meters or larger," Ranjan says. "They would have been similar to Don Juan Pond in Antarctica today, which has a summer seasonal depth of about 10 centimeters."

That may not seem like a significant body of water, but he says that's precisely the point: In environments any deeper or larger,

nitrogenous oxides would simply have been too diluted, precluding any participation in origin-of-life chemistry. Other groups have estimated that, around 3.9 billion years ago, just before the first signs of life appeared on Earth, there may have been about 500 square kilometers of shallow ponds and lakes worldwide.

"That's utterly tiny, compared to the amount of lake area we have today," Ranjan says. "However, relative to the amount of surface area prebiotic chemists postulate is required to get life started, it's quite adequate."

The debate over whether life originated in ponds versus oceans is not quite resolved, but Ranjan says the new study provides one convincing piece of evidence for the former.

"This discipline is less like knocking over a row of dominos, and more like building a cathedral," Ranjan says. "There's no real 'aha' moment. It's more like building up patiently one observation after another, and the picture that's emerging is that overall, many prebiotic synthesis pathways seem to be chemically easier in ponds than oceans."

*This research was supported, in part, by the Simons Foundation and MIT.*

<http://bit.ly/2v4kcqo>

## Linguists found the weirdest languages – and English is one of them

### *Is English "weird"?*

by Adam Schembri, [The Conversation](#)

Is English "weird"? Many of us [might feel this is true](#) when we're trying to explain the complex spelling rules of the language, or the meanings of idioms such as "it's raining cats and dogs" to someone who is learning English. Teaching or learning any language is, however, never an easy task.

But what is a "weird" [language](#) anyway? I am a linguist and we generally aim to be as objective as possible in the study of [human language](#). We view ourselves [as language scientists](#) who make

hypotheses about how humans use language and test them against linguistic data. Unlike so-called "language police," we believe it is important to avoid where possible making value judgements about language.

Some computational linguists have, however, used data in [the World Atlas of Language Structures](#) (WALS) to explore [which languages might be considered the "weirdest"](#). This was not just a value judgment: they systematically compared the information in the WALS website for 239 languages from different parts of the world.

Their aim was to find out which languages had the largest number of features that differed most from other languages. In this survey, English came in 33rd position out of 239 languages. So it was definitely "weirder" than over 80% of the other languages in the survey.

Critics though have claimed the survey indulged [in cherry-picking](#) only a few features of the world's many languages. Indeed, there are features of English that are not "weird" compared to many other languages, such as its basic [subject-verb-object word order](#). But let's look here at two features of English that might in fact be unusual.

### **English sounds strange**

English probably sounds a little "weird" to many speakers of other languages. According to the WALS, the average number of distinctive speech sounds in the world's languages is about 25-30 – known as "phonemes." [Pirahã](#), an indigenous language spoken in the Amazon region of Brazil, has an unusually small set of phonemes. It has eight consonants, and just three vowels: /i/, /a/ and /o/. In contrast, [Taa – also known as !Xóõ](#) is a language in southern Africa which has more than 100 phonemes, including many different types of click sounds. Sign languages, such as British Sign Language or [American Sign Language](#), do not use

sounds at all. Signs are, instead, composed out of combinations of handshapes, movements of the hands, and locations on or near the body of the signer.

Only 6,000 people in the world speak Chalcatongo Mixtec – considered to be the 'world's weirdest language'. Credit: Pexels  
English has more phonemes than many languages, [with around 44](#), depending on which variety of English you speak. It has an unusually large set of vowel sounds – there are around 11. According to WALS, most spoken languages only have [between five to six vowel sounds](#). This is part of the reason that English spelling is fiendishly complicated, because it has inherited five letters for vowels from the Roman alphabet and speakers have to make them work for more than twice that number of sounds.

English has some comparatively unusual consonant sounds as well. Two sounds, those represented by the "th" in "bath" and "bathe" respectively, are found [in fewer than 10% of the languages surveyed](#) in WALS. In fact, these two sounds are generally [among the last sounds acquired by children](#), with some adult varieties of English not using them at all.

### **The question of questions**

English grammar is also "weird." English uses varying word orders to distinguish between questions and statements – meaning that the subject of the sentence precedes the verb in statements. Take the phrase "life is a box of chocolates" for example. Here, the order is subject ("life") followed by the verb ("is"). In the question, "is life a box of chocolates?", the order of these elements is reversed.

In a WALS survey of 955 languages, [fewer than 2% of languages in the sample](#) used English-like differences in sentence structure for questions. Over 50% of the languages added a question particle to differentiate a question from a statement.

In Japanese, for example, you add the question particle "ka" to a statement to turn it into a question. The second most common

strategy in WALS was to change the intonation pattern, such as changing a falling intonation pattern (for a statement) to a rising one (for a question). In contrast, Mixtec (an [indigenous language](#) of Mexico) is a highly atypical language because it does not use any grammatical strategy to distinguish between questions and statements.

That said, it is impossible to conclusively make the argument that English is, or isn't, "weird" because all the data needed to make this judgement is not available. As several thousand languages have not yet been included in WALS, this means WALS can only be used to compare English with a small proportion of [the estimated 7000 languages](#) in the world today. So more [language documentation](#) is ultimately needed to give a better understanding of the world's amazing linguistic diversity.