

Loudspeakers make dead coral reefs sound healthy and fish swim to them

By Derek Hawkins, Washington Post on 12.13.19

Word Count **730**

Level **MAX**



Whitley's Slender Basslet fish swim between Mushroom Leather Corals and *Luzonichthys whitleyi*, Great Barrier Reef, Australia. When the scientists played the sounds of healthy coral ecosystems at damaged reefs in the northern part of the Great Barrier Reef, 50 percent more species showed up than at quiet sites. Photo by: Reinhard Dirscherlullstein bild via Getty Images

The desperate search for ways to help the world's coral reefs rebound from the devastating effects of climate change has given rise to some radical solutions.

In the Caribbean, researchers are cultivating coral "nurseries" so they can reimplant fresh coral on degraded reefs. And in Hawaii, scientists are trying to specially breed corals to be more resilient against rising ocean temperatures.

On November 29, British and Australian researchers rolled out another unorthodox strategy that they say could help restoration efforts: broadcasting the sounds of healthy reefs in dying ones.

In a six-week field experiment, researchers placed underwater loudspeakers in patches of dead coral in Australia's Great Barrier Reef and played audio recordings taken from healthy reefs. The goal was to see whether they could lure back the diverse communities of fish that are essential to counteracting reef degradation.

The results were promising, according to the researchers. The study, published in the journal *Nature Communications*, found that twice as many fish flocked to the dead coral patches where healthy reef sounds were played compared with the patches where no sound was played.

"Healthy coral reefs are remarkably noisy places — the crackle of snapping shrimps and the whoops and grunts of fish combine to form a dazzling biological soundscape," said Steve Simpson, a marine biology professor at the University of Exeter and a senior author of the study. "Juvenile fish home in on these sounds when they're looking for a place to settle."

According to the study, the number of species present in the reef patches where healthy sounds were played increased by 50 percent over the other patches. The new fish populations included species from all parts of the food web, such as scavengers, herbivores and predatory fish. Importantly, the fish that arrived at the patches tended to stay there.

"Reefs become ghostly quiet when they are degraded, as the shrimp and fish disappear," Simpson said, "but by using loudspeakers to restore this lost soundscape, we can attract young fish back again."

The technique, if it can be replicated on larger scales, could offer scientists another tool to revive coral reefs around the world that have been ravaged by climate change, overfishing and pollution in recent years. Scientists have warned that climate change may already be accelerating too quickly for some reefs to recover at all and that conservation efforts are not keeping pace with the devastation.

Severe coral bleaching triggered by extreme heat waves killed off 50 percent of the Great Barrier Reef, the planet's largest coral reef, in 2016 and 2017. Such bleaching events — which occur when the nutrient-rich and color-providing algae that live in corals are expelled because of heat stress — are occurring four times as frequently as they did in the 1980s, as *The Washington Post* has reported.

The researchers worked from October through December 2017 in a lagoon in the northern part of the Great Barrier Reef that has a large, shallow reef that runs along the coastline.

At the start of fish recruitment season, when fish spawn and mature, the team built 33 experimental reef patches out of dead coral on open sand about 27 yards from the naturally occurring reef. They then fixed underwater loudspeakers to the center of the patches, angling them upward to ensure the sound was distributed in all directions evenly.

Over the course of 40 nights, the team played recordings from a healthy reef in some of the patches. In other patches, they used dummy speakers that emitted no sounds, and they left a third group of patches untouched.

The process, called "acoustic enrichment," had a "significant positive impact on juvenile fish recruitment throughout the study period," the researchers wrote. The acoustically enriched reefs attracted fish more quickly and maintained them longer than the reefs without a healthy soundtrack, according to the study.

The researchers acknowledged that drawing fish back to dead or dying reefs will not reverse the damage by itself. But degraded reefs have a better shot at recovery if they have robust populations of fish, which play a variety of roles in keeping the coral healthy.

"Fish are crucial for coral reefs to function as healthy ecosystems," said the study's lead author, Tim Gordon, of the University of Exeter. "Boosting fish populations in this way could help to kick-start natural recovery processes, counteracting the damage we're seeing on many coral reefs around the world."

Quiz

1 Read the following selection from the article.

"Fish are crucial for coral reefs to function as healthy ecosystems," said the study's lead author, Tim Gordon, of the University of Exeter. "Boosting fish populations in this way could help to kick-start natural recovery processes, counteracting the damage we're seeing on many coral reefs around the world."

Which of the following conclusions can be drawn from the selection above?

- (A) Boosting fish populations is all that is necessary to counteract the damage done to many coral reefs.
- (B) Most coral reefs around the world have growing fish populations that are boosted artificially.
- (C) Sizable fish populations are essential for coral reefs to recover from damage they have sustained.
- (D) Coral reefs function as healthy ecosystems whenever nearby fish populations are increased.

2 Which of the following claims does the author support the LEAST?

- (A) Climate change is having a devastating effect on coral reefs.
- (B) Playing sounds of healthy reefs in dying ones attracts fish.
- (C) Scientists are using a variety of strategies to help coral reefs.
- (D) Playing sounds of healthy reefs in dying ones is an unorthodox plan.

3 Which of the following statements MOST accurately represents the relationship between the article's central ideas?

- (A) Many of the world's coral reefs are experiencing extreme degradation because of climate change and other reasons; to counteract this degradation, scientists are trying to attract fish to the reefs by playing audio from healthy reefs through underwater loudspeakers.
- (B) Many coral reefs in the world are experiencing extreme degradation because of climate change, overfishing and pollution; as a result, the reefs have become ghostly quiet as the shrimp and fish have completely disappeared from the reefs.
- (C) Researchers did a six-week experiment involving underwater loudspeakers playing audio from healthy reefs in dying reefs; the goal of this experiment was to see if fish populations could be lured back to the dying reefs.
- (D) A team of researchers built 33 experimental reef patches out of dead coral on open sand near a naturally occurring reef; the team then fixed underwater loudspeakers to the center of the patches and played audio of healthy reefs through the speakers.

4 Read the following two details from the article.

"Juvenile fish home in on these sounds when they're looking for a place to settle."

The process, called "acoustic enrichment," had a "significant positive impact on juvenile fish recruitment throughout the study period," the researchers wrote.

Select the option that BEST explains how these details develop a central idea of the article.

- (A) The details show that juvenile fish are more affected by sound from loudspeakers than mature fish are.
- (B) The details show that juvenile fish were attracted to the sounds they heard through loudspeakers.
- (C) The details illustrate the different steps involved when juvenile fish find a place to settle.
- (D) The details suggest that juvenile fish were enriched because they were recruited for the study.

Doctors try first CRISPR editing in the body for blindness

By Associated Press, adapted by Newsela staff on 03.23.20

Word Count **954**

Level **1220L**



Dr. Mark Pennesi, who leads Oregon Health and Science University's involvement in the trial (center right) looks on as staff at school's Casey Eye Institute perform the first-ever in vivo CRISPR gene edit procedure for the BRILLIANCE clinical trial in Portland, Oregon, on a patient who had an inherited form of blindness. It may take up to a month to see if it worked to restore vision. Photo: Kristyna Wentz-Graff/OHSU via AP

Scientists say they have used the gene editing tool CRISPR inside someone's body for the first time. Their success opens a new frontier for efforts to treat diseases by operating on DNA, the chemical code of life.

CRISPR stands for clusters of regularly interspaced short palindromic repeats. It is a specialized region of DNA. CRISPR technology is a new and powerful tool for editing DNA that allows scientists to alter DNA and the function of genes.

Treatment For Inherited Form Of Blindness

A patient recently had the treatment done at the Casey Eye Institute at Oregon Health & Science University in Portland, Oregon. On March 4, the companies that make the treatment announced it

was for an inherited form of blindness and would not give details on the patient or when the surgery occurred.

It may take up to a month to see if the treatment worked to restore vision. If the first few attempts seem safe, doctors plan to test it on 18 children and adults.

"We literally have the potential to take people who are essentially blind and make them see," said Charles Albright, the chief scientific officer at Editas Medicine, the Cambridge, Massachusetts-based company developing the treatment with Allergan, a company based in Dublin, Ireland. "We think it could open up a whole new set of medicines to go in and change your DNA."

"New Era In Medicine"

Jason Comander is an eye surgeon at Massachusetts Eye and Ear in Boston, another hospital that plans to enroll patients in the study. He said the surgery marks "a new era in medicine" using a technology that "makes editing DNA much easier and much more effective."

Doctors first tried in-the-body gene editing in 2017 for a different inherited disease using a tool called zinc fingers. Many scientists believe CRISPR is a much easier tool for locating and cutting DNA at a specific spot. Interest in the new research is very high.

The people in this study have Leber congenital amaurosis, a condition caused by a gene mutation that keeps the body from making a protein needed to convert light into signals to the brain, which enables sight. People are often born with little vision and can lose even that within a few years.

Scientists cannot treat the condition with standard gene therapy, which is the supplying of a replacement gene. The gene needed for the condition is too big to fit inside the disabled viruses that are used to ferry it into cells.

Editing Or Deleting Mutation

Instead, scientists are trying to edit, or delete, the mutation by making two cuts on either side of it. The hope is that the ends of the DNA will reconnect and allow the gene to work as it should.

The treatment is done in an hour-long surgery under general anesthesia. Through a tube the width of a hair, doctors drip three drops of fluid containing the gene editing machinery just beneath the retina, the lining at the back of the eye that contains the light-sensing cells.

"Once the cell is edited, it's permanent and that cell will persist hopefully for the life of the patient," because these cells do not divide, said Eric Pierce at Massachusetts Eye and Ear. Pierce is a scientist and study leader who was not involved in this first case.

Doctors think they need to fix one-tenth to one-third of the cells to restore vision. In animal tests, scientists were able to correct half of the cells with the treatment, Albright said.

The eye surgery itself poses little risk, doctors say. Infections and bleeding are relatively rare complications.

One of the biggest possible risks from gene editing is that CRISPR could make unintended changes in other genes, but the companies have done a lot to minimize that and to ensure that the treatment cuts only where it is intended to, Pierce said. He has consulted for Editas and helped test a gene therapy called Luxturna, that is sold for a different type of inherited blindness.

Independent Experts Optimistic

Some independent experts were optimistic about the new study.

"The gene editing approach is really exciting. We need technology that will be able to deal with problems like these large genes," said Jean Bennett, a University of Pennsylvania researcher who helped test Luxturna at the Children's Hospital of Philadelphia, Pennsylvania.

In one day, she had three calls from families seeking solutions to inherited blindness.

"It's a terrible disease," she said. "Right now they have nothing."

Kiran Musunuru, another gene editing expert at the University of Pennsylvania, said the treatment seems likely to work, based on tests in human tissue, mice and monkeys.

The gene editing tool stays in the eye and does not travel to other parts of the body, so "if something goes wrong, the chance of harm is very small," he said. "It makes for a good first step for doing gene editing in the body."

First To Edit A Gene Inside The Body

Although the new study is the first to use CRISPR to edit a gene inside the body, another company, Sangamo Therapeutics, has been testing zinc finger gene editing to treat metabolic diseases.

Other scientists are using CRISPR to edit cells outside the body to try to treat cancer, sickle cell and some other diseases.

All of these studies have been done in the open, with government regulators' approval, unlike a Chinese scientist's work that brought international scorn in 2018. He Jiankui used CRISPR to edit embryos at the time of conception to try to make them resistant to infection with the AIDS virus. Changes to embryos' DNA can pass to future generations, unlike the work being done now in adults to treat diseases.

Quiz

1 Read the following paragraph from the section "New Era In Medicine."

Jason Comander is an eye surgeon at Massachusetts Eye and Ear in Boston, another hospital that plans to enroll patients in the study. He said the surgery marks "a new era in medicine" using a technology that "makes editing DNA much easier and much more effective."

Which idea is BEST supported by this paragraph?

- (A) Treatments to edit DNA will be limited to diseases causing blindness.
- (B) Doctors are encouraged by the possibilities of the CRISPR technology.
- (C) Many patients are interested in participating in the gene editing study.
- (D) Medical treatments will soon be dominated by technological treatments.

2 Read the following statement.

Scientists believe CRISPR technology can be more widely used.

Which sentence from the article BEST supports the statement above?

- (A) One of the biggest possible risks from gene editing is that CRISPR could make unintended changes in other genes, but the companies have done a lot to minimize that and to ensure that the treatment cuts only where it is intended to, Pierce said.
- (B) "We need technology that will be able to deal with problems like these large genes," said Jean Bennett, a University of Pennsylvania researcher who helped test Luxturna at the Children's Hospital of Philadelphia, Pennsylvania.
- (C) Kiran Musunuru, another gene editing expert at the University of Pennsylvania, said the treatment seems likely to work, based on tests in human tissue, mice and monkeys.
- (D) Other scientists are using CRISPR to edit cells outside the body to try to treat cancer, sickle cell and some other diseases.

3 Why did the author conclude the article by explaining that the studies have government regulators' approval?

- (A) to confirm that the studies are not taking unnecessary risks with patients
- (B) to show that government approval is required to fund experimental treatments
- (C) to explain the rigorous process of getting approval for experimental treatments
- (D) to describe the unease that patients have with treatments that are not widely tested

4 How does the author analyze the claim that the CRISPR technology might be used to successfully treat diseases?

- (A) by offering expert opinions, describing the treatment and addressing concerns about risks of the treatment
- (B) by providing evidence of patients who have successfully received the treatment and the doctors who treated them
- (C) by giving the details of government approval of the technology and describing successful outcomes in trial treatments
- (D) by explaining the treatments that have been used in the past to correct DNA and showing that CRISPR technology is superior

A gorilla poop treasure hunt through Africa's Virunga volcanoes

By Jessica Leigh Hester, Atlas Obscura on 06.26.18

Word Count **1,061**

Level **MAX**



A baby gorilla clings to its mother in Virunga National Park near Bukima, Democratic Republic of the Congo. Photo by: Brent Stirton/Getty Images for WWF-Canon

In 2015 and 2016, troops of field researchers spent weeks slogging through the thickly forested Virunga Mountains, a volcanic ridge that slices across Rwanda, Uganda, and the Democratic Republic of the Congo. It was cold and humid, steep and slow-going. Sometimes, they'd only press on for a mile or so each day, machetes in hand, and return to camp exhausted. Their goal? Treasure troves of gorilla poop.

For decades, one method of tracking and counting rare mountain gorillas has involved following their tracks and looking for glimpses of hair. Scientists kept their eyes peeled for splintered bamboo or squashed vegetation, but this has never been an easy way to conduct a census. Paths splinter, jump, and veer off in unexpected directions, or dead-end if an animal decided to scale a tree.

Eyeball counts like that are still used for habituated populations — gorillas that are accustomed to the presence of humans. Researchers have given these creatures names and visit them every day.

They know when they're sick, when one is born, when one dies. But there are other gorillas that researchers know much less about, ones that live deeper in the forest. The prevailing wisdom, these days, is that they should get a wide berth. "We don't want to meet them, and we don't want to disturb them," says Anne-Céline Granjon, a graduate student in primatology at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

Mountain gorillas, one of the two or three subspecies of eastern gorilla, are highly endangered, and war and unrest have changed their world. By the mid-1980s, their numbers dwindled to around 250 individuals. Their ranks appear to have been buoyed by conservation efforts, but data about exactly how many there are, and where, are hard to come by.

When the International Gorilla Conservation Programme — a project of the World Wide Fund For Nature and Flora & Fauna International, which collaborates with parks and local experts across all three nations — set out to conduct that recent census, they wanted data but no close contact. So their field teams followed tracks, too, but in the opposite direction: back to the gorilla's nests. Like chimps, gorillas bend branches and leaves into little beds. When they wake up in the morning, they relieve themselves, and so their poop became a proxy.

"We basically look for the poop, and we do genetic analysis and look for DNA fingerprints, the way you would at a crime scene," says Granjon, who trained local field teams and performed the genetic work. The idea was that by studying the stool samples, researchers could get a better grasp of how many individuals there are, and where those individuals had been spending their time.

If gorillas are rare, their scat isn't, so the researchers had far more material than they could ever need. "They leave too much poop, these gorillas; they poop all the time," says Granjon. Gorillas heed this call every few hours, and each time produces as much as a large human bowel movement — male mountain gorillas routinely top 350 pounds. But their leavings aren't particularly rank. "They've herbivores, so it doesn't smell so much," Granjon says. "It smells when you're above it, but not from a distance."

In their search, the field teams walked more than 1,200 miles to cover 170 square miles of habitat. At the nests, they placed walnut-sized stool samples into vials and labeled them with GPS coordinates for analysis back at the Max Planck Institute laboratories. A given nest was only sampled once, unless it contained piles that looked really different, which could suggest a baby with its mother. Since DNA degrades in heat and humidity, each tube contained a high-percentage ethanol, which helped push water out of the sample. The following day, they were transferred to another tube, containing silica beads to continue the dehydration process.

No matter how swiftly and thoroughly dried the sample is, though, fecal forensics isn't ideal. "Poop DNA is not the most perfect DNA one can find in the world," Granjon says. Samples from blood and other tissues yield more precise results. Because fecal matter hangs around in the forest for a few days, exposed to sun, rain, and other animals, Granjon says, "it's already pretty fragmented to begin with." The samples have to be run several times, and since the mountain gorilla population has been low for years, Granjon says, they're fairly inbred, and the genetic differences are subtle. The scientists can tell individuals apart but can't necessarily construct detailed family trees.

Even so, the 1,100 samples generated a lot of data, and Granjon was able to revise the estimate of the number of gorillas in the area. By her count, announced last week, there are at least 186 unhabituated gorillas, in addition to the 418 habituated ones that researchers or tourists routinely

see. Overall, this suggests a 26 percent increase from the last census in 2010. "This represents one of the rare success stories in conservation," said Martha Robbins, a research scientist and gorilla expert at the Max Planck Institute, in a statement. "The population of mountain gorillas in the Virunga Volcanoes has more than doubled in the past three decades, despite intensive threats of poaching, habitat degradation, and civil conflict."

It's possible that a degree of geopolitical stability helped arrest the gorillas' decline since the end of the Second Congo War in 2003, but fatal skirmishes between rangers, militia, and smugglers are still common in the region. In response, Virunga National Park, home to many of the surviving mountain gorillas, will be closed to tourists until 2019, chief warden Emmanuel de Merode announced. "It is abundantly clear that the Virunga is deeply affected by insecurity and that this will be the case for some time," he said in a statement. All primates there — humans and gorillas alike — are vulnerable.

It also remains to be seen how much of the increased gorilla count is due to better methodology, and how much represents a real increase in the population. Chances are it's a bit of both, and researchers have reason to believe that there are more out there that their count missed. In the future, the team plans to use statistical analysis to take a guess at how many more there might be. "Probably," Granjon says, "there are a lot of gorillas we still haven't found."

Quiz

1 Read the following selection from the article

Researchers have given these creatures names and visit them every day. They know when they're sick, when one is born, when one dies.

Which of the following can be inferred from the selection above?

- (A) Researchers get too close to the animals they study.
- (B) Researchers intervene when gorilla populations need help.
- (C) Researchers observe some gorilla populations very closely.
- (D) Researchers rarely get attached to the animals they study.

2 Is the author of the article suggesting that poop DNA is extremely reliable? Which selection from the article BEST supports your answer?

- (A) Yes; "Poop DNA is not the most perfect DNA one can find in the world," Granjon says. Samples from blood and other tissues yield more precise results.
- (B) No; Because fecal matter hangs around in the forest for a few days, exposed to sun, rain, and other animals, Granjon says, "it's already pretty fragmented to begin with."
- (C) Yes; The samples have to be run several times, and since the mountain gorilla population has been low for years, Granjon says, they're fairly inbred, and the genetic differences are subtle.
- (D) No; By her count, announced last week, there are at least 186 unhabituated gorillas, in addition to the 418 habituated ones that researchers or tourists routinely see.

3 Why did the author begin the article by describing the rugged terrain of the Virunga Mountains?

- (A) to argue that gorilla poop is rare and very difficult to find
- (B) to argue that the Virunga Mountains should be protected
- (C) to show the beauty and danger of the Virunga Mountains
- (D) to show the work it takes for researchers to collect gorilla poop

4 Which of the following statements BEST represents Anne-Céline Granjon's approach toward studying gorillas in the article?

- (A) Gorillas should be studied from afar.
- (B) Gorillas should be studied in close contact.
- (C) Gorillas should be studied only through their poop.
- (D) Gorillas should be studied only through watching them.

How can life emerge from nonliving matter?

By Joseph Dussault, Christian Science Monitor on 10.22.19

Word Count **904**

Level **MAX**



Image 1. An artist's impression of early Earth, where the first simple proteins may have formed. In the early 20th century, the "primordial soup" model started to gain traction. It proposed that in Earth's prebiotic history, simple organic matter was exposed to energy in the form of volcanoes and electrical storms. Illustration credit: NASA

A recipe for the perfect, life-yielding, primordial soup has eluded science for decades. But a team of biochemists say they now have a key ingredient.

Charles Carter and Richard Wolfenden, both of the University of North Carolina, have uncovered new evidence of abiogenesis, the process by which life arises from nonliving chemical matter. Their study, published Thursday in the *Journal of Biological Chemistry*, suggests that a single ancient gene may have used each of its opposite DNA strands to code for different chemical catalysts. Those separate catalysts would have both activated amino acids, which then formed proteins – essential to the production of living cells.

Where does life come from? Despite years of research, scientists still rack their brains over this most existential question. If the universe did begin with a rapid expansion, per the Big Bang theory, then life as we know it sprung from nonliving matter. How this process, known as abiogenesis, could have occurred is a source of much scientific debate.

In the early 20th century, the "primordial soup" model of abiogenesis started to gain traction. It proposes that in Earth's prebiotic history, simple organic matter was exposed to energy in the form of volcanoes and electrical storms. That energy would have catalyzed chemical reactions that, in the span of a few hundred million years, could have produced self-replicating molecules.

In 1952, Stanley Miller and Harold Urey tested that hypothesis. They combined water, methane, ammonia and hydrogen in sealed vials in attempt to replicate Earth's original atmosphere. They bombarded the vials with heat and continuous electrode sparks to simulate volcanic activity and lightning. Eventually, the reaction produced a number of amino acids – the building blocks of proteins and, by extension, life itself.

Today, the Miller-Urey experiment is contested for a number of reasons, including the possibility that Earth's original atmosphere may have had a different composition. Still, the production of organic compounds from inorganic "precursors" laid a strong foundation for the primordial soup hypothesis. And new findings support that hypothesis, Carter says.

"Our work furnishes a likely explanation for how nature overcame one of the main obstacles in turning the building blocks, demonstrated by Miller, into genetic coding and inheritance," Carter explains.

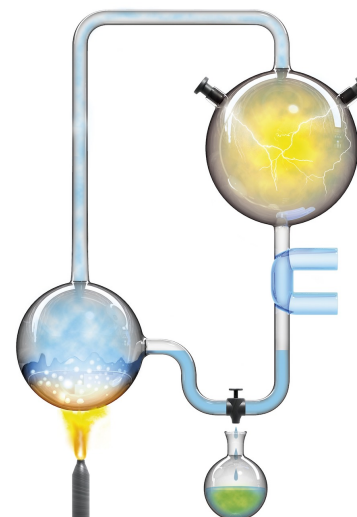
The obstacle Carter refers to is the fact that certain chemical reactions, essential to spontaneous protein assembly, occur very slowly. Unless they are sped up and regulated, the prospect of life becomes all but impossible. In modern living cells, that reaction is catalyzed by enzymes called aminoacyl-tRNA synthetases. These complex molecules belong to two separate families, or classes. Class I synthetases activate 10 of the 20 amino acids that form proteins. Class II synthetases activate the other 10.

In their experiments, Carter and colleagues took modern synthetases and stripped away all but their essential and universal components. They found that the remaining structure, which they call "Urzymes," were actually functional. These Urzymes probably resemble the ancestral molecules which eventually gave way to life, Carter says.

"We discovered Urzymes within the elaborate modern aminoacyl-tRNA synthetases by ignoring all the bells and whistles created by evolution," Carter says. "We showed that what was left was fully capable of translating the code."

According to Carter, the genetic code itself is strangely organized. One coding strand forms the outer surface of the protein, while the other forms the core. In other words, the two strands rely on "inside-out" interpretations of the same genetic information.

"We devised a way to show experimentally that the two families are related to each other, despite all evidence to the contrary," Carter says. "Our experiment shows that the ancestral Class II protozyme was built from exactly the same blueprint as the ancestral Class I protozyme, only the



blueprint behaved as if it were written on glass and interpreted from the opposite side. The stunning thing is that both interpretations work equally well in the test tube."

In other words, nature solved the protein production problem by evolving a single gene to do two separate jobs. And while Carter and Wolfenden's study leaves many questions unanswered, it does provide a "new set of tools" with which to move forward. Carter says his work could inform new experiments to "fill the gaps" in prebiotic chemistry.

Existential implications aside, there is another motivation for answering the abiogenesis question. If we fully understand which materials and conditions are necessary to the production of life, we can narrow our search for life elsewhere in the cosmos. In other words, a primordial soup recipe could revolutionize the study of astrobiology.

Carter, however, isn't as interested in his work's extraterrestrial applications.

"I myself am an inveterate 'terrestrial chauvinist,'" Carter says. "I believe that life as we know it involves so many enchanting coincidences that it is both unique and inevitable, given appropriate environments. My point of view is probably an outlier, but it is based on my life trying to understand what makes biochemistry tick and discovering just how well-suited so many of nature's choices really are."

Quiz

1 How does the author connect Charles Carter and Richard Wolfenden's work with the Miller-Urey experiment?

- (A) by showing how Carter and Wolfenden's work completely contradicts the Miller-Urey experiment
- (B) by highlighting the fact that both of their work is highly controversial and unsubstantiated
- (C) by demonstrating that they are both experiments that show support for the abiogenesis theory
- (D) by illustrating how both experiments demonstrate the process of producing proteins

2 WHY did the author conclude the article by quoting Charles Carter?

- (A) to show that Carter is excited about his work's extraterrestrial applications
- (B) to share Carter's opinions about life and why he does the work that he does
- (C) to explain that Carter does not believe that life can exist outside of the Earth
- (D) to summarize the exact findings from his work with Wolfenden and Urzymes

3 Read the following paragraph.

The obstacle Carter refers to is the fact that certain chemical reactions, essential to spontaneous protein assembly, occur very slowly. Unless they are sped up and regulated, the prospect of life becomes all but impossible. In modern living cells, that reaction is catalyzed by enzymes called aminoacyl-tRNA synthetases. These complex molecules belong to two separate families, or classes. Class I synthetases activate 10 of the 20 amino acids that form proteins. Class II synthetases activate the other 10.

Which phrase from the article helps to explain what "catalyzed" means?

- (A) occur very slowly
- (B) sped up and regulated
- (C) all but impossible
- (D) two separate families

4 What is the meaning of the word "simulate" as used in the following sentence?

They bombarded the vials with heat and continuous electrode sparks to simulate volcanic activity and lightning.

- (A) nullify
- (B) discover
- (C) pretend
- (D) reproduce

Mystery of sea nomads' amazing ability to free dive is solved

By Nicola Davis, The Guardian on 04.25.18

Word Count **767**

Level **MAX**



Image 1. A Bajau diver hunting fish on the reef. Photo by: Melissa Ilardo

The secret behind the ability of a group of "sea nomads" in Southeast Asia to hold their breath for extraordinary periods of time while free diving to hunt fish has finally been revealed – and it's down to evolution.

The Bajau people are able to dive tens of meters underwater with no conventional diving aids. Instead they rely on weights, handmade wooden goggles – and a single breath of air.

But while the Bajau people's talents have long been known, it was unclear whether the skill was the result of practice, as in the case of the excellent underwater vision of Thai "sea nomad" children, or the result of adaptations which have their roots in the Bajau people's DNA.

Now experts say they have the answer: over time the Bajau people have undergone natural selection, resulting in certain versions of genes becoming widespread – many of which are linked to biological changes, including having a larger spleen, that could help the Bajau to hold their breath underwater for many minutes at a time.

The team say the findings could eventually prove useful in medical settings, potentially allowing experts to identify patients that might be at greater risk of death if they experience a lack of oxygen, for example during surgery.

"There seems to be so much to learn from the Bajau and other diving populations about how the human body is able to react to oxygen deprivation, which is an important medical issue," said Dr. Melissa Ilardo, first author of the study who was at the University of Copenhagen at the time of the research.

Writing in the journal *Cell*, the scientists reveal how they unpicked the mystery following a clue from previous research: species of seals which can dive for longer have larger than expected spleens – an organ which, among its functions, can store oxygen-carrying red blood cells.

As a result the team used an ultrasound device to measure the spleen in 43 Bajau people and 33 people from a neighboring group of farming people, the Saluan.



"The spleen size is about 50 percent larger in these sea nomads than it is in the [Saluan], so already it was like 'Oh, my God – it is really [an] extreme physiological characteristic,'" said Professor Eske Willerslev, a co-author of the study from the University of Cambridge.

The team notes the trend held regardless of whether the Bajau individual was themselves a diver, and even when factors such as age, sex and height were taken into account.

Genetic testing revealed that certain versions of genes are more commonly found in Bajau people than would be expected, with many apparently linked to biological changes that could help individuals cope with low-oxygen conditions.

Among them is a form of a gene linked to an increased spleen size – an effect the team reveal is likely down to an increase in thyroid hormone levels. Crucially, a contraction of the spleen is one of the features of the so-called "diving reflex" – a set of responses in mammals that occur when the head is submerged. A large spleen means even more oxygen-carrying red blood cells can be pumped into the circulatory system when the organ contracts, allowing individuals to stay underwater for longer.

Another is a form of a gene linked to a different feature of the diving reflex: narrowing of the blood vessels to the extremities, aiding delivery of oxygenated blood to organs such as the brain, heart and lungs.

Further analysis by the team revealed that these genetic boons are not the result of chance, but evolutionary adaptations arising from natural selection.

Stephen Stearns, professor of ecology and evolutionary biology at Yale University who was not involved in the research, said the study adds to evidence for recent natural selection on certain genes in human populations – with previous examples including genes for lactose tolerance that

cropped up with the advent of domestication of dairy animals, and genes for adaptation to high altitude in Tibetans and Native Americans in the Andes.

"What we lack at this point, and badly need, are samples large enough to allow us to infer when the selection [in the Bajau] started to happen," he said. "We know that the Bajau have been leading this lifestyle for at least a thousand years, but we do not know when they started it – perhaps much earlier."

Quiz

1 Read the central idea statements below.

1. *Research has revealed that the ability of the Bajau people to hold their breath for long periods of time while diving is the result of changes to their DNA.*
2. *The Bajau people have a secret ability to dive tens of meters underwater with no conventional diving aids.*
3. *These changes are linked to a larger spleen and other genetic features that affect the storage and use of oxygen in the body.*
4. *These changes have also been proven in Tibetans and Native Americans in the Andes mountains in South America.*

Which two options accurately reflect the central ideas of the article?

- (A) 1 and 3
- (B) 1 and 4
- (C) 2 and 3
- (D) 2 and 4

2 Read the two details from the article.

"The spleen size is about 50 percent larger in these sea nomads than it is in the [Saluan], so already it was like 'Oh, my God – it is really [an] extreme physiological characteristic,'" said Professor Eske Willerslev, a co-author of the study from the University of Cambridge.

Genetic testing revealed that certain versions of genes are more commonly found in Bajau people than would be expected, with many apparently linked to biological changes that could help individuals cope with low-oxygen conditions.

Select the option that BEST describes how these details develop a central idea of the article.

- (A) Both details demonstrate the dedication of scientists to discovering the secret of the Bajau people's diving ability.
- (B) Both details reflect the view that further research is necessary to understand the genetic changes of the Bajau.
- (C) Both details contribute to the understanding that natural selection has given the Bajau extraordinary genetic traits.
- (D) Both details highlight the perspective that scientists can use their study of the Bajau people to understand natural selection.

3 Which idea did the author develop LEAST in this article about the Bajau people's ability to free dive?

- (A) the potential use the study of the Bajau people could have for doctors in medical settings
- (B) the need for further information about how natural selection in the Bajau occurred
- (C) the relationship between the size of the Bajau people's spleens and their ability to store oxygen
- (D) the methods that scientists used to evaluate the presence of natural selection in the Bajau

4 What role does the diving reflex play in the Bajau people's ability to hold their breath for long periods?

- (A) It is a set of responses that tells the body to adjust its use of oxygen by contracting the spleen and narrowing the blood vessels when the head is submerged.
- (B) It is a set of responses that develops over time in a population to increase the thyroid hormone levels that control the use of oxygen throughout the body.
- (C) It is a basic response that changes with age and sex among populations in order to allow those who practice diving to hold their breath for longer periods.
- (D) It is a basic response that helps those who have already benefited from natural selection to hold their breath and to see better when underwater.