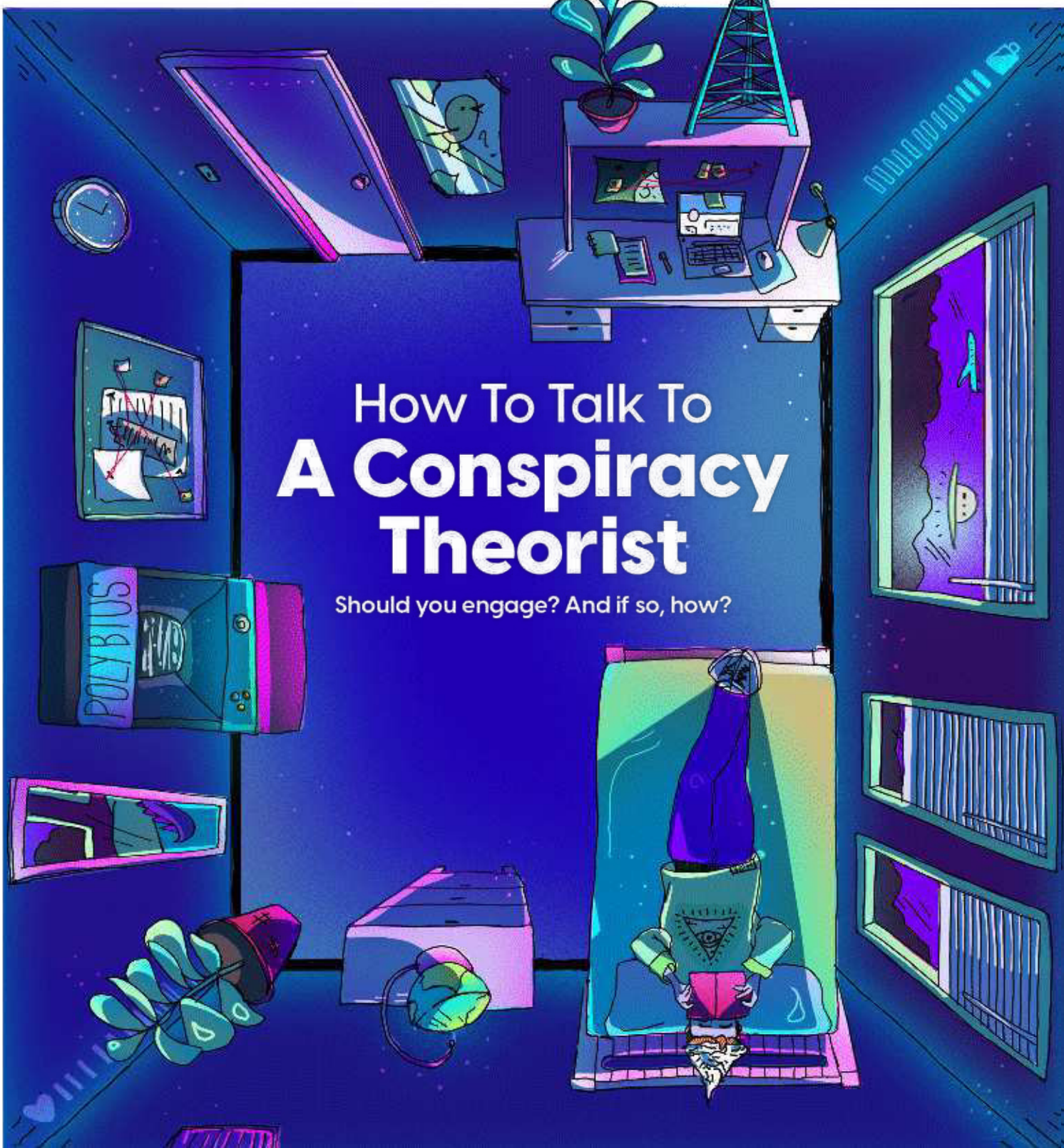
CURIOUS

WHAT WOULD LAVA TASTE LIKE? THAT IS, ASSUMING YOU DON'T DIE INSTANTLY...

CAN HUMANS SURVIVE BEING FROZEN LIKE A POPSICLE?

IFLSCIENCE.COM | AUGUST 2022



How To Talk To A Conspiracy Theorist

Should you engage? And if so, how?

IFLSCIENCE



WHERE ON EARTH

ITALY'S UPSIDE-DOWN FIG TREE

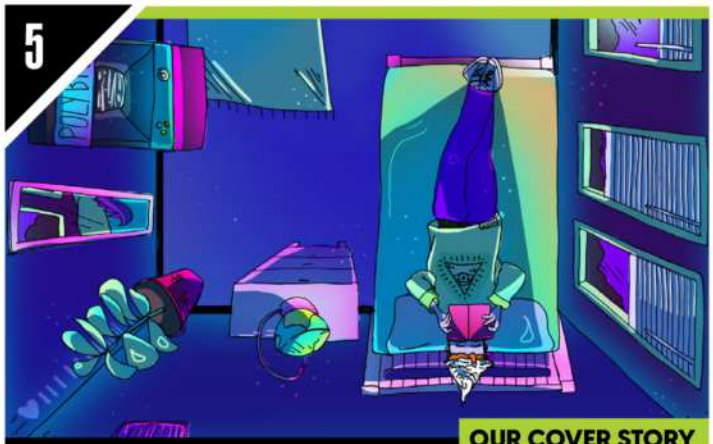
A botanical take on *Stranger Things* can be found in an ancient cave in Naples, writes Rachael Funnell.



DEEP DIVE

CAN HUMANS SURVIVE BEING FROZEN LIKE A POPSICLE?

Has anyone ever been frozen and lived to tell the tale? And what would it do to the body? Maddy Chapman investigates.



OUR COVER STORY

HOW TO TALK TO A CONSPIRACY THEORIST

James Felton explores how and when to talk to conspiracy theorists, and why it's worth not ignoring the issue altogether.

August 2022

CONTENTS

News Bites | page 3
What's new, what's weird, what's happening

What On Earth | page 8
The Crystal Caves Of Naica Mine, Mexico

We Have Questions | page 9
What does lava taste like?

Book Bites | page 14
Who discovered the first mammal fossil?

Meet The Author | page 15
Steve Brusatte on *The Rise And Reign Of The Mammals*

Science In Media | page 18
What to watch, read, and listen to in August

Dates To Remember | page 19
Science highlights this month

Dark Vs. Light | page 20
How will you end the issue?

IFLSCIENCE

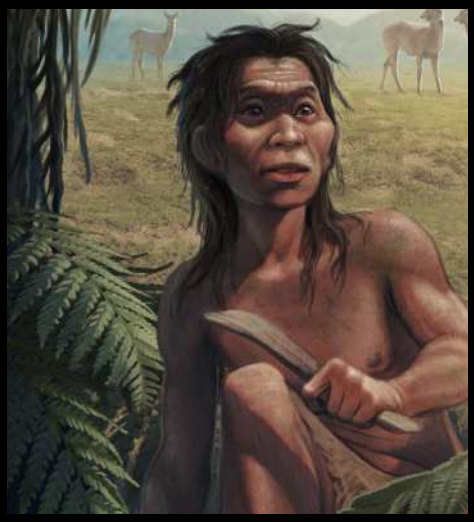
Cover illustration: AnnaMaria Vasco

Editors
Katy Evans
Rachael Funnell

Jr. Art Director
James Rodrigues

Contributing writers
James Felton
Maddy Chapman
Francesca Benson

NEWS BITES



Native Americans Come From... Ancient China?

For the first time, scientists have successfully sequenced the genome of mysterious human fossils from ancient China, and discovered this hominin was part of an extinct branch of modern humans that may have contributed towards the origin of Native Americans. Dating to around 14,000 years ago, the Chinese fossils included a skull cap with curiously modern and archaic human traits. The DNA extracted shows the "Red Deer Cave" people, as the remains have been called, were modern humans, not archaic. The genome was compared to that of people from around the world and a link was found with the East Asian ancestry of Native Americans. The team proposes that some southern East Asian intrepid explorers traveled along the eastern China coast, through Japan and Siberia, and crossed the Bering Strait to become the first people to arrive in what is now known as North America.



Pig Little Lies

The world's first reality television series starring pigs sets out to expose the truth behind the fashionable pet accessory, teacup pigs. A light-hearted dramedy with an underlying serious message, the show follows the adventures of bonded pot-bellied pigs Dante and Beatrice and their brood from shelter to rehoming, while exposing the lie that is "teacup pigs" and exploring what happens when a tiny piglet that can fit in your purse becomes a fully grown animal. All five episodes are available to watch for free on the **UnchainedTV app.**



Catherine Of Aragon's Secret Cipher Unraveled Using "Early Modern Wordle"

A hidden message by Catherine of Aragon, beleaguered first wife of Henry VIII, has been revealed to show her defiance against her husband's attempts to divorce her for Anne Boleyn. Vanessa Braganza, a self-described "book detective", became fascinated with a cipher designed by Tudor court painter Hans Holbein who was famous for designing jewelry and ornaments with coded symbols and ciphers. Braganza used a process she describes as "early modern Wordle" to uncover the hidden meaning, revealing the cipher spelled out HENRICVS REX and KATHERINE. It was likely commissioned by Catherine, who refused to accept Henry's attempt to divorce her, in an act of defiance for all to see who looked properly. Pretty impressive for someone who knew Henry and what he did to women he thought wronged him.

The Big Questions Season Two Launches!

IFLScience's popular podcast is back for a second season, with even more "Big Questions" and top experts to fire them at. This time we ask what is the fate of the universe, is there a limit to how fast computers can become, how does imagination work, how do drugs affect your brain, how does memory work, how do we know if a species has gone extinct, and can humans live forever?

Don't miss season two of **IFLScience The Big Questions**, kicking off from July 29 and available wherever you get your podcasts.

Image Credit Left: Xueping Ji *Right:* Linn Currie/Shutterstock

Ants Are Coming For Archaeologists' Jobs

Ten new species of ancient mammals have been found in Nebraska, shedding light on what it was like to be small fluffy prey 33 million years ago. But the archaeologists on the dig site can't take sole credit for the discovery. That goes to an ant army that unearthed thousands of fossilized teeth and jaw bones, which turned out to be from animals previously unknown to science. Harvester ants can dig over a meter down and carry materials up to 50 times their weight, so really, they make the perfect pocket tool for your discerning archaeologist out in the field.



Look Up! Spectacular Comet Outburst Debris To Thrill Stargazers This Month

Trails of dust from the largest comet outburst ever seen should be visible to anyone with a modest telescope throughout August, and curiously, they will appear in the shape of an hourglass. Back in 2007, an underwhelming comet called 17P/Holmes suddenly brightened by a factor of 1 million. Its massive trail meant it briefly became the largest object in the Solar System, making it visible even to the naked eye. Instead of dissipating, however, the trail has persisted, and astronomers predict it should be visible to Northern and Southern Hemisphere stargazers this month. The dust travels in an hourglass shape with two bulges and a narrow middle zone, a relic of the initial outburst.



Gophers Are Farmers

Yep, gophers are our closest agricultural relatives

Name: The southeastern pocket gopher (*Geomys pinetis*)
Appearance: Small- to medium-sized sized rodent. Big claws and teeth
Location: Southeastern USA, mainly Georgia, Alabama, and Florida
Farmers? Well, they don't identify as farmers, but they are the first non-human mammals known to farm their food, according to new research
How are we defining farming? Dig tunnel. Cultivate roots. Make a profit?
Tunnels? Gophers spend almost their entire lives eating, sleeping, pooping, and mating under the same bit of packed earth, so they make sure their dugouts (which are up to 100 meters (328 feet) long) are in tip-top condition
Am I standing on a gopher tunnel right now? Tell-tale mounds of sandy soil are good indicators, but these feisty rodents will let you know if you get too close
What do they eat? Pocket gophers are strictly herbivorous so plant roots, shrubs, grasses
What are they farming? Fields of subterranean plant roots
How do we know this? Scientists at the University of Florida were curious as to how a vegan diet was powering their energy-intense tunnel-keeping pursuits. They discovered that gopher tunnels are a perfect environment for roots to flourish in. In fact, the gophers were clearing space for the roots to grow and then harvesting them
A plant-gopher partnership? A potential food-production system. They're not planting the seeds but cultivating the produce
So, they're now one of us? This discovery makes them the only known mammal – other than humans – to farm for a living. It remains unknown if they have "largest root" competitions at the county fair.

Image Credit Right: NASA, ESA, and A. Dyer. *Left:* © iStock, stevelenzphoto



HOW TO TALK TO A CONSPIRACY THEORIST

Should you engage? And if so, how?

By James Felton

Conspiracy theories can range from the small and innocent (blue tack is just white tack that's been colored in with pen) to the downright dangerous and absurd (have the people who think Bill Gates is a super-genius capable of a global conspiracy to microchip everybody using vaccines ever tried using Bing?).

It may be easy to dismiss people who believe, for instance, that "the government, media, and financial worlds in the U.S. are controlled by a group of Satan-worshipping pedophiles who run a global child sex trafficking operation." But it's less easy to dismiss that 15 percent of American adults agreed with the above statement, according to a 2021 survey.

Like it or not, you will probably engage with conspiracy theorists at some point, be it a family member, friend, or colleague, so it's best to know how to respond when someone tells you the Earth is hollow.

First, let's look at why they believe conspiracy theories in the first place.

Why do people believe in conspiracy theories?

Our stupid, stupid brains

"The human brain is wired to see patterns to help us survive," neuroscientist Shannon Odell explained in a YouTube video for Inverse in 2019.

"Sensing patterns can save your life. Pattern processing became increasingly sophisticated with expansion of the cerebral cortex, particularly the prefrontal cortex and regions involved in image processing."

This is all pretty useful. It's a good thing, for instance, if you recognize the link between bubbles in a swamp and an alligator attack. But sometimes this survival mechanism goes beyond this, going from a way to keep us alive to making Uncle Chad bore you with his theories about 9/11, completely ruining Thanksgiving.

"As we evolved, the brain got so good at finding patterns that it sometimes sees a pattern in completely unconnected data," Odell explained.

This is how you end up with conspiracy theorists, and 200 BC peasants noticing their turnip harvest was diminished on the year they forgot to sacrifice a virgin to the volcano.

Out of control

Studies have shown that people who feel like they lack control over their lives or circumstances are more likely to believe in conspiracy theories. One study in 2020 found that people who had been seriously affected by tornados reported decreased control, which in turn predicted their belief in conspiracy theories. Higher levels of depression and anxiety are also predictors of stronger beliefs in conspiracies.

We are terrible at assessing probability

One interesting study from the Zurich Institute of Public Affairs Research suggests that people may believe in conspiracy theories due to being absolutely terrible at math.

In the study, volunteers were asked to read fictional news stories involving a journalist having a heart attack. In different versions, they were told that his doctor had suggested he either had a 1 percent, 25 percent, 50 percent, 75 percent, or 95 percent chance of having a heart attack. They were then asked to rate how likely it was that the journalist had had a heart attack, or had been murdered.

When the fictional news report stated that a heart attack was unlikely, the participants were more likely to believe that the journalist was a victim of murder. In a second experiment, they were told that the journalist had recently reported on government corruption. In this scenario, more participants believed that he had been murdered.

"The lower the probability of an event, the stronger participants embrace conspiratorial explanations," the study authors wrote.

"Conspiratorial thinking, we conclude, potentially represents a cognitive heuristic: A coping mechanism for uncertainty."

How to talk to a conspiracy theorist

Should I just mock them until they shut up?

No. As hard as it might be when someone tells you that Australia doesn't exist or when somebody reaches the edge of the world they are teleported to the other side like a flat-Earth Pac-Man, ridicule is not an effective way to get someone to change their mind.

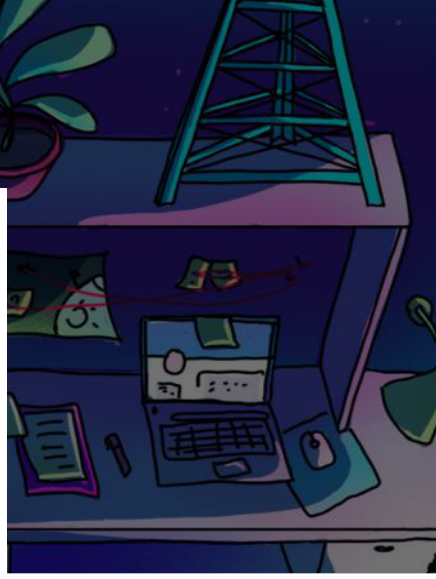
In fact, studies have shown that by making people believe you are on their side (e.g. through the use of agreeing statements: "I understand," "I see your point", "you're right" etc) you can make people more receptive to your own ideas and evidence.

Should I use evidence?

One of the most frustrating things about dealing with conspiracy theorists is that once they are committed to their beliefs it is almost impossible to refute using evidence. You aren't going to convince someone who thinks the Moon landings were faked because the flag is flapping on a windless Moon by pointing out that the flapping was caused by Neil



Image Credit: © iStock, Dusan Stankovic



Armstrong attempting to wiggle the pole into the lunar soil, and, crucially, below the flag is the Moon, as seen from the actual Moon.

However, there is evidence that exposure to health experts can reduce belief in conspiracy theories surrounding COVID-19, and a link between consumption of traditional media (certain television channels and newspapers as opposed to news through Facebook, YouTube, etc).

PEOPLE CAN BE INOCULATED AGAINST THE POTENTIALLY HARMFUL EFFECTS OF ANTI-VACCINE CONSPIRACY THEORIES

When is best?

The best time to dispel conspiracy theories is, uh, before people have read them. In a 2017 study, participants were presented with anti-conspiracy theory arguments before or after reading arguments in favor of conspiracy theories regarding vaccines and then asked whether they would vaccinate a fictional child.

They found that the anti-conspiracy theory arguments were effective in increasing intent to vaccinate, but only if presented to the participants before the conspiracy theories. On top of this, prior belief in anti-vaccine conspiracy theories was also a mitigating factor, making it less likely that they would choose to vaccinate the imaginary child, even after seeing the counterevidence.

"These findings suggest that people can be inoculated against the potentially harmful effects of anti-vaccine conspiracy theories," the team wrote in the study, "but that once they are established, the conspiracy theories may be difficult to correct."

Ignore the topic entirely

If belief in conspiracy theories was down to evidence vs counterevidence, the flat-Earth conspiracy theory would have vanished the second an image of our big bally Earth was beamed back from space.

As mentioned above, belief in conspiracy theories is much more to do with feelings of anxiety, depression, and lack of control by individuals. Just as people take solace in conspiracy theories to explain why the world is against them when they feel out of control, giving people a sense of control may help to lower belief in conspiracy theories too. Researchers found simply asking participants to recall a situation in which they were in control made them less likely to believe a conspiracy theory they were presented with. Asking them to recall situations where they felt out of control produced the opposite effect.

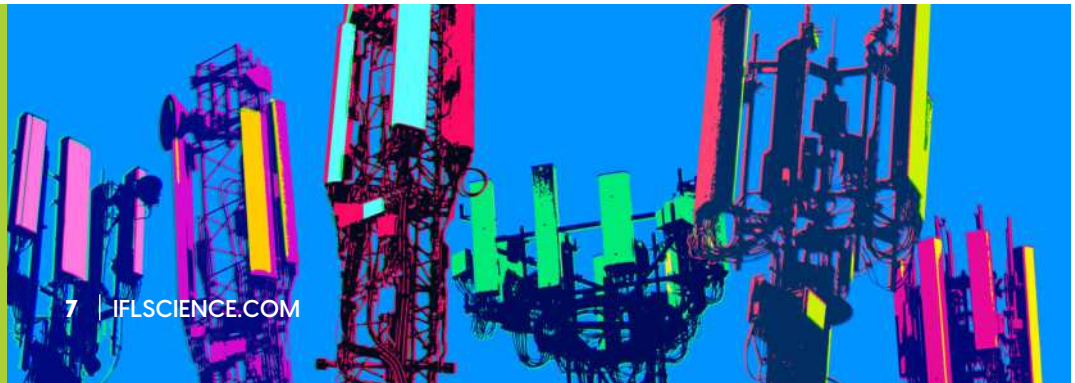


Helping a relative or friend to move away from conspiracy theories may be a case of treating the cause – feelings of being out of control – rather than the symptom. The belief that Big Bird died and was replaced by a second Big Bird with nefarious intent is probably masking a deeper issue.

Unfortunately, making people feel in control may not be so easy during a timeline consumed by the climate crisis and the world's current favorite game: whack-a-mole of global infectious diseases. Be patient.



Image Credit Right: © iStock, anilyanik. Bottom Left Corner: © iStock, smartboy10



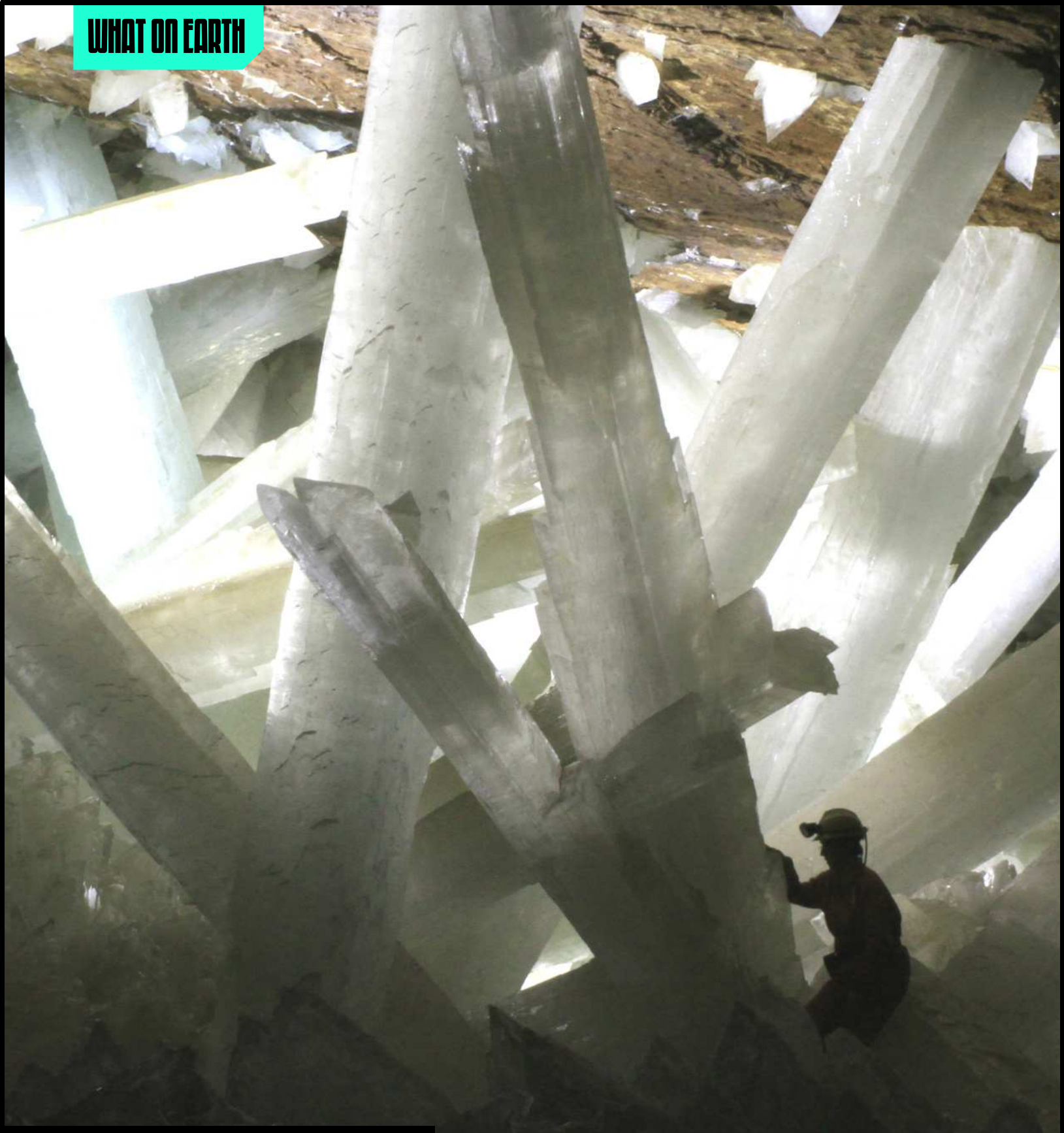


Image Credit: *Alexander Van Driessche - Gaianauta, CC BY 3.0, via Wikimedia commons*

CRYSTAL CAVES IN THE NAICA MINE

CHIHUAHUA, MEXICO

Enormous swords of gypsum have formed in the Cave Of Crystals which is attached to the Naica Mine in Chihuahua, Mexico. Several crystal caves have been discovered there, but the most impressive free-growing specimens stretch to 12 meters (39 feet) long and 2 meters (6.6 feet) wide. The caves sit deep below a mountain and while they are quite a sight, it's not a place for tourists, but a place of work. Here, lead and zinc are extracted from limestone by humans like the tiny silhouette in the bottom of this photo.

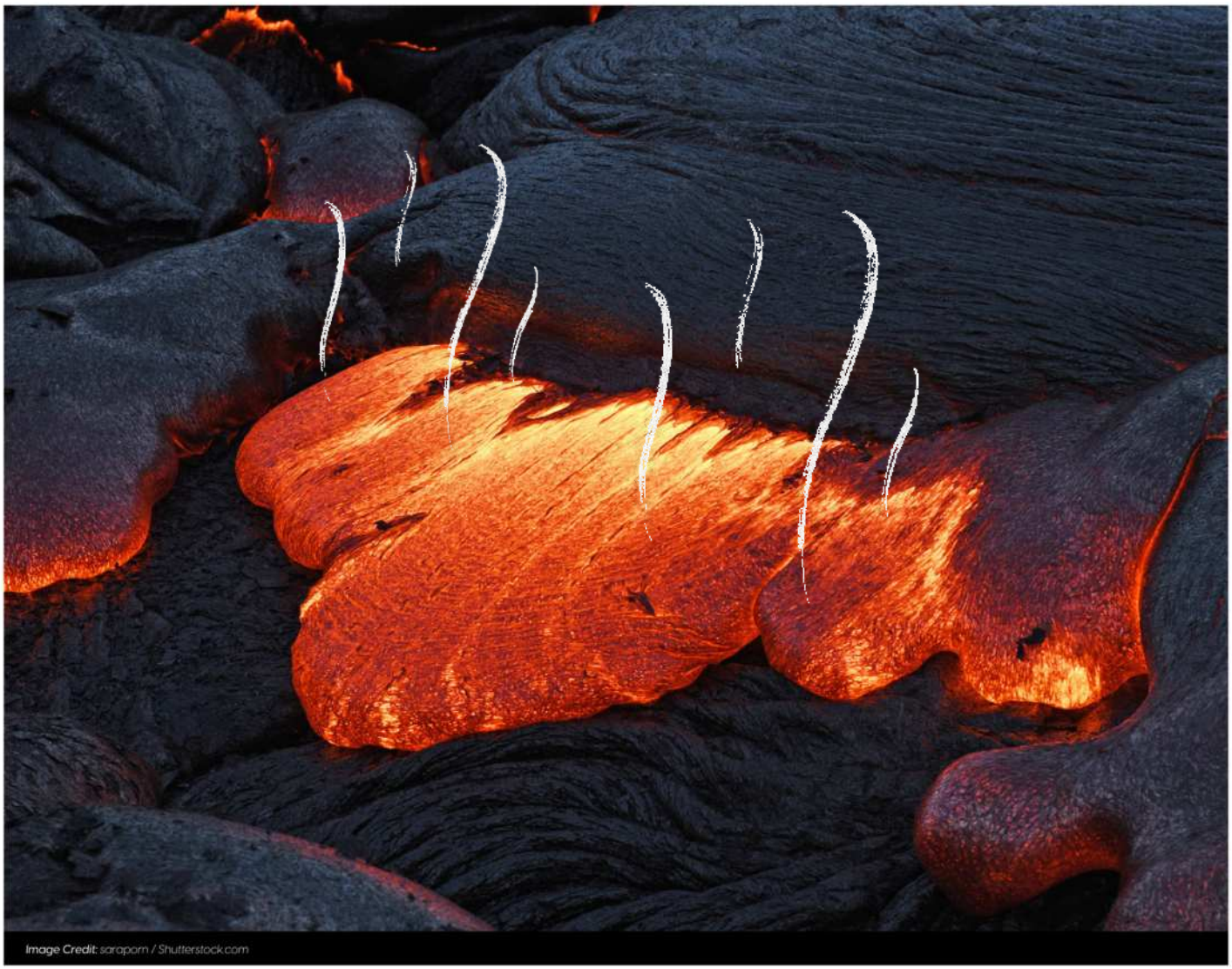


Image Credit: saraporn / Shutterstock.com

WHAT DOES LAVA TASTE LIKE?

SHOULD YOU EAT THE DELICIOUS-LOOKING LAVA? WHAT DO YOU THINK?

By Francesca Benson

Some impulses are more dangerous than others – say, for example, the urge to ingest lava. Weird as that may sound, many half-joking posts on social media proclaim that lava looks very delicious, with users expressing curiosity as to how the blistering liquid rocks would taste and feel.

A Reddit post titled "**God I want to eat lava so bad**" states that "something in my brain tells me it tastes good". Musician Jordan Keyes, in an **ode to lava drinking**, sings of an urge to "partake of yon spicy smoothie lake". An article with the brilliant title "**I want to eat the lava and God can't stop me**" by Frey Fife for Evidently Scientifical shows that even those who have studied volcanology are not immune to lava's supposedly yummy siren song.

Of course, we do not encourage any of you to chug lava, and won't do so ourselves, even for the sake of investigative journalism. Instead, we reached out to University at Buffalo Associate Professor of Geology and expert on planetary volcanology Tracy Gregg, plus Scientist-in-Charge at Yellowstone Volcano Observatory Michael Poland, with the most burning questions on this topic.

What would lava taste like?

Tracy Gregg: No idea. Your tongue would cauterize and kill your taste buds. Solidified lava would taste like a rock.

Michael Poland: Well, it's hard to imagine it tasking like anything, since it would instantly burn your tongue. And your whole mouth, really. Lava does have a smell – sort of acrid, and a bit sulfury (most of the sulfur gas comes out at the eruptive vent, but there is a little in the lava itself). And if it is true that taste is largely related to smell... Although that doesn't explain durian fruit at all!

What would the texture and/or mouthfeel of lava be (if we disregard the burning)?

TG: Again, no idea. Your cells would literally explode as the water within them superheated from lava contact.

MP: It's important to remember that this is rock. So even though it is a liquid, it has the density of a rock. Even when molten, lava is like taffy, and the crust solidifies rapidly.

How quickly would lava take to cool in your mouth and throat, and what would happen during that?

TG: It depends on what you mean by "cool," and by how much lava you are talking about. If it's a tiny bit of lava (half a teaspoon or less) it would form an outer rind of glass within a second or two, but it would remain hot enough to damage your flesh for several minutes.

MP: The outer parts of any bit of lava will solidify quickly. That doesn't mean it isn't hot. It's still hundreds of degrees, just no longer molten. The inner area of a cooling chunk of lava might retain some molten components for minutes, depending on the size of the chunk. Lava is a really wonderful insulator, and so it cools slowly once the initial crust forms. So in your mouth or throat, it would be hundreds of degrees, even if solid. If you've ever had coffee that is too hot, you know how unpleasant that is. Even a cooling piece of lava would be several times hotter than boiling coffee or tea.

If you fell into lava like Gollum or the Terminator, would you feel it or die instantly?

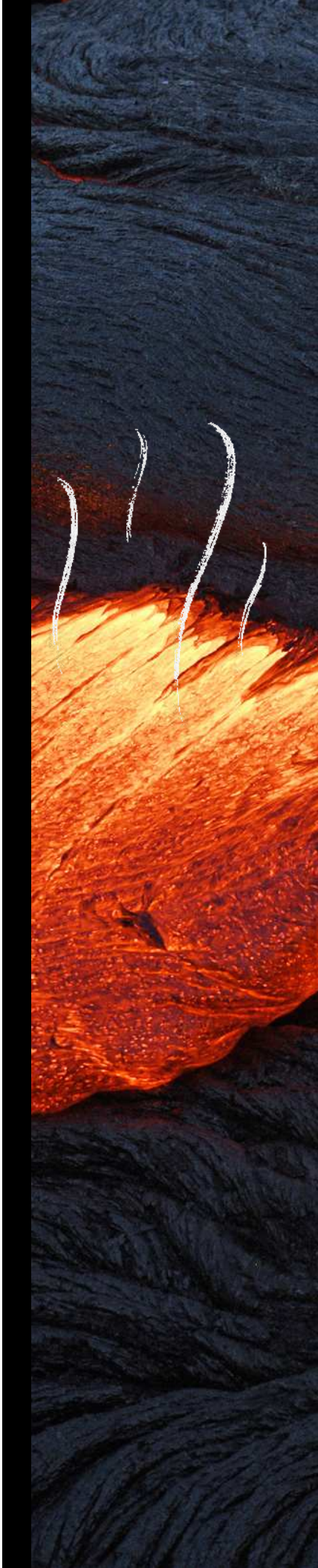
TG: It depends on the height from which you fell. Molten lava is not squishy and splashy like water. I can jump up and down on molten lava (and have done so) and won't sink into it. Jumping or falling onto a lava lake would be like jumping or falling onto hot asphalt. If the impact doesn't kill you, the burns might.

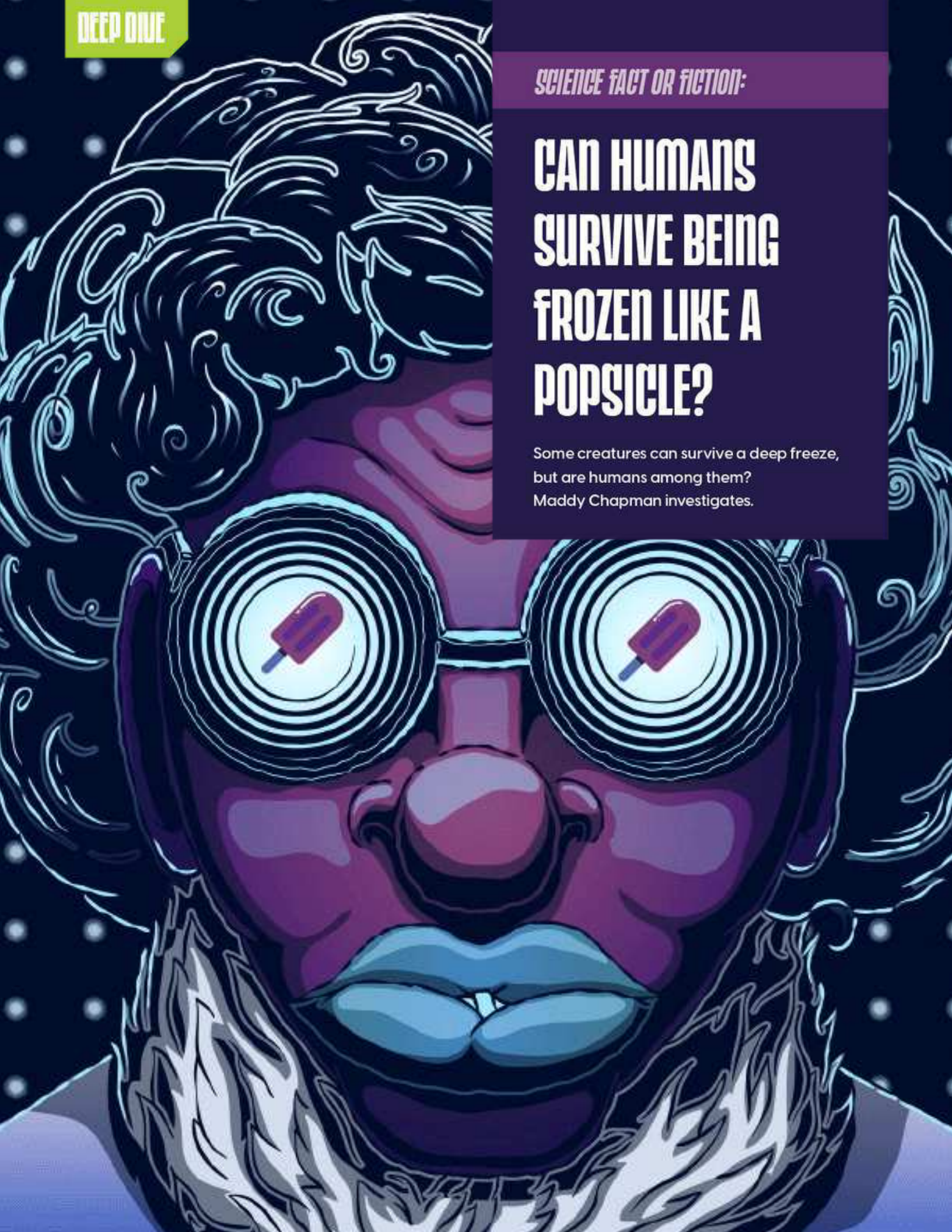
MP: Interesting question. It sort of depends. If you fall into a gas-rich lava lake – one that is roiling and bubbling intensely – you would probably sink. All of that gas means that the lava is not very dense, and so you would probably be denser than the lava and you would sink and burn from the intense heat. You would not last very long. Probably not even seconds. But if the lava is not gas-rich... That would not be a good way to go. You probably would not sink, so if you fell into a lava lake, when you hit the surface (assuming the fall was not so high that you went SPLAT) you would probably have many broken bones and be lying on top of a surface that is basically like a skillet on a hot stove. You might last longer than seconds, lying on the surface, cooking to death. Not so pleasant.

What is your safety advice for handling or being around lava?

TG: Don't handle it. Stay well back: active lava can spontaneously release gasses and splatter hot lava on you, which will burn and will hurt.

MP: Well, as far as handling lava, don't. I've supervised people collecting samples in Hawaii, and first-time folks are very surprised at how viscous it is. It's hard to register that it is rock, even if it is a liquid. So occasionally people are unprepared for the fact that it can be like taffy. Being around lava demands vigilance. Know your surroundings, and be aware of what you are walking on. I've known many people, including geologists, who have laid their backpacks down on something they thought was "old" only to find their packs melted a few minutes later – they set the packs down on a flow that might have been molten just a few minutes or an hour earlier, but that cooled to the point that it looked older because the surface of a lava flow freezes quickly. There can also be breakouts from a lava flow, with little pulses of molten lava that move quickly over short distances. So you really need to be aware of your surroundings, don't turn your back, be constantly vigilant, and best not to set things down unless you know for certain that what you're on is old and cold (if there is vegetation growing, that's a good clue). •





SCIENCE FACT OR FICTION:

CAN HUMANS SURVIVE BEING FROZEN LIKE A POPSICLE?

Some creatures can survive a deep freeze, but are humans among them? Maddy Chapman investigates.







With the looming threat of a giant asteroid strike, Meryl Streep et al. jet off on a spaceship, their bodies cryonically frozen as they search for a new planet to colonize, and inevitably destroy as they did the last. In case you haven't seen it, this is the ending to Netflix's *Don't Look Up*, the Oscar-nominated apocalyptic comedy released at the end of last year.

Of course, this is a work of science fiction and here at IFLScience, we prefer to deal with science fact. With that in mind, we ask: Can humans actually survive being frozen? Can we, like Meryl Streep, simply defrost our 22,740-year-chilled bodies and emerge on another planet like nothing ever happened (only to be savagely eaten by a dinosaur-like creature seconds later)?

While the latter question is firmly in the realms of sci-fi – the answer being a resounding no, definitely not – there are some examples of the human body surviving at pretty frosty temperatures.

In Minnesota in 1980, one woman spent six hours in the snow after crashing her car and searching fruitlessly for help. Doctors reported she was "frozen solid" and likened her body to "**a piece of meat out of a deep freeze**". And yet, somehow, with the help of some warming pads, she lived to tell the tale.

In a similar **story from 2016**, a 25-year-old man did a 12-hour stint in the snow at temperatures of -20°C (-4°F). Despite doctors being unable to detect a pulse, they managed to "bring him back to life", minus a few digits lost to frostbite.

Sounds pretty impressive, right? But did these people actually survive being frozen as the headlines claim?

Can humans survive being frozen?

"The short answer is no, it is not possible, and very probably never will be possible," Professor Gary Bryant, Associate Dean (Physics) at RMIT University, told IFLScience.

In fact, the human body – normally maintained at 37°C (98.6°F) – really can't cope with much temperature change at all.

"In general terms, damage will start to occur to the human body if the internal temperature changes by more than a few degrees," Bryant added.

"A fever of more than 40°C [104°F] is very dangerous, and hypothermia begins to occur if the body temperature drops below 35°C [95°F]."

And freezing, he added, "is a whole other issue. There are no examples of people being brought back after being actually frozen."

Why then, are there these reports of people recovering from being frozen solid? According to Bryant, these are simply examples of people being brought back from severe hypothermia. Arguably still pretty miraculous, but not quite as death-defying as they initially seemed. In medicine, there are some examples of low temperatures being used to prevent tissue damage – known as therapeutic hypothermia – but this happens at temperatures far above freezing.

"Controlled cooling of people during surgery is something that has been done (with cooling generally down to around 31-32 °C [87.8 - 89.6 °F])," said Bryant. "But its use is limited (and the benefits versus risks disputed)."

In 2019, a human was put into emergency preservation and resuscitation (EPR) – what sci-fi fans might refer to as "**suspended animation**" – for the first time, essentially becoming a human tardigrade. The process involves being pumped full of salty water to chill the brain to a cool 10-15°C (50-59°F), buying surgeons up to two hours to complete potentially life-saving operations.

But is the scientifically dubious field of cryonics – which speculates that humans can be put into low-temperature storage and preserved for reanimation later down the line – the future? No.

How do humans survive extremely low temperatures?

To understand how humans survive at low temperatures, we first need to understand just how low we're talking.

Image Credit Left: © iStock, DieterMeyrl *Right:* © John, some rights reserved (CC BY-NC 4.0) *Second Row Right:* © iStock, oversnap

In the case of the 25 year old "frozen" in a snow drift, "the... internal body temperature was unlikely to be below about 30°C [86°F]," Bryant told IFLScience.

Reports say his temperature didn't register on a digital thermometer, but, Bryant says, this doesn't mean it was sub-freezing.

"They were no doubt using a touchless (infrared) scanner and these generally do not register temperatures below about 34°C [93°F]. However, even if the skin temperature is 30°C [86°F] (such as my fingers on a cold day), the inside body temperature will still be around 37°C [98.6°F]."

As for how he survived, it seems he may have physics to thank, at least in part.

"From a physics point of view, being trapped under snow means that heat loss is quite slow because snow is a good insulator. Radiative losses would still occur, but over several hours these would only lower the body temperature by several degrees," Bryant said.

"None of the internal vital organs would have come close to being frozen, even if there was severe frostbite on the outer layers."

What happens in the body at these very low temperatures to keep us alive?

To answer that question, we can look to nature. It's no secret that in the winter months many animals retreat from the world and enter hibernation – often bulking up in preparation for the big sleep ahead (fat bears, we're looking at you). But what happens during this months-long hiatus is less well known.

To survive at such cold temperatures, hibernating animals slow (but don't stop) their metabolism – the process that converts oxygen and food into energy. For every degree Celsius drop in body temperature, metabolism drops by 5 to 7 percent. With a slower metabolic rate, animals in hibernation require less oxygen at lower temperatures and therefore slow their heart rates and breathing. This conserves energy when insufficient food is available.

In cases of extreme hypothermia, human bodies do much the same.

While this can be life-saving, it is still incredibly dangerous – as we know, breathing and having a heartbeat are essential when it comes to being alive. But, if someone suffering extreme hypothermia is discovered before the heart stops, then they stand a good chance of making it.

Why can't humans survive being frozen?

In one word: **ice**. Humans cannot survive having any ice in our bodies, and seeing as ice formation and freezing go hand in hand, it is quite the roadblock to surviving being frozen.

"By the time the internal temperature gets to below 0°C [32°F], the cold itself will have already killed many cells and organs, but once ice forms, it is basically going to be lethal to most cells, and therefore to the human," Bryant told IFLScience.

Unfortunately for anyone wanting to create a human popsicle, the adult human body is 60 percent water. Water is found in cells throughout the body: the brain and heart are nearly three-quarters water, the lungs are 83 percent water, and even our bones contain some. At extreme low temperatures, the water in these cells can freeze. As the water freezes, it expands, which can cause the cells to rupture. Lethal to both cell and human, as Bryant said. Most cells in the human body, in fact most mammalian cells, cannot survive being frozen. However, there are some exceptions to this rule: red blood cells, sperm cells, egg cells, stem cells, and some cell lines for cancer research have all been, and are routinely, cryopreserved – the process by which cells or tissues are preserved at sub-zero temperatures.

FROGS, MEANWHILE, ARE KNOWN TO BE ABLE TO SURVIVE BEING FROZEN FOR SEVERAL MONTHS.

Which animals can survive being frozen?

Where humans fall short, animals come into their own. It may not be common, but there are a couple of animals who, unlike us, can survive being frozen.

Tardigrades, for example, are no stranger to sub-zero temperatures. The microscopic beasties have evolved over hundreds of millions of years to accumulate high levels of cryoprotectants – chemicals that prevent cells or tissues from becoming damaged when frozen – which enable them to survive freezing.

Frogs, meanwhile, are known to be able to survive being frozen for several months. Wood frogs are filled with natural antifreeze (sugars), which lowers the freezing point of water in their bodies and prevents ice formation. This allows them to survive extreme winter temperatures as they freeze and thaw with the environment – they can freeze up to 70 percent of their body water and survive.

Sadly for humans, the ability to survive freezing won't be making the leap (frog pun intended) over to us. Even if we could engineer ourselves to have cryoprotectants, we wouldn't be able to tolerate them.

We're just going to have to crack out the thermals, wrap up in a blanket, and let the animal kingdom (and Meryl Streep) have the win on this one. •



Image Credit: © S.Wolf via iNaturalist, (CC-BY-NC 4.0)

WHO DISCOVERED THE FIRST MAMMAL FOSSIL?

Dive in to this sneak preview of *The Rise And Reign Of The Mammals* by Professor Steve Brusatte in which he explores how the first mammal fossils came to light.

It's a simple question with an unknowable answer. People have encountered fossils for millennia, but until recently, few have kept detailed records of what they found, and when. Then there is the issue of what is meant, exactly, by discovery. Who should get the credit: The first person to spot a fossil? The first to collect one? Or the first to correctly identify it and understand that it belonged to a particular type of animal that used to live in a distant era?

Here's something we do know. The first people in North America to find and accurately identify mammal fossils, and have their impressions recorded in writing, were African slaves. The entire enterprise of American vertebrate paleontology can be traced to a group of forced laborers, their names lost to history, kidnapped from their homes in modern-day Angola or the Congo and made to toil in the malarial swamps of coastal South Carolina.

Their discovery happened sometime around 1725, at a plantation called Stono, on the outskirts of Charleston. A little over a decade later, the name Stono would become infamous, the site of the bloodiest slave rebellion in the American colonies, which claimed over fifty lives and led to a brutal crackdown on the already-meager rights of assembly and education granted to the Africans. Later, a skirmish broke out here during the American Revolutionary War—an embarrassing Yankee loss that claimed the life of future president Andrew Jackson's brother. History being what it is in these parts, Stono again saw action during the Civil War. The Confederates captured a Union steamship on the Stono River, part of a string of victories before the war turned and the slaves were freed.



Long before the battles to come, a group of Stono slaves were digging in a swamp, perhaps planting cotton or rice. As they reached into the mucky ground, mosquitoes abuzz in the humidity, they felt something solid. Then more of them. Each was the size of a brick and covered in glistening enamel, with corrugated ridges aligned in parallel on one of the surfaces. To us, the pattern would recall the sole of a running shoe. The slaves, however, needed no analogy: they knew exactly what these things were.

They showed the plantation owners what they had found. Their masters, dumbstruck, realized that these things belonged to a large creature. But what? They defaulted to the explanation favored by so many people of the time, confronted with strange curiosities pulled from the ground: they must have been body parts of biblical beasts, which perished in Noah's Flood. You could imagine the slaves rolling their eyes. No, they insisted, they could explain.

The objects were teeth. Elephant teeth.

More precisely, they were molar teeth, the so-called grinders that elephants use to mill grass and leaves. The slaves were familiar with elephants, having lived alongside them back home in Africa. There were no elephants in the Carolina swamps, though, or anywhere else on the American continent, as far as anybody knew at the time. These were exotic, foreign animals. One can imagine the disbelief on the faces of the plantation owners. Preposterous! The slaves must be wrong.

But the slaves were correct—and everyone would soon recognize it. More "grinders" began to turn up across the northern and eastern reaches of the American colonies, and they were often associated with long, curving ivory tusks. It became evident that there were two varieties of molars: ones with corrugated ridges like the Stono specimens, and others with rows of pointy, pyramid-shaped cusps. For a while, all these fossils were grouped together as "mammoths," in reference to the similar elephantine brutes whose bones were thawing out of the Siberian permafrost. Later, anatomists realized that there were two different American elephants: true mammoths, with ridged teeth for grazing grass, and mastodons, with cusped teeth for snipping and grinding leaves.

One American colonist became obsessed with mammoths. During the late 1700s, there was a lot on Thomas Jefferson's mind— writing the Declaration of Independence, winning a Revolutionary War, preventing his new country from falling apart, running two of the most contentious presidential campaigns in American history, and raising (or at least producing) two families. Through it all, he kept thinking about mammoths. And writing about mammoths, begging people to send him mammoth bones, ordering generals to procure mammoth skeletons. Jefferson loved nature, and, in his words, preferred "the tranquil pursuits of science" to the pugilism of politics. •

AUTHOR Q&A



WITH PROFESSOR STEVE BRUSATTE

AUTHOR OF *THE RISE AND REIGN OF THE MAMMALS*

What did the earliest mammals look like?

The first mammals arose at the same time as the first dinosaurs, around 225 million years ago back when all the land was gathered together into the supercontinent of Pangea. These mammals were meek and humble. They were about the size of mice or hamsters, but they had hair and whiskers. They fed their babies milk. They were very smart, with huge brains and keen senses of smell and hearing. Yet, they still laid eggs, and they didn't grow as fast as today's mammals. I think if we saw one of them scurry by our feet, we would just think it was a mouse.

How were they able to survive while the dinosaurs perished?

Mammals lived alongside the dinosaurs for over 150 million years! After arising together in the Triassic period, the two groups went their separate ways. Dinosaurs were destined for grandeur, and they kept the mammals small. Never was there a mammal larger than a badger that lived with a dinosaur. But conversely, the mammals kept the dinosaurs big. You never saw a *T. rex* the size of a mouse or a Brontosaurus the size of a rat. This is because mammals so thoroughly seized the small size niches, and they diversified in the shadows. Then one day 66 million years ago, everything changed. A 6 mile [9.7 kilometer] wide asteroid fell out of the sky, detonated with the force of over a billion nuclear bombs, and the world went to chaos. All dinosaurs except for birds died. Shockingly, most mammals died too– maybe up to 90 percent of them. Mammals almost went the way of the dinosaurs, but thankfully we had ancestors that made it through the bedlam. The key, it seems, was being small, being able to hide and burrow easily, and having an omnivorous diet and the flexibility to eat many foods.

What battles did mammals face when they flourished following the extinction of the dinosaurs?

The world was wrecked. Wildfires, tsunamis, earthquakes, dust blocking out the sun and turning the world dark for years, ecosystems collapsing. Some mammals had to endure all of this – and one of them was our ancestor! Then, the Earth started to recover. Within about 20,000 years at most, dinosaurs were gone and mammals were taking control. Mammals took advantage of the emptiness by doing something they never could when they were living underfoot of dinosaurs: they got big! Within a few hundred thousand years there were mammals the size of pigs, within a million years or so there were mammals the size of cows.

However, these mammals were not that smart. Their bodies got so big so fast that their brains could not keep pace, and their brain sizes (relative to body size) actually shrunk! It would take another 10 million years or so for their brains to expand again, producing the highly intelligent mammals of today.

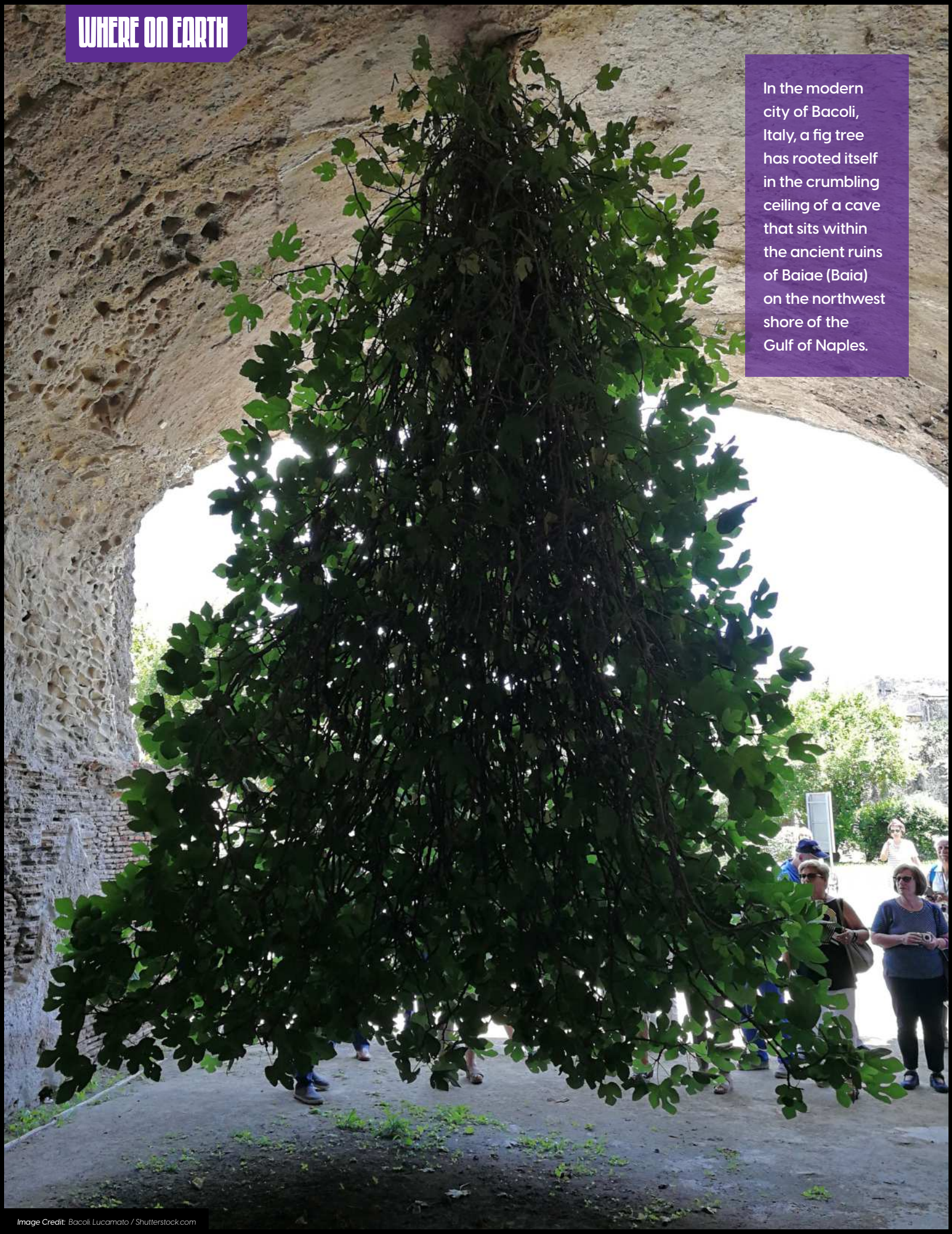
What do you hope readers will take away from *The Rise And Reign Of The Mammals*?

I want people to revel in our evolutionary story. We are mammals. This is the tale of our deepest ancestors and our closest cousins, and how they survived and adapted and endured everything nature could throw at them, from megavolcanoes to asteroid impacts, temperature spikes and ice ages.

I want to take readers on the 325 million year evolutionary journey that, eventually, through so many twists and turns, produced us: big-brained, bipedal, upright-walking apes that can ponder where we came from. And these apes – us – are rapidly changing the world today, more than any other mammal in history. So many of our sublime cousins are endangered and may go extinct: lions, tigers, polar bears, elephants and whales. We need to appreciate them, and we need to conserve them. •

***The Rise And Reign Of The Mammals* was published by Harper Collins and is *available to buy now*, RRP $29.99.**

WHERE ON EARTH



In the modern city of Bacoli, Italy, a fig tree has rooted itself in the crumbling ceiling of a cave that sits within the ancient ruins of Baiae (Baia) on the northwest shore of the Gulf of Naples.

Image Credit: Bacoli Lucamato / Shutterstock.com

ITALY'S UPSIDE-DOWN FIG TREE HANGS FROM AN ANCIENT RUIN

In Naples, Italy, visitors to the ruins of Baiae, which sit within the modern city of Bacoli, will find a botanical take on *Stranger Things*' The Upside Down. Here, from the ceiling of a cave in the Parco Archeologico delle Terme di Baia, a fig tree has grown the wrong way up. Exactly how the gravity-defying tree came to be there has botanists stumped, but its unlikely placement doesn't seem to be slowing it down as it continues to grow (albeit, downwards) and bear fruit.

In its heyday, the ancient Roman city of Baiae was a lively and fashionable resort for the ruling class. Now partially underwater, the vast undersea archaeological park is **described by archaeologists** as having once been the Monte Carlo of the ancient Roman era, where emperors such as Augustus, Caesar, and Nero had homes.

A hive of activity, Baiae was also – to its detriment – actively volcanic. Over several centuries, **undulations of the Earth's crust** in the region triggered hydrothermal and seismic activity, which saw much of the city slip beneath the shoreline.

It was not to be lost, however, thanks to a pilot who noticed that something unusual was going on beneath the waves just off the coast of Naples back **in the 1940s**. Though photos taken by the pilot appeared to show structures in the ocean, it would be two decades before researchers voyaged in submarines to get a closer look at what was going on.

While our famous fig tree can be viewed among the above-ground Roman ruins at the Parco Archeologico delle Terme di Baia, visitors can look into the sunken city, too, with glass-bottom boat tours which drift above the ancient archaeological remains.



How to get there

Naples International Airport is the closest to the ancient Roman era archaeological remains. Once in Bacoli, the upside-down fig tree can be found opposite the Temple of Mercury in the Parco Archeologico delle Terme di Baia.

WATCH

How To Change Your Mind

Docuseries on Netflix

Does psychedelic therapy have the potential to revolutionize mental health care? This documentary series, based on the book of the same name, explores different psychoactive substances to see what effect they can have on the mind and body. Looking at the history and uses of psychedelics like LSD, psilocybin, MDMA, and mescaline, the series seeks to find out if scientific research supports their use for conditions like PTSD, depression, and alcoholism. Netflix docuseries from NYT best-selling author Michael Pollan and Academy Award-winning filmmaker Alex Gibney.



*Series available on **Netflix**.*

SEE

Brian And Charles

Film by Universal Pictures and Focus Features

In the face of a loneliness which can't be quashed with one-person darts tournaments, amateur inventor Brian takes to his inventions pantry (read: cowshed) to build an artificially intelligent robot using a mannequin head retrieved from a bin. The result is as questionable functionally as it is aesthetically, with the self-named "Charles Petrescu" sporting a washing machine for an abdomen, but makes for a charming demonstration of the potential power of artificial intelligence and personal robots to make humans feel more connected. As Charles's explorations within the confines of Brian's home bring to light unexpected passions (an inexplicable obsession with cabbages and desire to go to Honolulu), a jaunt into the wet wilderness of north Wales puts the affable robot on the radar of a local bully from whom only Brian can protect him.



*Watch the trailer **here**.*

READ

Been There, Done That: A Rousing History Of Sex



Book by Rachel Feltman

In humans' pursuit of having control over genitals, we have employed everything from sneezing away pregnancy to turning to goat testicle transplants for erectile dysfunction. While many of the more unfortunate approaches to sexual health and birth control have fallen away over the years, some falsehoods have persevered to modern day. In this book, Feltman uses humor to dismantle stigma and fear around certain aspects of sex and uses scientific fact to tackle misinformation.

*Available **online** and in select book stores.*

SCIENCE IN MEDIA



PLAY

Words for Nerds

Game from The Scientist

Calling all puzzle fans! How's your scientific jargon? Back yourself to identify technical words from just a few scraps for clues? The Scientist have launched a new game, Words For Nerds, which challenges you to identify a scientific, five-letter word in just six guesses. Each time you submit a guess, the tiles will change to show if your letters were correct and in the right place. Like Wordle but with a science twist, the game has different difficulty settings so you can build on your skill.



*Check it out **here**.*

JOIN IN

Bad Bug Book Club

Organized by the Microbiology Society

During Bad Bug Book Club meetings, scientists and non-scientists come together to discuss novels in which themes center around infectious disease. The goal? To improve people's understanding and engagement with microbiology at a time when we're all a little more aware of the devastating potential of contagious illness. The club actually began before the pandemic but since then the meetings have gone online, meaning people can get involved from anywhere across the globe. Wherever you are, you can join existing book clubs to discuss novels and join in with the discussion, or Professor Jo Verran (who helped to set it up) can provide support for establishing your own book club in your local area.



*Further information available **here**.*

Image Credit Top Row Left: © 2022 NETFLIX. *Middle:* Bold Type Books. *Right:* The Scientist. *Bottom Row Left:* Universal Pictures and Focus Features. *Bottom Row Right:* GoodStudio / Shutterstock.com

DATES TO REMEMBER

Don't miss out on some of the science highlights for August 2022, including an annual favorite for meteor hunters and the chance to win prizes for your wildlife photography.

AUGUST



National Immunization Awareness Month

At IFLScience, we love a good vaccine and in recent years the world was served a hefty reminder as to their need and potential. However, pandemics aren't the only time these life-saving jabs should be on our minds. August marks National Immunization Awareness Month, a time when the National Public Health Information Coalition highlights the role we can all play in keeping each other safe by keeping up to date with our shots. There's a lot of power in those small pricks. Visit the **Center for Disease Control and Prevention's** dedicated website for more information



12

Is The Future Of Farming Underwater?

The next episode of IFLScience's The Big Questions teams up with BBC Earth to ask Nemo's Garden's Luca Gamberini: Is the future of farming underwater? Nemo's Garden's alternative system of agriculture uses underwater environments to try and grow plants in a way that's more sustainable than traditional farming. Presented in partnership with BBC Earth's #OurGreenPlanet impact initiative, **available wherever you get your favorite podcasts.**

20

World Mosquito Day

On this day in 1897, the devastating potential of mosquitos was first discovered as Sir Ronald Ross found a malaria parasite in the stomach of a mosquito. In recognizing **World Mosquito Day**, it's hoped that greater awareness can lead us towards better preventative treatments and therapies for mosquito-borne diseases.



12 13



Perseids Peak

The **Perseids Meteor Shower** peaks this month. So named because its meteors appear to originate from the Perseus constellation, it's easiest to spot in places free from light pollution. It can take 15 minutes for your eyes to adjust to the darkness, so keep phones away for a good show.

Photography Competitions

Do you fancy yourself as something of a wildlife photographer? Asian Geographic has two competitions with September 1 deadlines. VOO focuses on marine environments, while the **Asia Photography Contest** is for the land lovers. **Enter now!**



Image Credit Top Row: National Center For Immunization And Respiratory Diseases. *Second Row Left:* © iStock, OceanReefGroup2022. *Second Row Right:* © iStock, nechaev-kon. *Third Row:* © iStock, Allexxandar. *Bottom Row:* © iStock, Adex Ocean Gallery 2022.





ARE YOU DRAWN TO

THE DARKER OR LIGHTER

SIDE OF SCIENCE?

Choose how you end each issue. For those who prefer the darker side, discover the grim effect space has on your bones that may dash your childhood dreams. If you like your science lighter, let us share with you just how you find out that wolves take a nap just like dogs.

BEING AN ASTRONAUT AGES YOU

You may have had childhood dreams of being an astronaut and exploring the cosmos but would you be so keen if you knew you may end up like something out of M Night Shyamalan's movie, *Old*, or trying to *Benjamin Button* yourself once back on Earth?

A study published in Scientific Reports has discovered that astronauts lose the equivalent of 10 years of bone loss after just six months in space. Those who spent less than six months managed to claw back their bone strength after being back on Earth for a year, but for those in space longer, it was more severe, and may even be irreversible.

Though it's long been known that bones lose density in microgravity, the study quantifies the severity in terrestrial terms and how bones recover back on terra firma. This could have serious implications for anyone considering trips to Mars in the future, as it's likely due to the amount of time it takes to get there that trips will last around two years.

Bone loss happens in humans when we age, get sick, or can't move the body anymore. On Earth gravity applies a weight-bearing load to bones that allows them to maintain density. However, bone loss is accelerated in microgravity because they don't have to support our bodies since everyone is just floating around.

To combat bone and muscle loss, astronauts on the International Space Station work out six out of seven days for two hours each day. However, this may not be enough.

"We found that weight-bearing bones only partially recovered in most astronauts one year after spaceflight," said lead author Dr Leigh Gabel. "This suggests the permanent bone loss due to spaceflight is about the same as a decade worth of age-related bone loss on Earth."

> **"PERMANENT BONE LOSS DUE TO SPACEFLIGHT IS ABOUT THE SAME AS A DECADE WORTH OF AGE-RELATED BONE LOSS ON EARTH."**

Your dream of being an astronaut may not be deterred by the news you will undoubtedly age faster than your Earth-bound peers, but may we suggest you check the luggage limit for the ISS and take some dumbbells for your trip?

JUST PAWSING FOR A NAP

For the first time, scientists have measured the sleeping patterns of wolves to see if they nap in a similar way to their domesticated canine cousins. How do you measure a wolf's sleep? Carefully, as the joke goes.

Since dogs are adapted to human environments, a better understanding of their sleep patterns may shed some light on human sleep too, which may have been evolutionarily shaped by living in certain environments. We know dogs sleep more superficially when in unfamiliar environments, just like humans. This adaptation may occur in other animals too.

To better understand the effects of domestication with humans on physiology and phenotypes (observable traits determined by both genomic make-up and environmental factors) scientists compared dogs with their nearest relations, wolves.

It's not recommended to go out into the wild and find a wolf to snuggle down with, so scientists from Eötvös Loránd University in Hungary studied seven hand-reared wolves that had been intensely socialized from an early age so they could be handled and comforted like dogs. Adorably, the wolves were petted and caressed by familiar people until they grew drowsy and nodded off. If they woke up they were cuddled and told they were very good wolves until they fell asleep again.

Using the same EEG methods used to study sleep in dogs and humans – electrodes attached to the head – they were able to measure all the sleep stages: drowsiness, deep sleep, and REM.

> **"IF THEY WOKE UP THEY WERE CUDDLED AND TOLD THEY WERE VERY GOOD WOLVES UNTIL THEY FELL ASLEEP AGAIN."**

During REM, or Rapid Eye Movement, the brain increases activity, processing new learnings and motor skills from the day and committing things to memory. It's also the stage where dreams are more intense.

Curiously, the team found that wolves actually spend more time in REM than dogs. "While young dogs and wolves showed a pretty similar distribution of sleep stages, the time spent in REM seemed to be less in dogs than in wolves, and this difference is even more apparent in the senior animals," said first author of the study published in Scientific Reports, Vivien Reicher.

It's difficult to draw firm conclusions from the study, after all there is nothing to compare the results to, but this was an excellent test of how such data may be acquired in an easy, non-stressful way for the animals. Sign us up for round two.