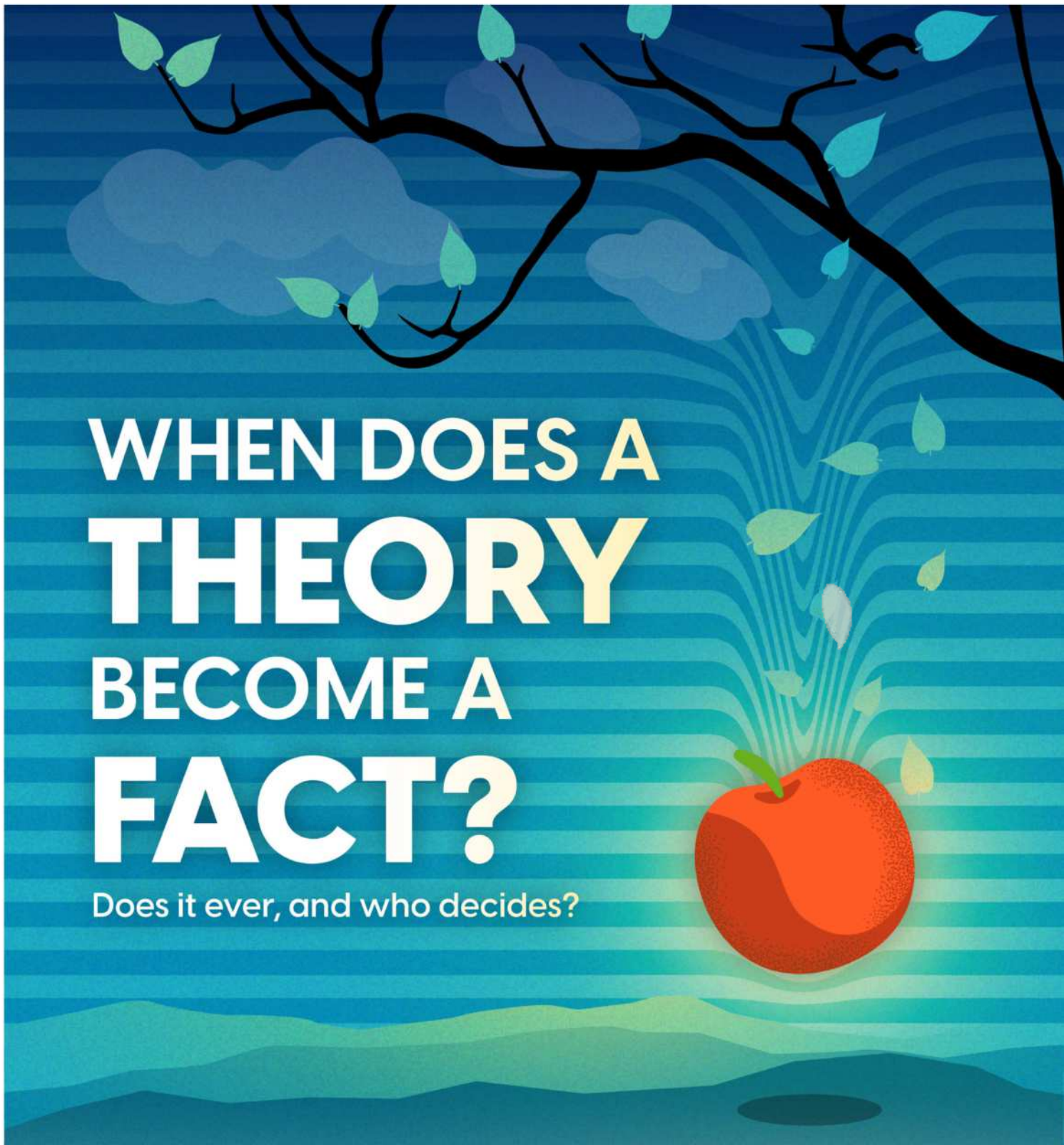
CURIOUS

CAN AI HELP US TALK TO ANIMALS?

WHAT IS CRYOCONSERVATION?

IFLSCIENCE.COM | OCTOBER 2022



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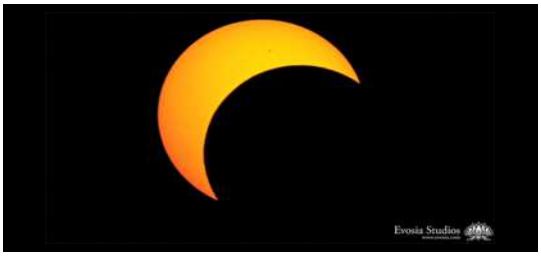
NEWS BITES

Tiny But Tough New Dinosaur Rewrites Rules

Meet *Jakapil kaniukura*, the first armored bipedal dinosaur found in South America, which may represent a new lineage of armored dinosaurs completely undetected until now. Though it only weighed about as much as a house cat and grew to just 1.5 meters (5 feet) long, *J. kaniukura* packs a mighty punch in scientific importance. The spikey little dinosaur had bony shields on its neck, back, and tail, similar to other armored dinosaurs like Stegosaurus, but lived 50 million years later, dying out around 100 million years ago. In a **new study**, scientists argue it suggests an entirely new lineage of previously unknown armored dinosaurs roamed the Southern Hemisphere. Most armored dinosaurs lived in the Northern Hemisphere, died out in the Middle Jurassic, and walked on all fours. *J. kaniukura*, on the other hand, lived somewhere palaeontologists had never thought to explore for armored dinosaurs, survived into the mid-Cretaceous, and **walked upright**.

Going Postal Where No One Has Gone Before

Grab yourself a little slice of history with the US Postal Service's newly issued "Forever" stamp, starring the iconic JWST. The USPS honors the largest and most sensitive space telescope ever launched in these glorious commemorative stamps that feature artist James Vaughan's digitally created depiction of the telescope in space. The 18 gold mirror segments combine to create a 6.5-meter (21-foot) primary mirror that can pick up the faint infrared (heat) waves of the earliest starlight. Infrared can pass more easily through cosmic gas and dust, meaning JWST can see further into space, and thus further back in time towards the cosmic dawn, than any other telescope. If you're thinking of starting a collection, or think this would make a pretty cool present for your nerdy friends and family, then you should know icons ranging from Buzz Lightyear to science fiction writer Ursula K. Le Guin are also available in stamp form from the **USPS store**.



Look Up This October!

Skywatchers will be rewarded this October with two meteor showers, a full Moon, and a partial solar eclipse. The Draconid meteor shower peaks on October 8-9, and the best time to catch shooting stars is just after nightfall, while the Orionids peak on 21-22 and are best seen after midnight and before dawn. The full Moon on October 9, traditionally known as the Hunter's Moon, may outshine viewing opportunities for the Draconids but the Orionids will be unaffected. October 25 sees the second partial solar eclipse of the year visible from most of Europe, northern Africa, the Middle East, and Western Asia – just remember, don't look at it without special eclipse glasses or your skywatching days may be over.

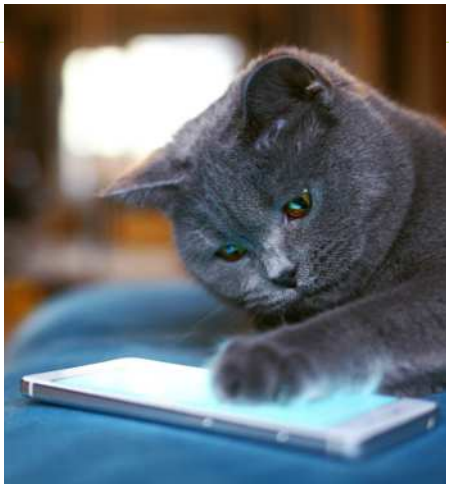
Hey Siri, Do I Have COVID?

The future may be your smartphone telling you whether you have COVID from the sound of your voice. Scientists have **presented** a new app that can detect COVID-19 from changes in your voice with 89 percent accuracy – that's more than the average at-home antigen test. Using AI, the app is built on data from Cambridge University's **COVID-19 Sounds App**, which has nearly 900 audio samples of over 4,000 infected and healthy people. As COVID affects the upper respiratory tract and vocal cords, it can lead to changes in a person's voice, which the AI detects. This is a quick, easy, and cheap way to detect infection, and a timely reminder as we head towards winter that we haven't beaten the virus yet.

Image Credit Left: Mauricio Álvarez and Gabriel Díaz Yanten (paleoGDY). *Right:* US Postal service.

Name An Exoplanet!

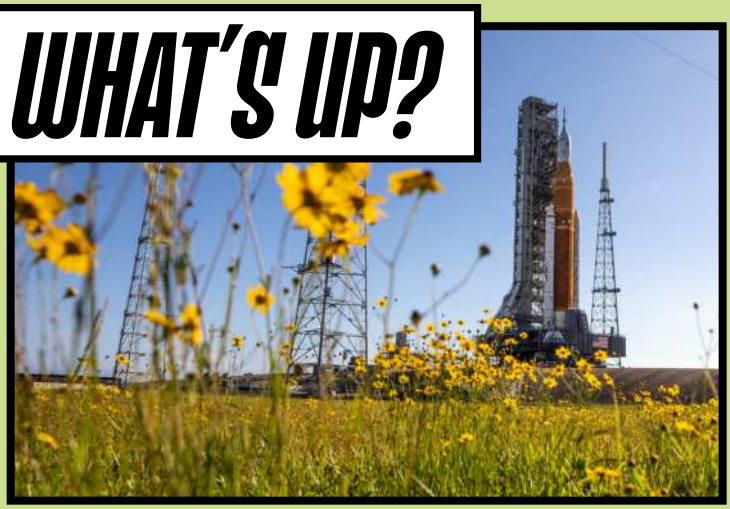
Do you want to name an exoplanet and its host star? Here's your chance. The International Astronomical Union is holding a contest to name 20 exoplanet systems that will be among JWST's first targets to observe. The deadline is November 11, 2022, so get your thinking caps on (100 percent, someone has already submitted Exoplanet McExoplanetface) and **enter here.**



Our Screens Are Making Us Age Faster

Excessive exposure to blue light from gadgets such as smartphones, laptops, and TVs could be accelerating the aging process, scientists have found. A **study** in fruit flies shows chemicals essential for cells to function properly are altered when exposed to LED lights, like those found in smart screens, and could lead to premature cell death. So what, they're fruit flies? "The signaling chemicals in the cells of flies and humans are the same, so there is potential for negative effects of blue light on humans," senior author Dr Jadwiga Giebultowicz explained. This comes hot on the heels of **another study** that found it may only take five years of aging for facial recognition algorithms on these gadgets to not recognize us anymore. Scientists found the accuracy of face recognition dropped continuously over time from when an image was taken, until it dropped off quite suddenly at five years. After that, AI struggled to identify people as the same person. So, if you want your gadgets to still recognize you, and not a prematurely aged person, perhaps pop them down for a bit.

WHAT'S UP?



Not Artemis, Apparently

Third time's a charm?

Name: Artemis I
Appearance: Bloody great rocket

Location: Still on the launchpad at the Kennedy Space Center, Florida – for now.

Who is Artemis? Named after the twin sister of Apollo, Artemis is the Greek goddess of the Moon and the hunt. This is the first of NASA's Artemis Moon missions that aim to eventually return humans to the Moon. Artemis I is the uncrewed test mission for both its mega Moon rocket, the Space Launch System (SLS), and the Orion spacecraft, which will carry astronauts one day.

Shouldn't it be in space by now? Yes. NASA rolled the SLS out to the iconic Launchpad 39B (of Apollo fame) in August and we all got excited. "We're going back to the Moon!" we cried, only for NASA to scrub the launch – twice.

Scrub? This doesn't mean the rocket has had a good clean. It's the name for an aborted rocket launch.

What seems to be the problem? Which time?

First? Scrubbed due to not being able to cool down one of the rocket's four engines to a safe temperature before liftoff. It got down to T minus 40 before they called it.

And the second? A fuel leak in one of the engines with three hours to go.

Are scrubs normal? Actually, yes. The Space Shuttle averaged 1.9 launch attempts to actual launches. Most people only remember the liftoff.

Better safe than sorry? "The cost of two scrubs is a lot less than a failure," so says NASA Chief Bill Nelson. SLS needs to work perfectly. Any damage it sustains will put the Artemis missions back years.

Third time's a charm? Fingers crossed for Sept. 27, or we're looking at October...

Image Credit Left: Shutterstock © USYK. *Right:* NASA/Ben Smegelsky.

WHEN DOES A THEORY BECOME A FACT?

Does it ever, and who decides?

By Dr Alfredo Carpineti

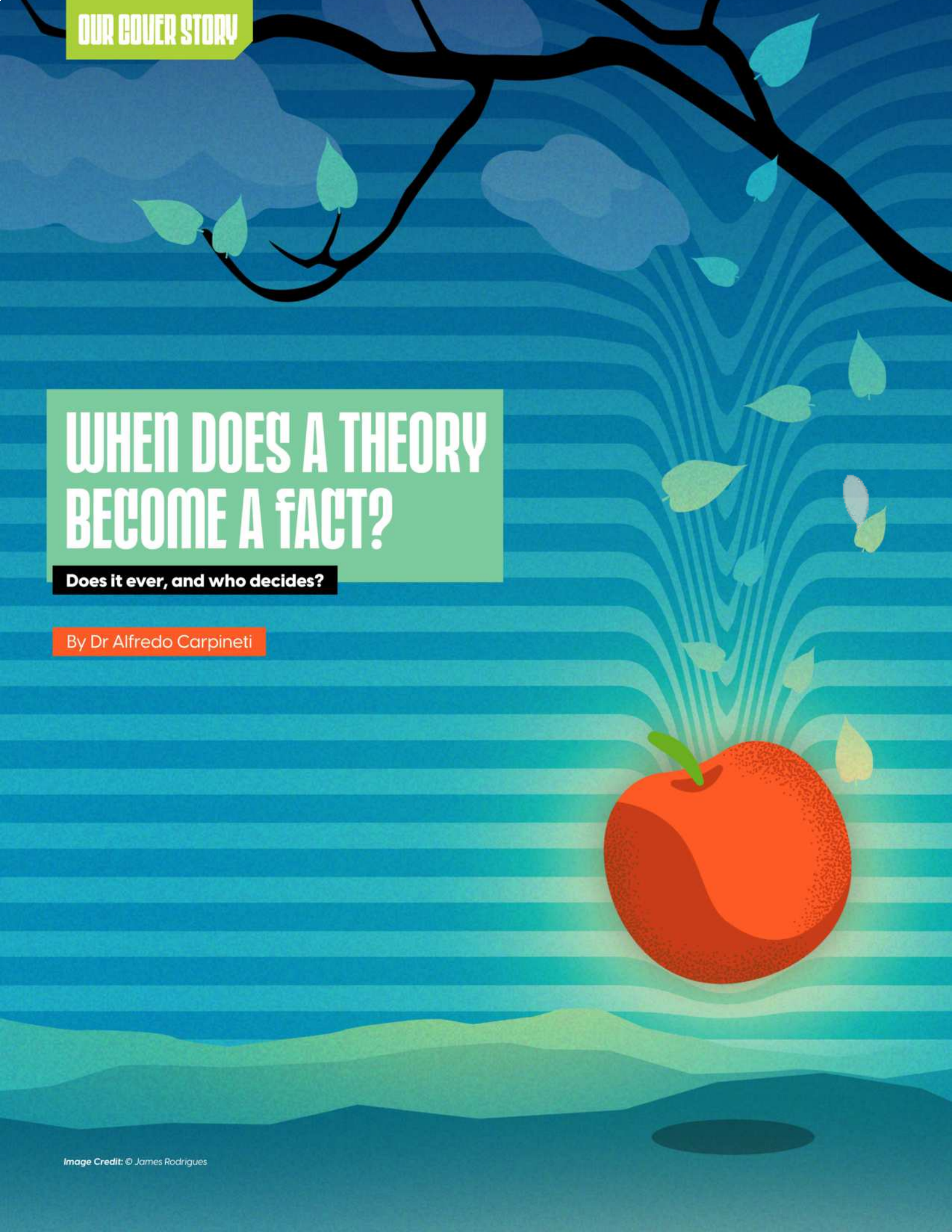


Image Credit: © James Rodrigues

There are few simple questions out there that can shake the foundations of science like "when does a theory become a fact?" A scientist, like Stephen Hawking, will tell you that it never does, that all scientific theories are just observations of facts from which we obtain a universal law. A historian of science might tell you that this view is more an aspiration for scientists than a rule, even among the most famous and successful theories, like the Big Bang or evolution. And the person that asked the question is none the wiser.

The "truth" of a theory is in its usefulness in linking a large number of facts that seek to explain a particular phenomenon, and enabling predictions of new ones that may have yet to be observed. Its great strength is that if a theory comes up against a fact that can't be eventually or even disproves it, it can eventually be discarded and replaced by a better one. This does, however, leave it open to attack by anti-science movements due to the dissonance in what we mean by "theory" and "fact" in the first place.

Are theories and facts the same for everyone?

There is certainly a linguistic barrier between what the public means when talking about "theories" and "facts" compared to a scientist. Often, in common parlance, "theory" is used as a synonym for a hypothesis. To use the phrase "it's just a theory" dismissively, meaning it's just an untested unproven hypothesis, is almost the opposite of what scientists mean when they talk about theory.

"For everyday people, this is a big tension. We use the word theory much more lightly," Rachel Ankeny, a professor of philosophy of science at the University of Adelaide, told IFLScience.

"Theories in science run the spectrum. There may be theories that are just being tested but, in many cases, scientists mean 'this is a theory that has been shown to be the case' and it's going to involve data, it's going to include all sorts of observations about the world, it's going to include what they would even call facts."

For most scientists, a theory is a robustly tested explanation for a phenomenon or group of facts that takes in both scientific hypotheses and scientific "laws". It's the best explanation we have to explain these phenomena or facts – until a better one is shown.

A good example is Isaac Newton and Albert Einstein's theories of gravity. Newton put forward his theory of gravitation in 1687. It remained the prevailing theory for hundreds of years until Einstein put forward an alternative in 1915. Einstein's general theory of relativity produced many of the same results as Newton's, but it could also explain aspects that Newton's could not. In 1919, Einstein's theory was proven to work, while Newton's did not, and though relativity has been tested and challenged many times in the century since, it still **holds** up as the best explanation we have.

A theoretical philosophical issue

So the definition of a theory is different from the common parlance but, at the same time, how it's used is not a rigid mold. Some theories have so much experimental evidence that it seems impossible they can ever be refuted. Others offer a really good explanation, and yet they are not perfect and we are aware of their limitations, like Einstein's relativity or the Standard Model of particle physics. And there are others that are much more speculative still being investigated.

Depending on the field of study and even on the particular theories, scientists have very different ideas on how you should deal with them. Some use the approach that Karl Popper, one of the most influential 20th-century philosophers of science, put forward. Popper did not believe that a theory could never be considered true, instead, scientists should prove time and time again that it is not false.

We know that general relativity and particle physics are extremely good at explaining what we see, but they are also flawed and limited. Their many tests (some of which they pass and some they don't), under Popper's view, would be an attempt at falsifying the theories. But many scientists are not working to prove ideas wrong.

Thomas Kuhn, another influential 20th-century philosopher of science and author of the much-cited *The Structure of Scientific Revolutions* (1962), disagreed with Popper. Kuhn instead believed that for most periods of time, research is in a "normal science" state and scientists shouldn't look for anomalies or try to prove the leading theory. The "immature" science is "pre-paradigmatic". But if anomalies arise then at some point there will be a revolution that will leave the old theory behind, and the science that has matured becomes "paradigmatic".

THE SKY IS BLUE IS AN EVERYDAY FACT BUT THE SCIENTIFIC FACT IS THAT THE COLOR OF THE SKY IS DUE TO AN EFFECT WE CALL RAYLEIGH SCATTERING.

This scenario can be seen at play both historically and in more recent times. There are those actually looking for anomalies in prevailing theories and limitations in our knowledge to push us forward, and there are theories that are thrown out completely from the history of science, but a good part of them continue to be useful even when a better interpretation of the world exists. Newtonian mechanics and Einstein's relativity are good examples of this.

While the Newton versus Einstein discourse first occurred in the early 20th century, this debate is still alive and well. The concept of a theory is at the very heart of science and given the role of scientific investigation in society, it is an issue that affects us all.

A scientific theory needs to explain observations and make predictions. Failing to

do so may lead to the theory being rejected or to it being refined into a better version. This tweaking is not a way to save a theory from its demise, either, but comes from the fact that nature is extremely complicated, and there is always more for us to know, and to know we have to test.

"Anything that is truly scientific is going to allow for that kind of refinement and even that kind of rejection. But this is not done lightly. Findings build up on each other, so it is not just finding one instance that seems to contradict it and then throwing out the whole theory," Ankeny explained.

A matter of facts

Similar to the separation in meaning between theory in common parlance and theory in science, an everyday "fact" and a scientific "fact" are also not necessarily the same thing. The sky is blue is an everyday fact (as long as you agree **what blue is**) but the scientific fact is that the color of the sky is due to an effect we call Rayleigh scattering.

SCIENTIFIC FACTS CAN BE FALSIFIED OR IMPROVED, THEY MIGHT EVEN CHANGE.

"Scientific facts have credentials that come along with them. For something to be a scientific fact, typically, they have to be a finding that has resulted from careful attention to building empirical evidence. Again, in different fields, these are going to be different but it often involves observations, testing, and measuring through experimentations," Ankeny continued.

"[The different fields] share this idea that something becomes a fact by being the result of something that can be repeated and something that has robust methods associated with its observation, measurement, or testing."

Scientific facts can be falsified or improved, they might even change. Scientific theories can explain and situate those scientific facts in a wider context, connecting them to a coherent picture.

In common parlance, we might say that gravity is a fact, or that microbes are a fact. They require more details to be seen as scientific facts but they have entered the everyday vocabulary following the introduction of revolutionary theories such as Newton's universal gravitation or Pasteur's germ theory. The connection between scientific theories and common facts is there, and should not be underestimated. Scientific theory is how they became everyday facts.

Let's start a conversation

Criticism of scientific investigation, the scientific method, and "facts" appears to be on the rise in recent years, especially surrounding subjects like COVID-19 and the unfolding climate crisis. Some of the criticisms, especially with regard to the pandemic, focus on uncertainty and how "facts" seem to change. But scientific research is not a snap-your-fingers portal to the ultimate truth.

"It's not about any one fact or set of facts, or any one theory. It is about the method. And that the method is something that is agreed to, that scientists in every field know what counts as a reasonable test of a theory," Ankeny said.

"Science can hang its hat on being the best available understanding of the natural world because of all those standardized methods."

There is an important conversation to be had about the limits of scientific theories and scientific facts, a conversation that needs to be shared across society to enable both better critics and better supporters of science as a discipline. Pinning down what we mean by these terms is just the start.

Image Credit: © James Rodrigues

***Image Credit**: Thomas Chitson, Royal Meteorological Society's Weather Photographer Of The Year 2022*

SUN HALO IN ANTARCTICA

Photographer Thomas Chitson was out Nordic skiing from the Rothera research station in Antarctica when he spotted this Sun halo. Halos around the Sun or Moon are the result of light being reflected and refracted by free-falling ice crystals in the air, or high cirrus or cirrostratus clouds. They can be white, when light is reflected, or colorful like this one when light hits the ice at the right angle to be refracted. Chitson submitted this image to the **Royal Meteorological Society's Weather Photographer Of The Year 2022.**

Image Credit: *Chester Zoo and Nature's SAFE*

HOW CAN CRYOCONSERVATION SAVE EARTH'S SPECIES FROM EXTINCTION?

SCIENTISTS ARE TRYING TO KEEP ENDANGERED ANIMALS "ALIVE" BY FREEZING THEIR TISSUES AT -196°C (-320°F).

By Rachael Funnell

Conservationists based at the UK's Chester Zoo announced earlier this year that they have begun freezing tissue samples of the world's rarest animals in an attempt to safeguard them from extinction. Here, **Nature's SAFE** (one of Europe's largest "living biobanks") was founded by scientists to create a store of cell lines that can be brought back as living tissue. Once back from the "dead", these cells could be developed and deployed in breeding programs to try and return a deceased animal's genetic material into a population.

To find out more about the futuristic approach to conservation, IFLScience spoke to Dr Sue Walker and Dr Rhiannon Bolton, cofounders of Nature's SAFE, to find out more about how the living biobank actually works, and what species have been given the unusual deep freeze treatment so far.

How does Nature's SAFE use cryoconservation?

SW: What we do at Nature's SAFE is basically, if an animal passes away, we can take tissue from their ear that has a large number of fibroblast cells in it. And then years or months later, we can then take them out of the tank and grow those cell lines again. The goal, in theory, is to one day be able to grow whichever cells you want from a cell line including oocytes and sperm... and these could one day be used for artificial insemination. So, all of this is about banking material that might have a use going forward.

What are the main benefits of the cryoconservation approach over existing methodologies?

RB: A lot of biobanks freeze their samples at -20°C [-4°F] and those samples are super important for conservation research, genetic analysis, and things like that. But when you freeze a tissue sample

at -20°C, the water within the cells explodes and it breaks the cell membrane. So, those tissues die.

We use a cryoprotectant and store our cells at -196°C [-320°F]. When you thaw them out, they are still viable, and the DNA is still intact. They're basically alive still. That's what enables us to do further things with the genetic material. We can do cell cultures or transform them into induced pluripotent stem cells. So that's the key difference, that we're a living biobank.

Are there any cells that can't be stored like this?

RB: I don't believe there are no, but we don't store every cell. We store eggs, ovarian tissue, testicular tissue, and somatic cells. We mostly get that from a sample of the ear which contains cartilage and skin and includes fibroblast cells that are very easy to grow. But for different taxa it's sometimes recommended to take different samples from the cadaver to get the best cell types for storage. So, for example, for fish they actually recommend gills.

SW: We're still learning which bits are the best, which sounds harsh, but Nature's SAFE is a very science-based organisation, so we want to make sure we're making the right decisions based on evidence. So, we're very slowly starting our research program up and we've partnered with Professor Suzannah Williams at the University of Oxford. She is helping us in terms of looking specifically at how to preserve ovarian tissue and then how best to bring that tissue back.

How do you cope working at temperatures of –196°C?

SW: We have to be suited and booted, wearing special protective equipment. Working with liquid nitrogen also presents its own risks. You can minimize those with gloves and goggles that would normally come in a lab. You're absolutely safe working with it, you just have to be very careful.

How do you choose species for cryoconservation?

SW: We don't usually choose them because we bank material from animals who have passed away naturally, from natural causes. So, we take samples opportunistically, and we will put them into our living biobank. What we're then trying to do is kind of give those cells or that individual and their genetics life after death, if you like. It gives us an opportunity to bring those genetics back into the population.

However, we're also starting to do a body of work to look at how we could strategically make wildlife samples. This is actually the subject of a PhD at Nottingham Trent University. And it's going to look at how we could strategically bank for populations that are most at risk, and how we could get those samples. Because we can't always afford to wait for individuals to pass away to get them.

What kind of animals do you have banked currently?

RB: We've got all sorts: African wild dogs, jaguars, cheetahs, onagers. There's lots of birds, including the Victorian crowned pigeon. Then there's mountain chicken frogs, which is super exciting because they're terribly endangered.

How might these biobanked samples one day help these species?

SW: We've actually got two proofs of concept as to how this can help: one is the black-footed ferret; I don't know if you've heard of **Elizabeth Ann**? Another is the **Przewalski's horse**. But it's exactly the same kind of idea. It's about looking at these at-risk populations and determining how we can support them genetically.

What's the ultimate goal?

RB: Preventing extinction! That's the whole point. I think we have a duty to do something. We've made quite a big mess and we're losing the genetics [of species] every day. If we don't do something today, even if the technology isn't 100 percent there yet, if we don't collect the samples and store them in a way that means they can be reused in the future, then they're just gone. We're going to lose so many different species otherwise, so that's my hope. And, having a young family, I want to make sure that there will still be elephants for [my sons].

SW: We've got a long way to go and if we don't bank it now, we've lost hope and we've lost that chance. So, right now, it's about establishing our network and bringing in samples. And at the same time, in parallel, developing and perfecting our techniques to bring that tissue back to life.

Image Credit: Chester Zoo and Nature's SAFE

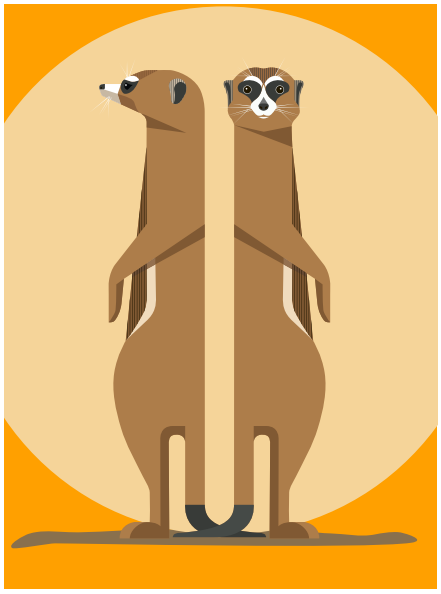
SCIENCE FACT OR FICTION:

CAN AI HELP US TALK TO ANIMALS?

Is artificial intelligence the next Dr Dolittle? Maddy Chapman investigates how AI could help us "talk" to animals.

On the surface, it may not appear that Dr Dolittle and artificial intelligence (AI) have much in common. One belongs to 1900s children's literature, while the other is firmly rooted in the 21st century. One is a physician turned vet who can talk to animals, and the other a computerized technology that cannot. Unless...

AI has already given us the ability to bark instructions at robots like Siri and Alexa – could its potential be extended to the animal kingdom? Could it help us decipher some of the mysteries of the natural world and maybe one day allow us to "talk" to animals?



There are certainly some who think so. And some progress has already been made in attempting to decode animal communication using AI. It might be a way off allowing you to dish the dirt with your dog or spill the tea with your tortoise, but technology has – and hopefully will continue to – improve our understanding of other species and how they interact.

When it comes to communicating with animals, perhaps Dolittle walked (and talked) so that AI could run.

Do animals use language?

The first hurdle in "translating" animal communication is understanding what that communication looks like. Human language is made up of verbal and non-verbal cues, and animal communication is no different.

Dogs wag their tails, for example, to convey a range of emotions. Bees dance to let other bees know where to find a good source of nectar or pollen. Dolphins use clicks and whistles to relay information.

However, there is some debate as to whether this can be considered a "language". A debate which, according to Dr Denise Herzing, Research Director at the Wild Dolphin Project, AI could help us put to bed.

"We currently don't know if animals have a language," Herzing told IFLScience. "[But] AI can help us look for language-like structures which might suggest animals have parts of a language."

How can AI "translate" animal communication?

"Bioacoustics research has shown that animal vocalisations carry many types of information, from their identity to their status, internal state, and sometimes external objects or events," Elodie F. Briefer, Associate Professor in Animal Behaviour and Communication at the University of Copenhagen, told IFLScience. "All of these could be picked up by AI."

WHEN IT COMES TO COMMUNICATING WITH ANIMALS, PERHAPS DOLITTLE WALKED (AND TALKED) SO THAT AI COULD RUN.

More specifically, by machine learning. This is a form of AI that can analyze data without needing to follow specific instructions. In theory, it could be used to process recordings of animal communication and build language models based on these recordings.

"Machine learning is a powerful tool as it can be trained to identify patterns in very large datasets, so it could allow us to process large amounts of data and gain crucial knowledge about how information contained in animal sounds changes over time, etc," Briefer added.

It's the same technology we use every day to power predictive text, Google translate, and voice assistants. Turning it to animal communication may prove more challenging, but that hasn't stopped researchers from trying.

"There are many different techniques and ways to approach the science," Herzing told IFLScience. These will differ, she

Image Credit Top: © James Rodrigues. *Bottom:* © iStock, Oleksandr Chaban.

added, "[depending] on the data, the AI technique, or even the understanding of the animals themselves."

The Earth Species Project, for example, is a nonprofit "dedicated to decoding non-human language". Their focus so far has been on cetaceans and primates, but will, they say, eventually stretch to other animals, including corvids.

The project uses a machine learning technique, which treats a language as a shape, "like a galaxy where each star is a word and the distance and direction between stars encodes relational meaning." These can then be "translated by matching their structures to each other".

Optimistically, Britt Selvitelle, cofounder of the Earth Species Project, believes the approach could help decode the first non-human language within the next decade, according to **The New Yorker.**

Others, however, are more skeptical of AI as a tool for unraveling animal communication.

It's all well and good analyzing recordings, but it's meaningless without context, says Julia Fischer at the German Primate Center in Göttingen. "[AI] is not a magic wand that gives you an answer to the biological questions or questions of meaning," she told New Scientist.

It's still vital to look to nature and correlate recordings with real-world observations, and that is no mean feat.

What has been achieved so far?

Lots of projects are currently working on unraveling the secrets of animal communication with the help of AI, the Earth Species Project being one of them.

Last December, the project published a **paper** that claims to have solved the "cocktail party problem" – the issue that arises when distinguishing the source of a sound from multiple simultaneous sounds.

Imagine a cocktail party, if you will. Among the chatter and background noise, it's almost impossible to figure out who exactly the calls for another espresso martini are coming from. And the same issue is present when deciphering animal communication.

In the study, the researchers describe an experimental algorithm – which they applied to species including macaques, bottlenose dolphins, and Egyptian fruit bats – that has allowed them to pinpoint which individual in a raucous group of animals is "talking".

AI is cementing itself as a valuable tool in other areas of zoology too. "[It] has been used notably in a relatively new field termed 'ecoacoustics', which monitors biodiversity through passive acoustic monitoring and requires very large datasets," Briefer told IFLScience.

"People have also used it to extract information from long-term recordings (e.g. identifying marine mammals from underwater recordings). More recently, it has been used to identify patterns in other contexts as well, such as to identify underlying emotions in [pigs and chickens]."

ASIDE FROM THE OBVIOUS – FINALLY FINDING OUT WHAT YOUR CAT REALLY THINKS OF YOU – THERE ARE LOTS OF WAYS THAT AN IMPROVED UNDERSTANDING OF ANIMAL COMMUNICATION CAN BE BENEFICIAL.

Briefer's work includes one such **study**. She and her coauthors trained an AI system to recognize positive or negative emotions in the grunts, squeals, and oinks of pigs.

In rodents, software called DeepSqueak has been used to judge if an animal is experiencing stress based on its ultrasonic calls. These sounds, imperceptible to the human ear, are how rodents socially communicate. The software has also been used on primates and dolphins to help researchers automatically label recordings of animals' calls.

The nonprofit Wild Dolphin Project, founded by Herzing, aims to use AI to discover patterns in dolphin calls and explore communication between dolphins and humans. In 2013, after teaching a pod of dolphins to associate a particular whistle with a type of seaweed, researchers used a machine-learning algorithm to identify and translate the sound in the wild.

Image Credit: © James Rodrigues

Meanwhile, **Project CETI** (Cetacean Translation Initiative) is attempting to decode the communication of sperm whales by using language models to decrypt their songs and establish their "language".

Why these animals?

No species is superior when it comes to decoding communication, Briefer believes, but still, some have been targeted by researchers more than others.

"When considering acoustic communication, of course the most interesting ones are those that are very vocal (birds, pigs, meerkats) and those that have a large sound repertoire," Briefer told IFLScience.

> ***THE TOOLS WE DEVELOP WITH SPECIES ON EARTH MIGHT APPLY TO FAR AWAY WORLDS SHOULD WE ENCOUNTER ANY OTHER LIFE FORMS.***

Equally, social animals such as primates, whales, and dolphins are more likely to have well-developed communication systems, making them ideal for study. "Dolphins live in highly social societies, live long lives, and have long memories, suggesting that they have complex relationships to communicate about," Herzing explained. Intelligence may also play a part.

"Cetaceans, or at least dolphins, are known to have a high EQ [emotional intelligence], abilities to learn artificial languages, understand abstract ideas, and to recognize themselves in a mirror," Herzing added. "These are some of the bedrocks of intelligence."

What are the benefits of understanding animal communication?

Aside from the obvious – finally finding out what your cat really thinks of you – there are lots of ways that an improved understanding of animal communication can be beneficial, for humans and animals alike.

"For both captive and wild species, it allows us to understand them better, and know when they are thriving or suffering," Briefer told IFLScience.

"This is crucial for the species we have around us (pets and farm animals for example), as their welfare depends on us."

Not only could this make us better pet owners, but it has the potential to forever change our relationship with all animals.

"Knowing that animals have language would hopefully make humans understand that we are not the only sentient species on the planet," Herzing added.

At the very least, this could inspire more sympathy toward other species and lead us to rethink the way that we treat them. This could have far-reaching implications, including for the usage of animals in sport, entertainment, and research.

It could even trigger a complete overhaul of animal agriculture. With a better understanding of the animals around us, can we still justify practices that exploit and kill them?

From a human perspective, there is also a lot we could learn, not just about animals but about ourselves and, maybe, other life forms.

Understanding animal communication could teach us about the evolution of language, Briefer told IFLScience.

"The tools we develop with species on Earth might apply to far away worlds should we encounter any other life forms," Herzing speculated, adding that these tools could help us gauge their intelligence and whether we could communicate with them.

Making the leap from animal to alien communication is certainly a move Dolittle never made. Should the fictional vet be worried about being bested? Not just yet. Using AI to actually *talk* to animals, let alone extraterrestrials, is a big leap. But it certainly has the potential to improve our understanding of other species and the world around us. In fact, it already has. Perhaps Dolittle should start feeling a little nervous after all. •

Image Credit: © James Rodrigues

GETTING CORAL "GOING"

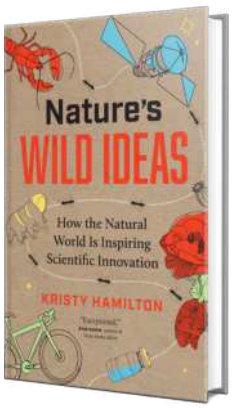
IN ORDER TO GROW BRICKS

In this excerpt from *Nature's Wild Ideas*, author Kristy Hamilton describes her experiences learning about the unique way in which scientists are taking inspiration from coral to grow building materials.

I'm crammed inside a pitch-black room with enough space to fit myself and another person. That's it. There is no light. It is can't-see dark. Except. Click. A red flashlight flickers on. That's when we see an aquarium of coral. It all seems a bit over-the-top for this undercover containment facility, but the scientists here are trying to reproduce coral, a notoriously tricky task. The coral are hermaphrodites, meaning they possess both sperm and eggs. One would think this would make it easy to get them to procreate, but it turns out coral are also underwater romantics. They require just the right conditions to "get them going": they favor a perfect water temperature and will only spawn after the flush of light of a full or new moon. If the ambiance is seductive enough, the coral synchronize their spawning on the same match-making night and release their bundle of eggs and sperm (which resemble small seeds), and the buoyant bounty floats to the surface.

When I visited San Francisco's Steinhart Aquarium a few years ago, few institutions had managed to make coral release a cloud of sperm in the lab. "It's like snowfall in reverse," said Dr. Bart Shepherd, director of the aquarium, as we stood there awkwardly looking at the dual-sex coral doing nothing remotely sexy. When I looked online to see what he was talking about, it became clear that his description was spot on. The orgiastic blizzard rises to the water's surface like trillions of little pastel-pink balloons. Finally, in April 2020, the Steinhart Aquarium made it happen. If the "night of action" had happened in the ocean, the free-swimming larvae would have gone for a ride, floating for days or even weeks before they found their forever homes. The larvae use chemical cues to guide themselves toward a reef and then drop to the ocean floor. The equivalent for us would be if someone else's child randomly descended from above and started growing out of our side, except on a reef everyone is connected and sharing nutrients. Because of this connection, Earth's largest living structure is the Great Barrier Reef, reaching 1,400 miles (2,300 kilometers) in length, or almost the vertical length of the United States. In fact, the maze of coral is so grand, astronauts can see it from space.

It's these kinds of coral that Ginger Krieg Dosier cares about. In photographs, Dosier typically wears black and is often seen holding a concrete brick. Not surprising, given her job. Dosier is the president and chief executive officer of Biomason, a biotechnology start-up in Raleigh, North Carolina, that grows concrete bricks like a gardener grows carrots or cucumbers. Well, not quite. A better analogy is that Biomason's bricks grow like hard coral reefs in the ocean.



Dosier stumbled upon her inspiration for homegrown bricks on the sandy beaches she played on as a child, picking up seashells and wondering how they grew. At the time it was nothing more than childhood curiosity and games. It wasn't until she was working toward a master's degree in architecture that her interests in design and the ocean merged into an attempt to upend a centuries-old industry. And it all started with a small lab she fashioned in her kitchen, which soon spread to the second bedroom of the apartment she shared with her partner, Michael Dosier. In their version of romance, they'd often return early from their dates to "feed" the cement with different strains of bacteria, testing out dozens to unearth which binds best to the sand grains used in cement. The Dosiers were trying to replicate how coral grow in the sea in their homemade laboratory.

Coral may seem like lifeless towers at the bottom of an otherworldly domain, but they are as much an animal as a tiger or an elephant. Scale and complexity is the wondrous might of the animal kingdom and, until recently, coral have been amorous superstars. There are more than 3,600 species of hard coral, their intricate architecture ranging from finger-like protrusions to flat disks to squiggly bulges that look as if thousand-pound brains have ruptured from the seafloor.

Excerpted and adapted from the book *Nature's Wild Ideas: How the Natural World is Inspiring Scientific Innovation*, by Kristy Hamilton and published by Greystone Books.

Image Credit: Greystone Books

Q&A AUTHOR WITH KRISTY HAMILTON

AUTHOR OF *NATURE'S WILD IDEAS*

What made you want to write *Nature's Wild Ideas*?

Nature's Wild Ideas was the book I wanted to read. I began this journey by creating a spreadsheet to catalogue all the biomimicry discoveries I read about. This went on for a year. Every time another story emerged, or a scientific paper was published, I added them to the list. I was working a full-time job, so I used my spare time to investigate the story behind these discoveries and creations. Some of the stories were more captivating than others, and if I could interview the scientists involved, all the better. I reached out to some 48 researchers for the book, and I'm immensely grateful for the time they shared with me.

Do you have a favorite innovation inspired by the natural world you can share with us?

I love this question for the simple reason that readers have different favorites! Personally, I love the chapter "Fishing for Stars: Lobsters Inspire Telescopes to View Cataclysms in the Cosmos." Why? Well, there is such a beautiful cascade of events that led astronomer James Roger Prior Angel to design a new space telescope that captures X-rays. Angel's creation was inspired by – of all things – an unassuming creature that crawls in the ocean; to grasp a portion of the astronomical universe from a lobster's eye is astounding, and also a bit absurd. This chapter indulges in both the beauty of nature and humor in its absurdities. The very basis of science is not knowing something – and sometimes humor allows us to explore those edges and unknowns in a safe way.

I also love the final chapter "Flashes of Brilliance: Jellyfish Inspire Nobel Prize-Winning Tool to Peer Inside Our Bodies." This chapter really digs into the sweat of scientific achievement, and I find that more inspiring than divine epiphanies. Science at its core is teamwork.

What do you enjoy most about working in science communication?

I love chatting with people who are passionate about their work. I'm deeply inspired by other writers, scientists, and adventurers. For me to contribute to science communication in some small way is a gift. I am a reader first and foremost, and I hope to recreate the joy I find in science for other readers.

Any memorable moments from your research?

Ice climbing in Hyalite Canyon, Montana, was a memorable moment for me. I was surprised by just how wildly my temperature could fluctuate if I wasn't careful. Sweat is typically a great mechanism for cooling humans during exertion but if you sweat too much while climbing icefalls, your damp clothes quickly make you even colder in below-freezing temperatures; your hands stiffen and using ice tools becomes more difficult. Part of ice climbing is judiciously taking layers of clothes off and on again, and pacing yourself to not sweat too much. Some ice climbers bring three pairs of gloves or more into the mountains to prevent their hands from getting too wet.

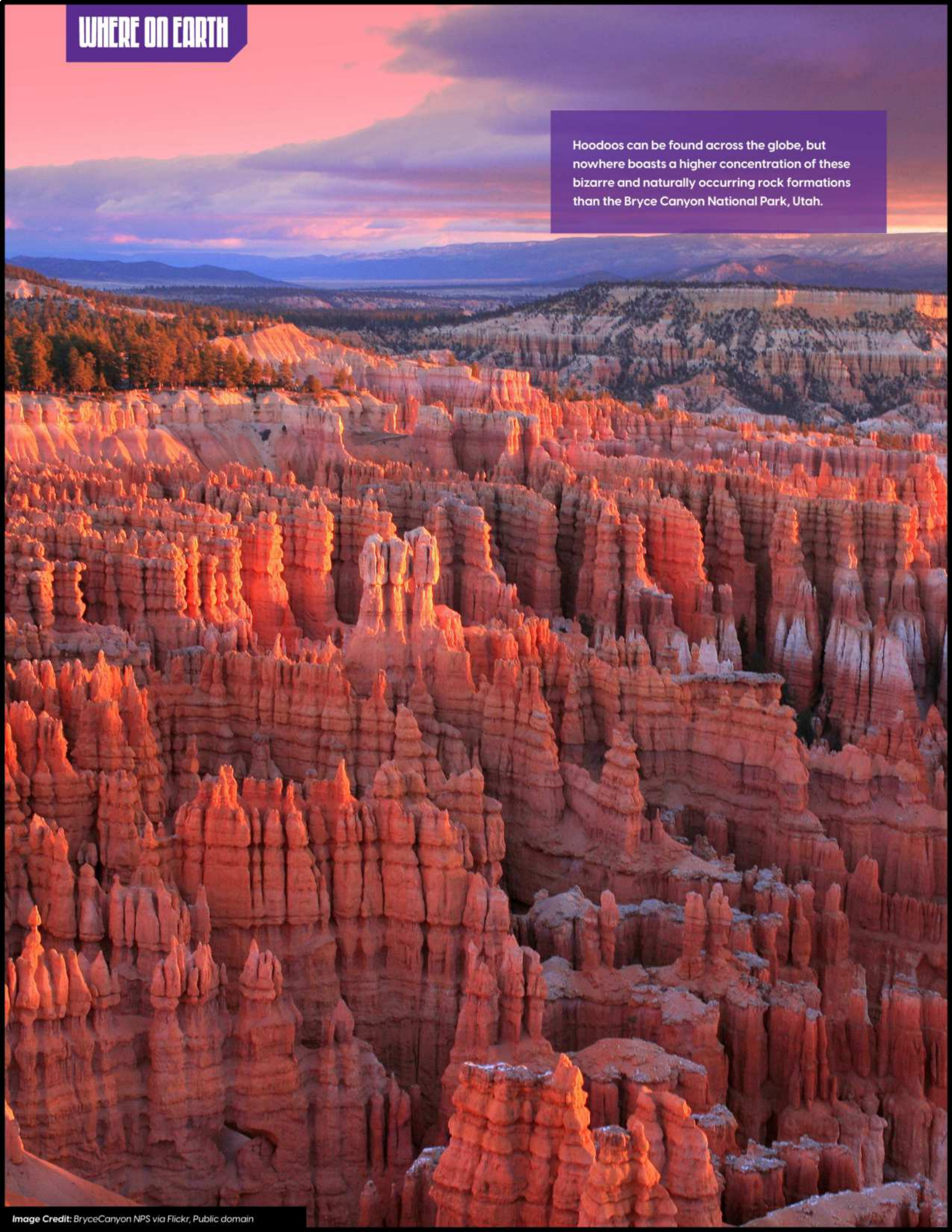
There is also something called the "screaming barflies" that is triggered by diminishing blood flow to your hands. The cold causes blood vessels to constrict and shunt blood to your core to prevent hypothermia. Swinging and hanging from ice axes over your head – and thus above your heart – limits circulation as well. When you lower your hands, they start to rewarm and can cause intense – or "scream – inducing" – pain. Thankfully, this never happened to me, but I do have a newfound appreciation for life in such difficult extremes. Our survival in these harsh landscapes has less to do with our physical abilities and more to do with our talent to devise tools to overcome our mortal limitations.

What do you hope people will take away from it?

I hope people take away just how vital the natural world is to our creativity and innovation, especially in science and medicine. We owe a great deal to Earth's plants and animals, and preserving diversity benefits all creatures on this planet – us included. I hope people come away with a deeper appreciation for the beauty of the natural world. And I hope there is a recognition that science is a stepping stone of achievements that builds on the prior work of scientists. •

***Nature's Wild Ideas* is published by Greystone Books and is available to buy from October, RRP $32.95**

Image courtesy of: Kristy Hamilton



Hoodoos can be found across the globe, but nowhere boasts a higher concentration of these bizarre and naturally occurring rock formations than the Bryce Canyon National Park, Utah.

Image Credit: *BryceCanyon NPS via Flickr, Public domain*

BRYCE CANYON IS HOME TO A RECORD-BREAKING NUMBER OF HOODOOS

Bryce Canyon's emergence began around **50 million years ago** when parts of Utah were still covered in an ancient lake and floodplain system during which time layers of sediments began to accumulate. As the land dried up and the layers were committed to the region's geological record, the plateau was uplifted by plate tectonics, exposing the alternating layers of rock made up of different strengths and colorations.

Bryce Canyon's rocks contain limestones, dolostones, mudstones, siltstones, and sandstones. As weathering broke down these layers at different rates, erosion stripped the weaker parts away until, eventually, they carved out hoodoos: a geological term used to describe **rock spires** carved out by natural forces.

Ice and rain are the key sculptors to thank for the staggering creation that is Bryce Canyon National Park, now home to the greatest concentration of hoodoos on Earth. The extreme elevation of the canyon is partially to blame, putting it at a height where freezing temperatures are experienced for more than half of the year.

The constant freezing and thawing of water in the rock results in what's known as "ice wedging", where water turning to ice expands and breaks the rock apart. These breaks often start as walls, then become holes, and later morph into hoodoos.

Considering ice and freezing temperatures have been so pivotal in Bryce Canyon's formation, it's a source of concern for geologists as to what might happen to the region in the face of the climate crisis. With freeze-thaw days apparently on the decline, warming temperatures could erase Bryce Canyon's iconic hoodoos. However, little research has been done on the topic and, as Clare Crise concluded for the **National Park Service** "without the science, we cannot hope to address or adapt to climate change's impacts on them." •

How to get there

The closest flight destination is Cedar City Regional Airport, which is roughly a two-hour drive from Bryce Canyon National Park. For international flights, Las Vegas and Salt Lake City airports are good alternatives.

SCIENCE IN MEDIA

WATCH

The Midnight Club

TV series on Netflix

What happens to us after we die? This is what the eight members of *The Midnight Club* meet to discuss in the face of their impending deaths. Set in a hospital for terminally ill young adults, the Netflix series brings to life Christopher Pike's book of the same name. Each night, at midnight, the group meet to discuss tales of the supernatural and promise to make contact from the other side when their time comes to die. A suitably spooky dance with mortality for October from *The Haunting of Hill House* and *The Haunting of Bly Manor*'s Mike Flanagan.

Available to stream on* Netflix *from October 7.

LISTEN

The Big Questions

Podcast from IFLScience

Tune in this October for two new episodes of The Big Questions. As IFLScience's very own podcast, it puts some of the most pressing questions of our time to scientists and experts. On October 7, host Dr Alfredo Carpineti will be exploring how our imagination works with cognitive scientist Prof. Tyler Marghetis. Then on October 21, he puts what's sure to be a contentious question to Prof. Nira Chamberlain by asking, "Is math the greatest subject?"

***Listen on* Apple Podcast, Spotify, *and other* podcasting platforms.**

PLAY

Insect Worlds

Game on PC

Ever wished you could explore the world from a bug's-eye view? Well, now you can in Insect Worlds, an early access game soon to be available on PC. From the point of view of different species, you can explore forests and learn about insects' way of life while completing quests and mini games. Being but a bug in the big wide world is a treacherous lifestyle, and you'll face down foes in fights as you creepy-crawl your way around in search of resources and trading cards. You'll get to take in the microcosm from a whole new perspective, all while growing your knowledge of insects.

***Play via* Steam.**

LEARN

Teach Me In 10

Series from Technology Networks

Can virtual reality (VR) be wielded to complement psychotherapy? What if you added psychedelics into the mix? These are the questions explored in this episode of *Teach Me In 10*, an educational series from Technology Networks that aims to do exactly what it says on the tin with short educational videos. Here, they speak with Agnieszka Sekula, co-founder of Enosis Therapeutics and PhD Researcher at Swinburne University of Technology, to discuss how VR could be used in psychedelic-assisted psychotherapy.

***Available to* watch now.**

SEE

Black Adam

Film from Warner Bros. Pictures

This sci-fi fantasy film, based on the DC Comics character of the same name, begins in ancient Kahndaq when Teth Adam was bestowed the almighty powers of the gods. After using them for vengeance, "Black Adam" (Dwayne "The Rock" Johnson) was imprisoned in a tomb for 5,000 years, but now he's been released. Enraged but free, Black Adam takes on the modern-day heroes Hawkman, Dr Fate, Atom Smasher, and Cyclone, in pursuit of what he deems justice. As the spin-off to *Shazam!*, it marks the 11th film in the DC Extended Universe.

***Showing from* October 21.**

Image Credit Top Row Left: *Eike Schroter/Netflix © 2022.* ***Middle:*** *© IFLScience* ***Right:*** *Insect Worlds.*
Bottom Row Left: *Technology Networks.* ***Right:*** *© 2022 Warner Bros. Entertainment Inc. All Rights Reserved..*

DATES TO REMEMBER

October is bringing lots of lunar entertainment for stargazers, while animal enthusiasts will have plenty to sink their teeth into as the annual Wildlife Photographer Of The Year competition gets into full swing for 2022.

OCTOBER 1

International Observe The Moon Night

Calling all Moon enthusiasts: as we welcome October, NASA is encouraging people to get involved with celestial observations for **International Observe The Moon Night**. Taking place between September and October each year, it's an opportunity to take in Earth's sidekick during one of its most observable phases. There are plenty of in-person and virtual events to get involved with, or you can host your own. Participants are encouraged to share their thoughts and observations with the hashtag #ObserveTheMoon and you can also get involved on Facebook and Flickr.

11-17

Wildlife Photographer Of The Year 2022

The Natural History Museum's **Wildlife Photographer Of The Year** is kicking off in October. First, the winners of the 2022 competition will be announced on October 11, with exhibitions opening their doors from October 14. Visitors inspired by what they see can then get involved from October 17 when entries open for the 2023 competition. If the **highly commended entries** are anything to go by, we're in for a treat.

25

Solar Eclipse

Parts of the world will be treated to a **partial solar eclipse** on October 25, marking the second for 2022. Don your spiciest protective eyewear if you find yourself in Europe, northern Africa, the Middle East, or western parts of Asia to watch as the Moon partially eclipses the Sun. Solar eclipses never happen alone, usually coming two weeks before or after a lunar eclipse. The next event of the season will be a total lunar eclipse on November 8.

10 - 14

Wildscreen Festival 2022

Wildscreen is back for 2022, bringing you the best in wildlife filmmaking from across the globe. This year's lineup has been announced welcoming explorers and presenters Steve Backshall and Bertie Gregory alongside activist and leader of the Indigenous Brazilian Borari community, Chief Dadá Borarí. They'll also be joined by environmentalist, drag queen, and sustainability icon Pattie Gonia, and musician Imogen Heap. Together, they'll explore "The Future of Natural World Storytelling for a Better Planet" through a series of talks, exclusive film screenings, and networking events, and you can get involved either in person or online.

31

Halloween

We love nothing more than a science-themed Halloween costume, but if you want to take your trick or treating to the next level this year, why not get stuck into some tasty physics and make your own iridescent chocolate? The mesmerizing confectionary is the result of the chocolate's surface, no special coating or ingredients involved, so anyone can make it at home. You can find out how **here**.

Image Credit Top Row Left: NASA. *Right:* Wildscreen 2022. *Bottom Row Left:* Tree Frog Pool Party, Brandon Güell, Wildlife Photographer of the Year 2022. *Right:* ETH Zurich/Giulia Marthaler.

ARE YOU DRAWN TO THE DARKER OR LIGHTER SIDE OF SCIENCE?

Choose how you end each issue. For those who prefer the darker side, Maddy Chapman explains how as mammals, our evolutionary choices seem to be crabs or slime. If you like your science lighter, she reveals the unexpected trash battle humans and cockatoos are locked in.

IT ALL ENDS IN CRABS OR GOO

One day, when humans are finished destroying the planet, all that's left will be crabs. From cat to caterpillar, every animal will convert to crab. Or so the **meme** goes (scientifically speaking, this isn't totally baseless: there does seem to be some evolutionary bias, in crustaceans at least, toward a crab-like form).

MUCUS IS ESSENTIAL FOR LIFE, SO IT'S NO WONDER MUCINS ARE SUCH PROLIFIC SUPER-SPREADERS.

But what about an altogether weirder and arguably much grosser evolutionary outcome?

The future, it appears, could be slime.

According to new research, published in Science Advances, mucins – components of mucus that give it its gooeyness – have evolved many times in mammals, and will likely continue to evolve many more.

They have emerged repeatedly and independently, silently spreading their slimy agenda to unsuspecting proteins. Comparing mucin genes in 49 mammal species, the researchers identified no less than 15 so-called "mucinization" events – when mucins evolved from a protein that wasn't originally a mucin.

As for how these poor proteins meet a (literally) sticky end at the hand of mucins, the team suspects sections of amino acids are duplicated over and over and tacked on to the original protein until it succumbs to the slime.

Mucus is essential for life, so it's no wonder mucins are such prolific super-spreaders. From slimy snail trails to slippery saliva, the stuff is everywhere in the natural world.

"If these mucins keep evolving from non-mucins over and over again in different species at different times, it suggests that there is some sort of adaptive pressure that makes it beneficial," first author Petar Pajic **said**.

"And then, at the other end of the spectrum, maybe if this mechanism goes 'off the rails' – happening too much, or in the wrong tissue – then maybe it can lead to disease like certain cancers or mucosal illnesses."

Goo, apparently, is pretty complex stuff. And who's to say how far its penchant for evolving could take it? If it continues down this path, monopolizing molecules to build its army of mucins, it could even come to rival crabs as evolution's rumored end game.

So, what will it be? Crabs or mucus? All bets are off.

BATTLE OF THE BIN

You may well be familiar with the saying "one man's trash is another's treasure", and it seems it's the same case for birds. Apparently, cockatoos in Australia are well versed in human proverbs and, keen to demonstrate this, have been partaking in a spot of bin-diving.

"One man's trash is a cockatoo's treasure" doesn't roll off the tongue in the same way, but it's certainly true of an area of southern Sydney, as residents can attest.

What they toss in the garbage, the cockatoos fish out for food. They've made attempts to keep the birds out, but the cockatoos have bested them. And so an unlikely war between human and bird has been waged.

The Battle of the Bin, as we're coining it, is the subject of a very important study, published in Current Biology, which details the increasingly inventive efforts of both sides to snatch victory from the other and be crowned ruler of the refuse heap.

On one side, we have the wily sulfur-crested cockatoos. Motivated by a taste for bread and a flair for the chaotic, their favored tactics involve prying open the bins with their beaks, before flipping the lid open and calling for reinforcements.

"We could actually show that this is a cultural trait," **said** lead author Dr Barbara Klump. "The cockatoos learn the behavior from observing other cockatoos and within each group they sort of have their own special technique, so across a wide geographic range the techniques are more dissimilar."

IT'S ALL TO PLAY FOR IN THE BATTLE OF THE BIN.

At the other end of the battlefield (read: pile of trash), we have the humans. Renowned for their big brains, they've turned to bricks, water bottles, and ropes to secure their lids. They've even used sticks to block the hinges.

"It's not just a social learning on the cockatoo side, but it's also social learning on the human side," Klump said. "A lot of people actually learn [new protection methods] from their neighbors or people on their street."

Smart strategies from both sides, but which will prevail? We couldn't possibly call it. Even the scientists don't know. It's all to play for in The Battle of the Bin.