CURIOUS

IFLSCIENCE

WHY DO HAMMERHEAD SHARKS HAVE HAMMER-SHAPED HEADS?

IS THERE A FIFTH DIMENSION?

AUGUST 2026

HOW DO ANIMALS GET THEIR PATTERNS?



17

WHERE ON EARTH

THE WORLD'S CREEPIEST CENOTE

Do you dare dive into Cenote Angelita?



8

WHAT ON EARTH

FREAKY FERROMAGNETIC FLUID

No, this is not Venom's origin story.



11

DEEP DIVE

IS THERE A FIFTH DIMENSION?

Possibly, but not how you think, Dr Alfredo Carpineti explains.



4

COVER STORY

HOW DO ANIMALS GET THEIR PATTERNS?

And how is Alan Turing (yes, that one) involved? Tom Leslie investigates.

AUGUST 2026

CONTENTS

PAGE 2 | NEWS BITES

What's new, what's weird, what's happening?

PAGE 9 | WE HAVE QUESTIONS

Why Do Hammerhead Sharks Have Hammer-Shaped Heads?

PAGE 15 | BOOK BITES

Queering Fatherhood

PAGE 16 | MEET THE AUTHOR

Perrin Roosevelt Ireland on *Poking The Squid*

PAGE 19 | SCIENCE IN MEDIA

What to watch, read, and listen to this month

PAGE 20 | IN THE FIELD

IFLScience walks the green carpet for a climate documentary world premiere

PAGE 21 | DATES TO REMEMBER

What to look out for this month

PAGE 22 | DARK VS. LIGHT

How will you end the issue?

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NEWS BITES



Total Solar Eclipse

On August 12, 2026, a total solar eclipse will briefly block out of the Sun across parts of the Northern Hemisphere for the first time since April 2024. Back then it was North America that got the best views; this time it's Europe's turn (the first since 1999!) with the narrow path of totality sweeping over Greenland, Iceland, and northern Spain. Totality will last up to 2 minutes and 18 seconds – which is nothing on next year's "eclipse of the century", where totality is expected to be over 6 minutes – but it's not to be sniffed at. You may even be lucky enough to spot the rare **Baily's Beads** phenomenon. Much of Europe will experience a partial eclipse, too, with up to 90 percent of the Sun covered. Because the eclipse is happening late in the day, the Sun will be low on the horizon, so many partial viewers will get a sunset eclipse. Don't forget to wear your eclipse glasses – or **make a pinhole camera** or even use a **disco ball** – and never look at the Sun directly.



CURIOUS Turns 4!

Issue 49 marks four years of your favourite digital science magazine! Not only do you get a monthly magazine (with **48 back issues** for your perusal) packed with deep dives, interviews, weird questions answered, exotic geographic highlights, and the latest science news, books, movies, and shows, but you get CURIOUS Live and a podcast to boot. The ***We Have Questions* podcast** offers up longer, more in-depth discussions with the experts featured in the magazine column. Catch up with any episodes you missed **here** and subscribe on your favorite podcast platform so you don't miss any again. As part of your membership, you also automatically have access to our **CURIOUS Live events**, where we chat to experts on a range of fascinating topics, and you can even ask questions. Our most recent event explored the science of magic as we visited the UK's only MAGIC (Mind, Attention, and General Illusions in Cognition) Lab to talk with director, psychologist and magician Dr Gustav Kuhn about the psychological underpinnings of magic. So let's continue to explore the weird world around us and stay CURIOUS!



20th Anniversary Of Pluto's Demotion

August 24, 2026, marks the 20th anniversary of Pluto's reclassification from the Solar System's ninth planet to a dwarf planet. The International Astronomical Union defined new criteria in 2006 requiring a planet to clear its orbital neighborhood of other objects, which Pluto doesn't. The decision reshaped how astronomers classify small icy bodies beyond Neptune and introduced the category of dwarf planets in modern astronomy. Twenty years later, the debates about planetary definitions are ongoing and people are still salty – even current NASA chief Jared Isaacman wants to "Make Pluto a Planet Again".

SpaceX To Hit The Moon

On August 5, a large section of a SpaceX rocket is set to crash into the Moon. It's unclear yet if ordinary telescopes will be able to see it from Earth, but try if you can! The Falcon 9 upper stage (the bit that carries the payload) will be traveling at 8,690 kilometers (5,400 miles) per hour when it is projected to hit the lunar surface near the Einstein crater – about 10 o'clock on the Earth-facing side of our satellite – at about 6:44 am UTC. That's over 2 kilometers per second. If you do happen to capture it, you can add your footage to the citizen science **Impact Flash! program.**



Image Credit Left: valiantsin suprunovich/Shutterstock.com, **Top Right:** ESA/CESAR/Wouter van Reeven, **Middle Right:** NASA/JHUAPL/SwRI, **Bottom Right:** Pink_Zebra/Shutterstock.com

Watch An Epic Animal Migration

Right now, the largest overland animal migration on Earth is taking place, and you can watch it on livestream from the comfort of your home. The Great Wildebeest Migration involves over 1.5 million wildebeest – alongside hundreds of thousands of zebra and gazelles – covering roughly 800 to 1,000 kilometers (500 to 600 miles) across Tanzania's Serengeti and Kenya's Masai Mara. By August it reaches peak density as the herds attempt to cross the steep banks, fast currents, and crocodile-infested waters of the Mara River, setting the stage for one of nature's most intense survival events. You can watch the **drama unfold here**.

Mirror Moon

Have you ever wanted to reach out and touch the Moon? Short of undergoing full astronaut training, this may be your best shot. A new installation by artist Luke Jerram has landed at the Royal Observatory in London. The 2-meter (6.6-foot) Mirror Moon allows you to see and feel the lunar surface like never before. Made from stainless steel, Jerram used NASA topographical data to accurately replicate the Moon's surface. Run your hands over mountains, craters, valleys, and lava fields. You can even explore the once elusive far side – just this year the Artemis II astronauts became the first humans to see the Orientale Basin with their own eyes.



WHAT'S UP?



LAUNCHING A FANCY TELESCOPE

That's the Roman Space Telescope to you.

Name: Nancy Grace Roman Space Telescope
Appearance: A bit like a theater spotlight? It's a round tube (the telescope) with a nice little shader over the top
Location: Currently on Earth, but soon to be out there, orbiting Lagrange 2 (we'll get on to that)

So, what is the Roman Space Telescope?

This is NASA's latest fancy telescope. It will search outer space for exoplanets, look out for galactic fossils, and hopefully calculate the expansion rate of the universe. The new telescope is so powerful it'll be able to photograph an area of the sky at least 100 times larger than Hubble's iconic Ultra Deep Field image.

And what's it got to do with Italians?

No no no, it's not named after *those* sorts of Romans. Its full name, the Nancy Grace Roman Space Telescope, honors NASA's first female executive and first Chief of Astronomy. Roman created NASA's space astronomy program and is known as the "mother of Hubble" due to the key role she played in the planning of that foundational mission. It is hoped that this new telescope will take on the mantle and push our understanding of the universe even further.

Can we go back to the… Lagrange?

Ah yes, this is where things get a bit complicated. So, the telescope will be orbiting what is called Lagrange 2, or L2 for short, which is a point located about 1.5 million kilometers (932,000 miles) from Earth in the direction of outer space. This is basically the point at which the gravitational pull of the Earth and Sun combined balance themselves out. It means that an object, like a telescope, can sit in that orbit and follow the Earth as we go round the Sun, but is far enough away that things like the Earth's heat, radio waves, and magnetic radiation don't affect its instruments.

Oh, that's neat.

We're not done yet. There is a bit of a problem with L2. Precisely because it is so useful an orbit, we've already polluted it with plenty of other objects, including none other than the JWST. This means that Roman has to go on something of an obscure, not-quite-elliptical orbit to dodge all the other crap we've left out there.

When can we expect it to launch?

It's currently scheduled to lift off on August 30, so we'll be keeping all our fingers and toes crossed that Roman will hit its mark.

Image Credit Left: Royal Observatory, **Right:** NASA

HOW DO ANIMALS GET THEIR PATTERNS?

Alan Turing (yes, that one) pioneered a whole new branch of mathematical biology to explain how the tiger got its stripes.

By Tom Leslie

Image Credit: therealvector/Shutterstock.com, modified by IFLScience

There's more than one way to skin a cat. Or to put skin on a cat.

That is to say, if you were told you could leaf through nature's palette of pelts and pick out a swatch for a new species, you'd have a wealth of patterns to choose from – the stripes of the tiger, the spots of the cheetah, or even the ombré patches that dapple the flanks of the clouded leopard.

And that's just big cats. Widen your search and you'll find all kinds of eye-catching skin-wear, from fish wrapped in silvery bands of iridescence to lizards bedecked in beaded scales of orange and black; there's no shortage of snazzy designs.

But there is a conspicuous lack of animal fashion designers to dream them up – so how did these patterns come to be?

The Turing pattern

It's a deceptively hard problem. Without a brush to paint them on, such patterns must form by themselves. This means that, from a field of identical hair follicles on a cheetah, for example, some must decide they're going to be the black, spotty bits while others remain yellow.

Surprisingly, one of the first people to look into how cells make these kinds of decisions was Alan Turing. That's the same Turing who led the Hut 8 section at Bletchley Park during World War II, eventually breaking the Enigma cipher, and whose Turing machines are the basis for all modern computers.

In 1952, just two years before his untimely death by cyanide poisoning – and only five months after he was convicted of "gross indecency" for a homosexual relationship, for which he was not pardoned until 2013 – Turing published a paper on animal patterning, laying out a concept that would come to be known as the "Turing pattern".

"So, this absolute genius and hero was alone at home," **Michel Milinkovitch**, lead researcher at the Laboratory of Artificial & Natural Evolution at the University of Geneva, explains to IFLScience.

"And then, because this guy was an absolute genius, he was thinking, what can I do to not get bored?"

"Oh, he thinks, there is something interesting called biology. You start from a single cell, and then you make an organism that is complex. How is this possible? So, he took a pencil and a piece of paper, and he imagined exactly that."

The maker of forms

Turing's central insight was the idea of a morphogen, a chemical whose quantity tells a cell what shape or color it needs to be. In our cheetah example, high levels of a certain morphogen would cause some cells to grow black hairs, while low levels would make them sprout yellow. The word comes from the Greek meaning "form-maker."

Turning the problem into a question of chemicals was a neat trick that allowed Turing to tackle it with the mathematics of chemical reactions. This made the problem relatively simple, as math like this had been used for nearly 100 years to describe the rates of reactions and how molecules move around by diffusion.

"AND THEN, BECAUSE THIS GUY WAS AN ABSOLUTE GENIUS, HE WAS THINKING, WHAT CAN I DO TO NOT GET BORED?"

That meant Turing could imagine a starting situation, such as a drop of morphogen placed in a liquid, and write an equation that would tell him how much of the substance ends up at any given point at any given time. Assuming he could find some way to make the morphogen levels form a pattern, then that pattern could tell the cells on our cheetah's skin what to do, solving the problem.

With a single morphogen, however, there's just no way you could get complex structures like spots or stripes. The molecule would spread out like ink in water until it was completely homogeneous. Then every hair follicle would receive the same amount of chemical and your cheetah's skin would end up unable to tell which cells should form the trademark spots.

But what would happen if we added a second molecule that interacts with our original morphogen? It turns out this simple change creates enough complexity that, by fiddling around with the numbers, Turing could coax the system into behaving in all sorts of interesting and exciting ways. He called this idea a reaction-diffusion mechanism.

The long and short of it

"Turing's paper actually talked about four or five different kinds of reaction-diffusion mechanisms," says geneticist **Greg Barsh** at Stanford University, who studies how cats get their markings. "The one most people think about is the notion that if you have diffusible signals – activators and inhibitors – and with the right diffusion coefficients and activities, order will emerge over time."

The key is to have a "short-range activator" and a "long-range inhibitor." This means there are two morphogens; one that diffuses over short distances and stimulates the production of both molecules (the activator), and another that diffuses faster and further and slows production down (the inhibitor).

One way to think about how this works is from the perspective of the inhibitor. Like a sprinter released from the starting blocks of the cell in which it was produced, it races past the activator, forming barriers beyond which no more activator can be made. These zones can't spread too wide, however, because the inhibitor still needs the activator nearby, or it will cease to exist itself. This creates a kind of self-sustaining feedback mechanism.

Calculating what happens when this mechanism plays out on a two-dimensional surface like skin was beyond the computers of 1952. So Turing shrank the problem until he had a one-dimensional line of 20 cells joined end to end like a necklace.

Starting with both molecules spread evenly around the ring, but with some slight perturbations so they weren't completely uniform, Turing plugged his equations into the Manchester Mark 1 computer – quite a flex, by the way, since 15 years earlier he had come up with the concept of universal computation on which that machine was based.

As the simulation ran, the system spontaneously developed from an orderless distribution into an ordered stationary wave. The level of the activator in the cells formed a fixed pattern of peaks and troughs around the ring. You can think of it like the undulating curves of sand dunes; there would be a couple of cells with a high level, then the level would fall away until there was very little, before rising once more.

"To me, it's one of the most important papers in biology, even though a minority of biologists

are reading it," said Milinkovitch. "You start from something homogeneous. And then by itself, through just the noise that is in the system, you generate a pattern."

"This is mind-blowing. This is absolutely remarkable. And it was so much in advance of its time that this was completely ignored for decades."

Get on my wavelength

Presumably because of the heavy math and the fact Turing wasn't a trained biologist, his work ended up going under the radar of the wider biological community. It took until 1972 for it to be picked up by German researchers Alfred Gierer and Hans Meinhardt at the Max Planck Institute, and later by James Murray at the University of Oxford.

This new generation of researchers took advantage of the more powerful computers at their disposal to show what happens when reaction-diffusion is set to work on a 2D plane. You can actually play around with these **simulations yourself online.**

As the system is agitated, a wave spreads out in two dimensions. The resultant standing waves are more complex in 2D, and they produce spots of activity hemmed in by borders of inhibitor. Set up the system with a slightly different combination of reaction and diffusion properties, the same equations result in stripes.

The really cool thing here is that you don't need a new framework or mechanism to understand how these two different kinds of patterns come to be, you just need to have slightly different properties for the same interacting molecules, and hey presto, different forms will appear as if by magic.

Prediction time

The killer question, of course, is whether this is actually going on in real animals. If reaction and diffusion really are behind what we're seeing, the simulations should be able to predict specific features, not just vaguely look like a spotty or stripy coat.

One thing you see on a real cheetah, for example, is that it isn't spotty all over. As you reach the end of its tail, you find the spots start transitioning into stripes. You might think that means some different mechanism is at play in the cheetah's tail compared with its body, but it turns out that isn't the case.

It's a bit like a guitar string, where the note you hear depends on how long the string is, because the wave has to fit neatly between the two ends. Slide your finger down the neck to shorten the string, and only shorter wavelengths can play out. Turing's patterns work the same way, because the spacing between one peak and the next is set by what he called the "chemical wavelength" of the system.



> "THIS IS MIND-BLOWING. THIS IS ABSOLUTELY REMARKABLE. AND IT WAS SO MUCH IN ADVANCE OF ITS TIME THAT THIS WAS COMPLETELY IGNORED FOR DECADES."

On the broad canvas of a cheetah's body, there's loads of room for the waves to form a periodic pattern in any direction. But a tail has a much shorter circumference, which restricts how much space the wave has to form. At a certain point, the circumference drops below a minimum length, and vertical waves can no longer be produced, leaving only the waves that run lengthways, generating evenly spaced bands that form stripes.

There's also a second prediction, one that describes what happens when patterns bump into each other. For this, we're taking a detour away from big cats to look at another animal known for its strikingly patterned fur – the zebra.

On a zebra's flank, the stripes do their neat, orderly, vertical thing, which helps zebras blend in with the tall grass of the savannah. But just above the front leg, the stripes go a bit haywire, forming triangular, chevron-like shapes before transitioning into horizontal stripes on the leg itself.

It turns out this is also explainable with Turing's reaction-diffusion equations. When the pattern arrives at the shoulder as more than one wave coming in from different directions, they collide and generate a pile-up. Milinkovitch's group modeled what would happen if the body and leg stripes followed a reaction-diffusion mechanism, and they got something that looks startlingly like what is going on at the zebra's shoulder.

Written in the fur

The next step was to see if scientists could actually identify biological molecules that had the same, or similar, properties to Turing's hypothetical morphogens. While he kept the properties of morphogens plausible for real molecules, he didn't have actual examples to point to.

Some researchers, Milinkovitch among them, would argue that this doesn't matter. If the math reproduces the process and correctly predicts complex features, then it has already told you how the system works and the identity of the molecules doing that work is largely beside the point.

"We have to realize that it's not only by studying individual molecules that we will move forward, but also by studying the system. And sometimes we can study the system even by ignoring the molecules, and looking into the interactions and modeling it mathematically. It can be incredibly efficient," he said.

Image Credit: DenisaPro/Shutterstock.com

Others, however, would really rather have the molecules. Which brings us back to the cats, and to geneticist Barsh, who has spent years working out how tabby cats get their stripes.

To do this, Barsh's group looked at cat embryos' skin as it developed. Weeks before there was any fur, any hair follicles, or indeed any of the pigment cells that would eventually do the coloring, the skin had already sorted itself into alternating thick and thin regions – and those regions matched up with where dark and light markings would eventually turn up in the adult pattern.

> "IT IS LIKELY ANALOGOUS TO MECHANISMS THAT PLAY OUT IN A LOT OF DIFFERENT SCENARIOS, BUT THERE'S A LOT MORE TO IT, TO PATTERN FORMATION, THAN TURING."

"What we have shown is that at this stage, when there is just a single outer layer of cells in the epidermis, there are groups of cells that then produce different molecules from adjacent groups of cells in a very Turing-like way. And those groups of cells – defined by the genes they express, the molecules they produce – foreshadow the areas that will later give rise to black or yellow hair," Barsh told IFLScience.

When his team looked at which genes were switched on in those cells, one stood out. A gene called DKK4 was active in areas that would later produce dark fur and not in those that would produce lighter fur. DKK4 makes a protein that gets secreted from one cell, travels a long distance, and switches off a signaling pathway in the cells it reaches. Which is to say, it's a real molecule that acts like the hypothetical long-range inhibitor.

That's the kind of thing you can test. If DKK4 really is doing the long-range inhibition from Turing's equations, then weakening it ought to have a very particular effect on the pattern.

And, as it turns out, some cats have naturally broken versions of this gene. Barsh's group found two mutations that stop the protein getting out of the cell properly, meaning it becomes a slower, weaker inhibitor. When the team looked at a Savannah cat carrying one of these mutations, they found that the dark spots were smaller, more numerous, and closer together – exactly what happens if you reduce the power of the inhibitor in a reaction-diffusion simulation.

There's a second gene involved too, called Taqpep, which doesn't map quite so neatly onto Turing's design but seems to act as a modifier, reining in how far DKK4's influence extends. Break this gene, and you get the opposite situation: instead of crowding in, the dark spots sprawl outward and run together, which is, again, exactly what you'd expect to happen based on the math.

The broken Taqpep gene shows up in "blotched" tabby cats, which have less-defined stripes than normal tabbies, in "king" cheetahs where the spots swell and coalesce into stripes along the back, and also in rare pseudo-melanistic tigers, in which the stripes broaden and merge into one another.

"Work that we've done suggests that this mechanism does operate across all felids," said Barsh. "All 34 species of cats."

That said, biology is complex, and the specifics of what is going on in any animal probably don't amount to exactly one activator and inhibitor being responsible for the whole pattern.

Another issue is that the math requires a completely random distribution of molecules to start with. Real animals generally develop a succession of patterns, such as in zebrafish, which look one way as a juvenile before developing horizontal stripes as an adult. In this sense, the adult pattern departs a little from Turing, since it isn't developing out of pure noise.

What's fascinating is that Turing acknowledged these limitations from the outset, making clear in his paper that he was working under computational constraints that prevented him from taking into account the whole messiness of nature. Still, remarkably, he struck at the essence of how patterns form across a great swathe of the natural world.

"In terms of Turing, I would say, it's beautiful," said **David Parichy** at the University of Virginia. "I mean, it's inherently so elegant. It is likely analogous to mechanisms that play out in a lot of different scenarios, but there's a lot more to it, to pattern formation, than Turing."

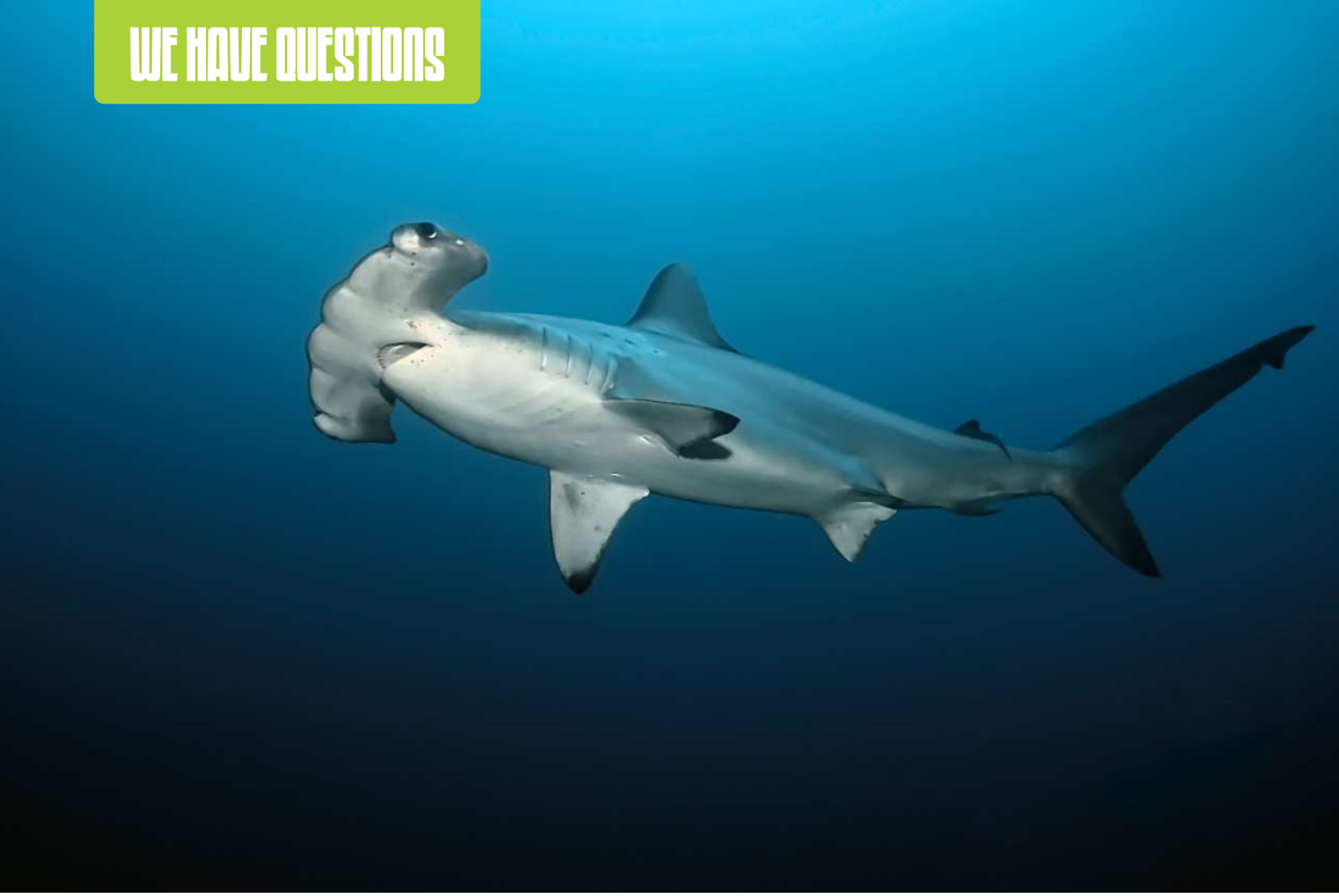
Image Credit: therealvector/Shutterstock.com, modified by IFLScience



FREAKY FERROMAGNETIC FLUID

No, that's not Venom. You're looking at ferromagnetic fluid, the invention of NASA's **Stephen Papell** in the 1960s. He was trying to figure out how advanced space missions could ensure fuel could be pumped into combustion chambers in zero gravity, and he figured magnetic fluids might be the solution. The fluid contains tiny iron particles that align with magnetic field lines when exposed to a magnet, forming spectacular spikes.

Image Credit: Free_styler/Shutterstock.com



WHY DO HAMMERHEAD SHARKS HAVE HAMMER-SHAPED HEADS?

It's high time you got to know the metal detectors of the sea.

By Rachael Funnell

Is there a more perfectly named animal than the hammerhead shark? It's a name that really hits the nail on the head, and – as I only recently learned – in more ways than one.

Hammerheads are pretty new on the scene as far as sharks go. They've only been around for about 20 million years, and in that time they've taken the shark body plan to new and unusual places.

To find out why such a wacky design proved to be so beneficial, I spoke to Professor **Stephen Kajiura**, a professor in the Department of Biological Sciences at Florida Atlantic University, who specializes in the sensory biology of sharks. As he told me, a wide old noggin is actually pretty great when you live like the metal detectors of the sea.

Why do hammerheads have hammer-shaped heads?

SK: There's no simple explanation. What we can do is come up with great little Rudyard Kipling *Just So Stories*. We can come up with explanations as to how it works and why it works, but what the actual story is is still to be determined.

Lay it on me.

SK: One of the ideas is that the hammerhead head shape confers an advantage when it comes to sensing the world. If you take the normal pointy-nose shark head and you stretch it out to the side, laterally expand it, you've spaced your eyes very far apart. You've spaced your nostrils very far apart. All sharks have electroreceptors that detect electric fields in the environment, and now you space those electroreceptors very far apart. You've basically made your narrow, pointy head a much broader head, so you're sampling a larger volume of the environment. And so maybe the broad head confers an advantage in terms of visual fields.

Image Credit: Nicolas-SB/Shutterstock.com



We looked at the visual fields of these hammerhead sharks. We'd anesthetize the animal and we'd put a little recording electrode on the cornea – it's called an electroretinogram – so we're recording the electrical activity from the retina when we shine a light on it. What we found was that the hammerheads have a significantly larger visual field with each eye than a pointy-nosed, normal-looking, conventional shark.

How does that affect their vision?

SK: It means that although they have large visual fields, they also have a blind spot right in front of their head where they can't see anything because their eyes are so far apart. So, as the hammerheads swim, they yaw their head back and forth, left and right, to a greater degree than would a more conventionally shaped shark. As a result of that, they're able to fill in that blind spot by first letting one eye see forward and then the other eye see forward. It reduces the blind area in front of them.

Any other sensory benefits?

SK: All sharks can detect electric fields in their environment through a special sensory system known as the Ampullae of Lorenzini. If you look at the head of a shark, you see these little pores all over the surface of the head – those pores open onto the external environment and they detect electric fields.

Let's say you had a little fish that buries under the sand. You can't see it, you can't smell it, it doesn't make any noise – there are no other cues. But the fact that fish is still alive means that it's maintaining concentrations of ions inside its body that are different from the external environment. It's basically a little battery.

The ions in its body are leaking into the environment through the mouth and through the gills. Those little charges that are pulsing in the water as that fish is breathing are what sharks and their relatives, the rays and the skates, can detect with their electroreceptors.

All of them can do that, but the hammerheads, because they have this big broad head, they have electroreceptors spread out over a much greater distance. It's sort of like going to the beach with a metal detector. If you have a little coil, it's going to take you forever to go across the beach. But if you have a big coil, you can cover a lot more ground much more effectively, much more quickly. That's basically what the hammerhead does. It has a big, giant metal detector head, and that enables it to sweep a broader swath of the sea floor in search of prey.

That's very cool.

SK: And here's where it gets fun. They have a bigger head, more surface area, so what they have is a much greater number of electroreceptors than a conventionally shaped shark. What that means is they have the same density, the same number of receptors per square centimeter, as a conventionally shaped shark. So, they're not losing anything by having a big, giant head. They're still sensing the same resolution as a pointy nose shark, but they're sampling a broader area.

And because their head is so broad, the electroreceptors inside the head can have tubes that are quite long. Sensitivity is a function of the length of the tube, and so the hammerheads can be exquisitely sensitive to these electric fields, more so than a conventionally shaped shark that, by necessity, has shorter tubes because its head isn't as wide. So, they're sampling a broader area with just as good a resolution, and they're doing it with even better sensitivity than a conventionally shaped shark.

When it comes to the broad hammerhead head shape, electroreception is another contender for how that could be an advantage and could be an explanation for the evolutionary drive to develop this big, giant head in the first place.

Any other *Just So Stories*?

SK: The next one that I think is fun deals with bigger hammerheads, like the great hammerhead. A couple of times now, people have documented that these great hammerheads are feeding on stingrays on the bottom, but what's particularly cool is they've seen these hammerheads use their big flat head to literally hit the stingray and pin it to the sea floor and hold it there while the hammerhead bites off the wings.

So, another function of this head is in prey manipulation. You can't do that if you have a pointy nose because it's going to slip out on either side, but if you have a big flat head, you can sort of hold them down and pin them in place.

We have Questions with IFLSCIENCE

Hungry for more CURIOUS questions? Head to the ***We Have Questions*** podcast for new episodes monthly.

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DEEP DIVE

SCIENCE FACT OR FICTION:

IS THERE A FIFTH DIMENSION?

The fifth dimension is probably not what you think it is, Dr Alfredo Carpineti explains.



Image Credit: sakkmesterke/Shutterstock.com



Do you wish to travel to a parallel dimension? Whether you do or don't, the question tends to conjure something in your mind. Is it a world like ours but with small or big differences? In the collective imagination, extra dimensions are seen as places, even places that could be real, but scientifically, things are very different.

Point, line, plane, and solid. Geometry is how we learn about dimensions. A point has none, a line has one dimension, a plane has two, and a solid has three. Then you might encounter algebra, and those geometric ideas are turned into the x, y, z… But why stop there? Math doesn't. You can, in fact, add an arbitrary number of dimensions to it. Even infinite if you want. You can describe them in mathematical terms, but those are just scratches on paper. Picturing them, well, that is beyond human capabilities. A feat akin to witnessing a cosmic horror.

After all, we humans are stuck in three dimensions. Well, that's what we thought before physics told us that things might not be as straightforward as what our senses suggest.

A whole new world

With the advent of relativity and quantum mechanics, our eyes were opened to a different world. Suddenly, reality existed in four dimensions, three of space and one of time.

Einstein's theory of special relativity in the early 1900s reshaped physics by linking space, time, mass, and energy in a universe governed by the speed of light. It also unified the three dimensions of space and one dimension of time into a four-dimensional continuum known as space-time.

The early 20th century was a period of profound change in physics. The development of relativity and quantum mechanics was a paradigm shift. The quantum revolution was ushered in by a novel understanding of light and particles, whose classical counterpart was simply the theory of electromagnetism.

Developed across the 1800s, electricity and magnetism were explained as interconnected phenomena that can be unified into a single theory (a success that is about to be relevant again in our stories). Particles have an electric charge, being positive or negative; their motion generates a current. A current generates a magnetic field, and the opposite is true as well.

Those considerations fell beautifully into the quantum theory. Light is how electromagnetism propagates, and it was Einstein who both demonstrated its quantum nature and its connection with space-time. Nothing can travel faster than light in our universe, a cornerstone of special relativity.

The extension of Einstein's theory of relativity to include gravity, and the leap in our understanding of the quantum nature of electromagnetism, happened shortly after. Then physicists set their eyes on a much grander idea: the theory of everything. If we have unified electricity and magnetism, why not add gravity to the mix?

If you have encountered the classical laws of gravity and electricity, you might have noticed that the equations look the same, once you swap the charge for the mass. You are not alone. Maybe there was a way to connect the two, and that led researchers to consider something very unusual. If the universe has four dimensions, why stop there?

"The original draw of the fifth dimension goes back to Einstein: physicists realized that extra dimensions leave signatures in our four dimensions," **Dr David Marsh** from King's College London told IFLScience.

"In particular, the original fifth dimension had properties that look in our four dimensions like electromagnetism."

A theory of everything?

In the early 1920s, Theodor Kaluza and Oskar Klein proposed a unified theory of gravity and electromagnetism. It suggested that along our well-established three dimensions of space and one dimension of time, there was an extra and extremely tiny dimension of space.

This theory was very exciting. It could reproduce the laws of general relativity and particles' electric charge would appear as a motion in this hypothetical fifth dimension.

Image Credit: sakkmesterke/Shutterstock.com

Finally, the two fundamental forces known at the time – gravity and electromagnetism – could be described with a single theory. Too bad, it was hopelessly wrong.

For example, the prediction of the mass of the electron by the Kaluza-Klein theory is off by a factor of 1 billion billion. We might want a theory of everything with a tad more precision.

Clearly, this was not the way forward for unifying the forces, especially since at the time, it was not known there were two more fundamental forces: the strong and weak nuclear forces. That quest is ongoing, and while the Kaluza-Klein hypothesis did not work, it was influential.

A fictional fourth dimension

Before we continue with the physics, we have to talk about society. The idea of a fifth dimension that exists as a physical, explorable place had to come from somewhere. As is often the case, it was literature that started it all, even though, ahead of Einstein's combination of space and time, the fifth dimension was actually thought of at the time as the fourth.

Edgar Allan Poe proposed four-dimensional space-time in his 1848 philosophical essay *Eureka: A Prose Poem*, where he also provided a solution to the Olbers' paradox: the reason for the darkness of the night. Neither had any mathematical backing, but the work was influential.

The father of electromagnetism, James Clerk Maxwell, wrote a poem in which he claimed that the secrets of the universe lie in a four-dimensional space. This was in 1878, decades before Kaluza and Klein thought of it as a serious scientific solution.

We then get to the 1880s, where this concept appears in Dostoevsky's *The Brothers Karamazov*, in Oscar Wilde's *The Canterville Ghost* (the ghost comedically exits through the Fourth Dimension of Space), and in the satirical novella *Flatland*, about a two-dimensional protagonist experiencing other dimensions.

The concept of a fourth dimension of space and/or of time later spread into science fiction stories like H.G. Wells' *The Time Machine*, satirical works, classics of literature such as Marcel Proust's *In Search of Lost Time*, and more.



Across the early decades of the 20th century, the idea as a plot device was already well established. With the scientific world providing new insights into the possible nature of it all, the idea flourished.

Stories of different times and different places existing in what appears to be the same locality, and simultaneously, have thrived since science has shown that time and space are both relative. The concept of alternative history gets folded in, and you have Star Trek's mirror universe and many more. Movies from *2001: A Space Odyssey* to *Interstellar* continue to explore the higher-dimensional physical environment.

Dimensions, despite having a very specific mathematical meaning became, through metaphors and analogies, a location. Somewhere that main characters visit or are aware of, a place for antagonists or allies.

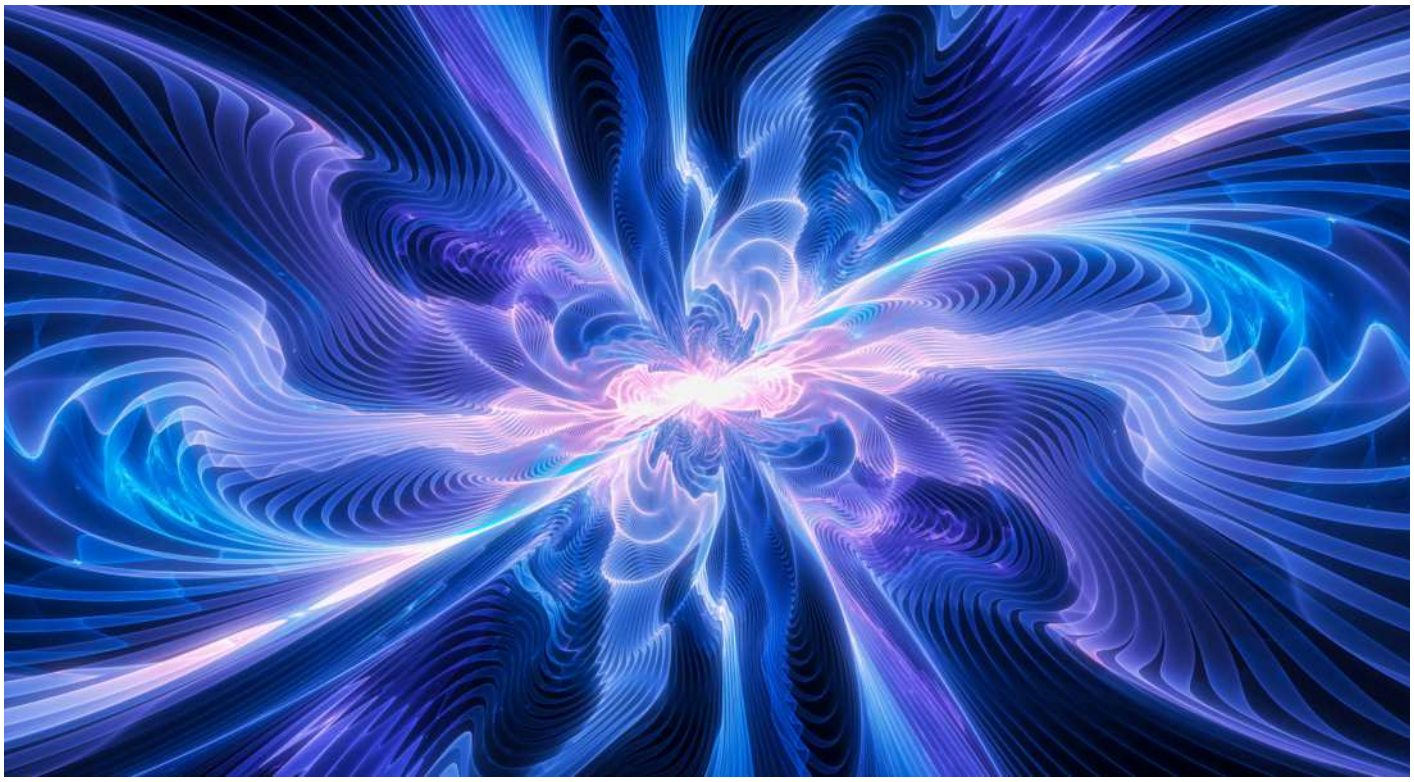
While the concept was flourishing in culture, it was only in the 1970s and 1980s that we also saw a resurgence in physics. The reason for it was, once again, the theory of everything.

A grand unified theory

Since their inception, general relativity and quantum mechanics have achieved successes in explaining reality in their respective domains. The problem was putting them together.

Black holes and the Big Bang itself revealed that these incredible theories are successful in their specific realms, but they break down at the extremes of the universe, where they should work together but don't. In search of a solution to bridge the gap between the two, extra dimensions became once again relevant.

Image Credit: sakkmesterke/Shutterstock.com



Proposals for these grand unified theories do not need to have extra dimensions, but several do. Among them, there is supergravity, the extension of a hypothesis known as supersymmetry, which has been proposed to explain certain properties in particle physics that currently have no explanation. That includes dark matter, the hypothetical substance that is believed to outweigh five-to-one the regular matter that makes us, planets, and stars.

Supergravity needs to explain not just gravity but all the forces, and the extra dimensions are needed to make the whole ensemble mathematically consistent. Without them, the theory produces some anomalies that break it.

For most people, though, the concept of higher dimensions comes from the popularization of string theory, one of the leading candidates for the theory of everything.

String theory is the idea that everything in the universe is made up of tiny, vibrating one-dimensional strings smaller than atoms, electrons or quarks, instead of standard point particles. A lot of string theory descriptions require at least 10 dimensions; however, to unite them all under a single one, it requires 11 dimensions (or up to 26, but we are not going to get into that).

But, testing string theory in the lab has been beyond our technology. The strings are too small to be detected by particle accelerators on Earth. Researchers like Dr Marsh are hoping to find evidence supporting string theory in the cosmos.

Without experiments, string theory is just an interesting idea. Marsh's work is exciting because he's trying to bring the "untestable" theory into the realm of things that we can test. There could be astrophysical phenomena impacted by string theory and that's what Marsh is looking for.

"My work is about experimental consequences, in a precise way, of the extra dimensions of string theory," explains Marsh.

"In one example, we searched through many extra-dimensional models and identified a tiny subset of candidates that could explain an anomaly in cosmic structure formation called the Lyman-alpha forest by the way in which the extra dimensions predict a sub-component of wave-like dark matter."

The dark matter in question is known as axions, particles with so little mass and so spread out in the universe that their wave nature becomes a dominant effect, more than their particle nature. In nature, everything is both particle and wave.

The signal might be hiding in the Lyman-alpha forest, which is not a real forest, but a particular signal we get from very distant galaxies and quasars, the very bright state of active supermassive black holes. It's only now we have the tools to investigate.

"Theories of extra dimensions make precise and understandable predictions about, in my interest, particles called axions. These predictions are falsifiable, and we are just learning now how to use new computational tools to realise this dream," Marsh says.

It would be quite something finding evidence for both dark matter and string theory in a single go.

A quarter of the way into the 21st century, over 130 years since the first literary suggestions of an extra space dimension, the idea of a fifth – and more – dimension is alive and well in both science and art.

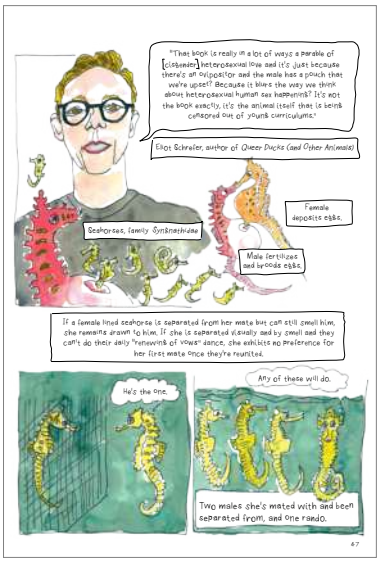
If this concept is a reality or a literary mechanism, only time will tell, and if Marsh and collaborators are right, we'll get there with a little help from the most distant active supermassive black holes.

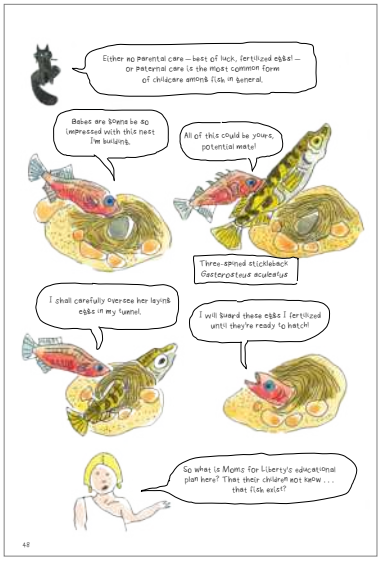
Image Credit: sakkmesterke/Shutterstock.com

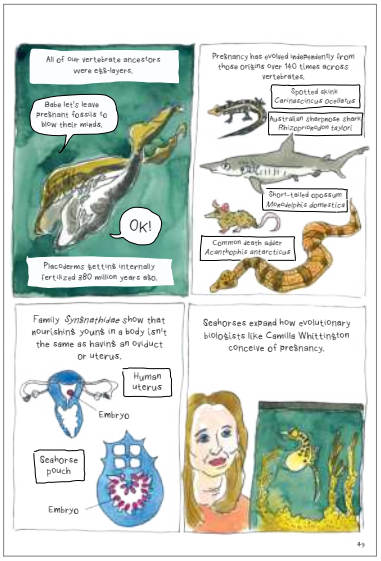
QUEERING FATHERHOOD

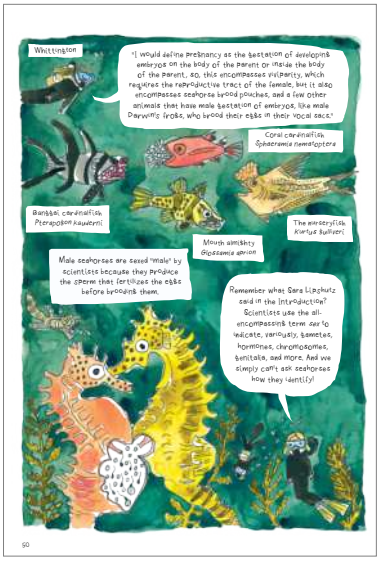
In this illustrative excerpt, author of *Poking The Squid* Perrin Roosevelt Ireland outlines how fatherhood comes in many forms in the animal kingdom.

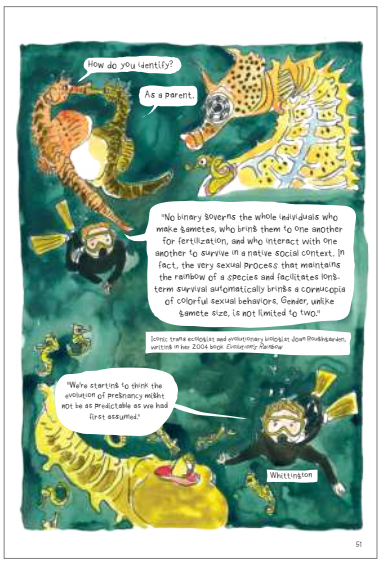


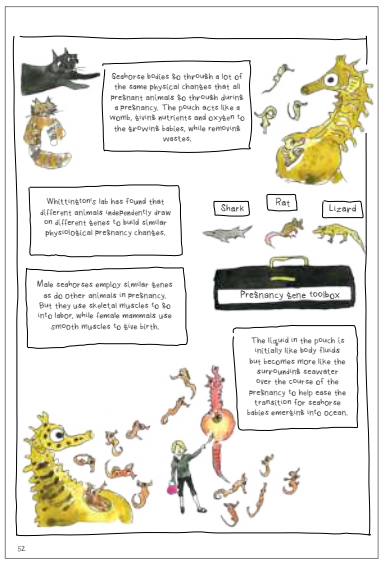


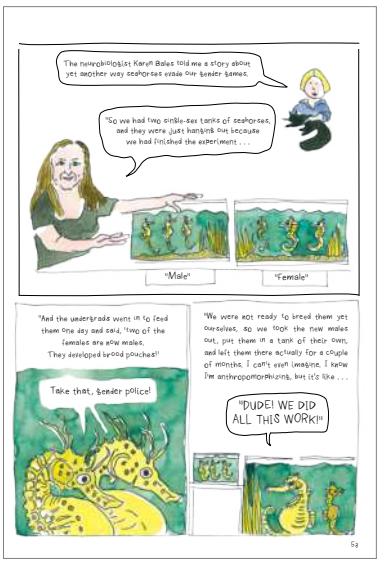












Credit: Excerpted from *Poking the Squid: What We Can Learn Animal Sex*. Copyright © 2026 by Perrin Roosevelt Ireland. Used with permission of the publisher, W. W. Norton & Company, Inc. All rights reserved.



Q&A WITH

PERRIN ROOSEVELT IRELAND

AUTHOR OF:

POKING THE SQUID: WHAT WE CAN LEARN ABOUT ANIMAL SEX

Why should we care about the sex lives of animals? As the author of *Poking the Squid*, Perrin Roosevelt Ireland makes a great case: it's a powerful reminder of the dizzying number of ways there are to live on Earth. What a wonderful world worth fighting for, then, eh?

Why so drawn to animal sex?

Animals are sexual geniuses. Spending time with the immense array of sexual diversity in the animal queendom is a fun way to stay engaged in activism against the biodiversity crisis. Penis-fencing flatworms? Marsupials with a four-headed penis who only use two heads at a time? Vaginas with dead ends and cul-de-sacs? 50-year-long seabird relationships? There's something for everybody, and I want a world where critters get their rocks off in as many ways as possible. Don't you?!

Favorite fact?

Alligators, alpaca, brown rats, and many species of snakes have clitorises. But scientists didn't publish the official report detailing the anatomy of the snake "hemiclitores" until 120 years after the first detailed description of snake penises. When we study female genitalia, we realize female animals are active agents in their sex lives.

How did drawing bring the subject to life?

Drawing things is a way for me to express my devotion and love to them. To draw something, I need to attend to it deeply, and that changes me; I emerge from making a drawing with more reverence and respect for what I've drawn. Working in watercolor and pen on sketchbook paper means I get to practice everywhere. As someone who has taught people drawing my whole career, having a low bar to entry on materials and being able to have a pop-up studio anywhere is important to me. But I also work on bigger pieces at my studio. Lately I've been painting underwater murals on sheets from the thrift store.

Why make this book?

First, what we think about animal sex is what we think about ourselves, our sex lives, and our bodies. Even though the scientific process is built to be as impartial as possible, it's a political discipline because humans are the ones driving it. The questions scientists ask, the conclusions they draw from their data, and how that story gets circulated within science and to the general public reflects our cultural norms, laws, viewpoints, and experiences. For example, humans have been obsessed with studying animal monogamy, but until recently, hadn't studied female animal anatomy very much at all. Second, having more diversity in who makes science means we see animals better. The book features an incredible group of scientists trying to understand animal sex. Whether they're making vaginal popsicles with dental silicone or video recording worms sucking sperm out of their bodies to avoid getting pregnant after sex, these scientists should be worldwide celebrities.

Why should everybody know about animal sex?

Climate change has already impacted animal sex and changed mating patterns. Scientists have observed that albatrosses, a species that historically mates for life, have seen a large uptick in "divorce." After studying a colony on the Falkland Islands, scientists discovered that "divorce rates" are higher in years when the ocean surface temperature is warmer. Scientists cite a "partner-blaming hypothesis": they think females blame their increased hunger and stress on their mate, when, sadly, human activity is the ultimate culprit. I think understanding how animal sex that we admire or delight in is endangered by our behaviors helps us grow our investment in protecting sexual diversity as a form of biodiversity.

What can we learn from its complexity and diversity?

There is not a mutually agreed upon scientific definition of "sex." Spending time with the diversity of animal sexual expression allows us to learn from nature that sexual variables do not always align in the same repeatable ways. But the term "biological sex" is being weaponized outside of the academy right now, to extreme detriment to the lives and wellbeing of trans people, LGBTQ people, and all women. Science needs to grapple with its role in the discrepancy between what is being claimed about "biology" and what the study of biology is actually finding about sex.

***Poking the Squid: What We Can Learn Animal Sex* is published by W. W. Norton & Company, Inc. and available now.**

Image Credit: Frances F. Denny

WHERE ON EARTH



Do you dare dive into Cenote Angelita? Divers are swallowed by an underwater cloud lurking at the bottom of this 60-meter-deep (197 feet) sinkhole. Ghostly trees can be seen emerging from the fog below, so what causes this unusual natural phenomenon?

By Rachael Funnell

Image Credit: Marianna Tombini/Shutterstock.com



THE WORLD'S CREEPIEST CENOTE

Around 66 million years ago, an asteroid changed the face of Earth forever. Splashing down in the shallow sea that became the Yucatán Peninsula, it left a pockmark on the Earth in the form of the Chicxulub Impact Crater, which we only found in 1978.

It took us so long because it was buried under a thick blanket of limestone rocks. It's this characteristic of Mexico's geology that explains why the place is peppered with cenotes.

Cenotes are natural freshwater sinkholes that form when the roof of a limestone cave collapses, creating an opening into a deep pool of water. The limestone collapses as a result of rainwater absorbing carbon dioxide and becoming mildly acidic. As it leaks through the limestone, it gradually erodes calcium carbonate until caves appear. When one of those caves loses its roof? Hey presto! You have yourself a cenote.

There are thousands of cenotes in Mexico, but among them exists an especially spooky sinkhole: Cenote Angelita.

It's found near the ancient Mayan city of Tulum on the peninsula's east coast. Cenote Angelita means "little angel," though you might not feel as if you're drifting towards the heavens when you dive in.

Divers brave enough to venture into its depths find themselves faced with a perplexing image. The cenote appears to fade into smoke, and branches can be seen emerging from below. Is it a lake within a lake? An underwater cloud? The answer is much saltier.

Cenote Angelita has crystal-clear waters in its upper 10 meters (30 feet) due to the purifying quality of limestone. This means divers have excellent visibility up until they come across a layer where freshwater meets saltwater – something that's known as a halocline.

A 3-meter-thick (10 foot) layer of hydrogen sulphide gas sits between the two layers, and this is what appears like a cloud in the water. According to Canadian videographer **Mike Corey**, who has dived Cenote Angelita, "Once through, it turns into a night dive, and you need to use your torches. You only have a few minutes beyond the layer before you have to start ascending again. It's a murky landscape, with petrified trees sticking out of the cloud."

"Mayans believed that cenotes were the gateway to the underworld, and yeah, after visiting this one in particular, I can see why."

The branches cutting through the layer of toxic gas are trees that have fallen into the cenote. And they're not the only thing we've found inside these sinkholes.

The water quality of cenotes means they preserve organic remains exceptionally well, slowing decomposition and protecting carcasses from scavengers. As a result, we have found all sorts of interesting things in their depths, including the fossil of a **giant sloth**.

Who knows what secrets are lurking beneath Cenote Angelita's shroud of poison gas…

Image Credit: IFLScience



LISTEN

WE HAVE QUESTIONS

Podcast from IFLScience

Did AI conspire to kill the Queen of England? In 2021, a young man named Jaswant Singh Chail made the news in the UK for breaking into Windsor Castle with a crossbow with the intention of killing the Queen. What wasn't in the headlines was that his assassination plan wasn't hatched alone.

Chail had been speaking with an Artificial Intelligence "girlfriend" in the months leading up to the attack. A virtual companion on the site Replika had encouraged his plans to assassinate the Queen. In this episode of *We Have Questions*, host Rachael Funnell asks Professor Hannah Fry – presenter of *AI Confidential* – who is responsible both legally and morally?

Available Aug 24.



WATCH

THE END OF OAK STREET

Film by Warner Bros

Who among us hasn't daydreamed of visiting Jurassic Park? A day out to the captive Cretaceous – what could be better? Those same dinosaurs might not be so fun if they were to, say, be running around your neighborhood. If you fancy watching Anne Hathaway and Ewan McGregor face up to that exact conundrum, this is the film for you.

In cinemas Aug 14.



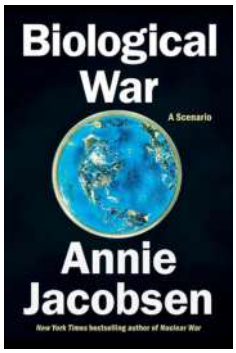
FINANCE

WORMING FROM HOME

Game from Zach Northrop

Tired of tapping away on your keyboard? We get it. So, here's an opportunity to instead #RiseAndGrind by hurling your invertebrate body across the keyboard to buy, buy, buy – sell, sell, sell. Become The Worm Of Wallstreet.

Launching summer 2026.



READ

BIOLOGICAL WAR: A SCENARIO

Book by Annie Jacobsen

Jacobsen returns following her deep dive into **nuclear war** with a look at how a lab accident or bio-attack could lead to a global pandemic and ultimately the collapse of society. From mass death, widespread insurrection, and anarchy, it's a frightening fate. Are we doing enough to prevent it?

Available now.

WATCH

THE DOG STARS

Movie from 20th Century Studios

Based on the novel by Peter Heller, this post-pandemic adventure sees pilot Hig (Jacob Elordi) team up with a gun-slinging neighbor to defend an old airfield. As he struggles to adapt to his new normal, a mysterious radio transmission raises questions as to whether a better life could be waiting just out of reach.

Available Aug 28.



LISTEN

THE BIG QUESTIONS

Podcast from IFLScience

In the latest episodes of season 6, catch Space Editor Dr Alfredo Carpineti on Aug 13 asking, Can AI Be Conscious? Then on Aug 27, Health & Medicine Editor Laura Simmons explores, What's The Next Frontier In Dementia Research?

Find all episodes here.

SURVIVE

BEAST OF REINCARNATION

Game from Game Freak Ink.

With all this talk of the apocalypse, we figured you might like to have a stab at seeing how well you would survive the end of the world. How better to find out than with canine companion, Koo. Explore the ruins of the world you knew as Emma in this expansive role-player game.

Available Aug 3.

Image Credit Left: IFLScience, Center: Torva, Right: IFLScience

IFLScience Hits The Red (Green) Carpet

Josh Davis heads to Leicester Square for the ultimate "How To Video"



What if we had a manual to save the Earth?

Well, if Benedict Cumberbatch's film is anything to go by, maybe we do.

Last month, IFLScience got invited to the world premiere of the climate documentary *How to Live On Earth* at Leicester Square, London.

Walking the green carpet (well, it had to be, didn't it?) along with climate activists, filmmakers, and the odd celeb all dressed in their fanciest finery on one of London's hottest days, the irony wasn't lost.

Settling down in front of the screen, we were first entertained by the fun, if slightly unsettling, tunes of a traditional cinema organist playing all the classics like *Pearl & Dean* and *Jurassic Park*. This eventually gave way to a few introductions by the likes of Julia Marton-Lefèvre, the former Director General of IUCN, and none other than the voice and narrator of the film itself, actor Benedict Cumberbatch.

The film opens with the extraordinary scenes of Chinese farmers clambering through the branches of pear trees with feather dusters to pollinate the flowers and enable the trees to grow fruit. This is then juxtaposed with a new technological development: drones.

New tech, putting old farm workers out of work. But this shouldn't have been the case in the first place, as nature had already engineered the perfect solution to pollination before the spread of industrial farming and pesticides killed off all the local bees.

"Is this how we want to live on Earth?" asks Cumberbatch.

Despite the rather bleak opening, *How to Live on Earth* takes a slightly different approach to climate films that have come before it. Rather than focusing on the doom and gloom aspects of the crisis we're facing (although, to be honest, there are still enough montages of deforestation and flooding in the film), it instead looks at the more positive actions that individuals and communities can take.

There is a community in the US that is fighting for the removal of dams to allow for the river to, once again, run free. A climate activist from Mexico looking for ways to make large businesses pay for the protection of her homeland. And a chef, exploring the alternatives to the highly destructive production of beef throughout the Amazon rainforest.

Don't get us wrong, it will still require top-down measures to solve these problems, but as a way to spread a little hope and maybe some encouragement, it manages both.

Image Credit: IFLScience

DATES TO REMEMBER

CURIOUS TURNS 4!

August marks four whole years of your favorite science e-magazine (we can't believe it either). To mark the occasion, why not treat yourself to a look back at some of our iconic **previous issues**?

2026 AUGUST

This month, there's plenty to see if you look up: a total solar eclipse (don't forget your eclipse glasses), a partial lunar eclipse, a next-generation telescope taking to the skies, and the best meteor shower of the year.

NATIONAL IMMUNIZATION AWARENESS MONTH

In the US, National Immunization Awareness Month is an annual observance that highlights the importance of vaccination for people of all ages.

1
WORLD WIDE WEB DAY

9
INTERNATIONAL DAY OF THE WORLD'S INDIGENOUS PEOPLES

Despite their invaluable impact, Indigenous Peoples are among the most vulnerable groups on the planet, hence August 9 is designated to raise awareness for their protection.



13, 27
NEW THE BIG QUESTIONS PODCAST EPISODES!

We're exploring whether AI can be conscious and diving into the next frontier in dementia research.

12
TOTAL SOLAR ECLIPSE

If you're in Spain or Iceland, don't forget your eclipse glasses!

12
PERSEIDS PEAK

The "best meteor shower of the year" will peak overnight on August 12-13, offering excellent viewing conditions this year thanks to the New Moon ensuring dark skies.

19
WORLD HUMANITARIAN DAY

30
NANCY GRACE ROMAN TELESCOPE LAUNCH



24
NEW WE HAVE QUESTIONS PODCAST EPISODE!

Did AI encourage an assassination attempt on the Queen of England? This wild story explores the dangers of thinking chatbots are your friends.

28
PARTIAL LUNAR ECLIPSE

This is a very deep partial eclipse, with 96.2 percent of the full Sturgeon Moon in Earth's dark umbral shadow instead of the usual 93 percent.

30
FRANKENSTEIN DAY

What would have been Mary Shelley's birthday is now an annual (unofficial) celebration of her beloved 1818 novel *Frankenstein; or, The Modern Prometheus.*

Image Credit Top Center Left: IFLScience, Right Top: IFLScience

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

Choose how you end each issue. For those who prefer the darker side, Josh Davis explores how even the zombie fungus that infects insects must look out for itself. If you like your science lighter, perhaps we can interest you in pigeons that have jobs? Find out what these feathery researchers are discovering for science.



EXPLORE YOUR SIDE ON FACEBOOK

WHAT PARASITIZES THE PARASITES?

In the depths of the rainforests of Borneo, there is a mind-controlling parasite.

Known as ***Ophiocordyceps***, or the zombie fungus, this organism not only infects its insect host with spores but then proceeds to send out root-like mycelium into their bodies, seizing control of their nervous systems.

The parasite strips the host of its instinctive fear of heights, encouraging the insect to climb to the highest point of the nearest plant and making it clamp its jaws around the stem in a death grip.

This is when the fungus starts to grow mycelia around the feet of the insect, stitching it to the plant. A fruiting body then sprouts from the carcass of its host, growing antenna-like structures that release countless spores into the air to float down and infect new victims.

But it turns out that the zombie fungus is not top of the food chain.

Scientists have described a new species of what they call a "hyperparasite". While looking at a zombie-infected insect, they discovered a second type of fungus growing not on the flesh of the bug, but on the *Ophiocordyceps* itself.

"Rather than manipulating the insect's nervous system itself, *Pleurocordyceps* infiltrates and feeds directly on the thriving *Ophiocordyceps* tissue inside the host," said Jaya Seelan Sathiya Seelan, the deputy director of the University of Malaysia Sabah's Institute for Tropical Biology and Conservation, **to AFP**.

"These newly documented fungi hold immense potential... both as sources for developing next-generation antimicrobial drugs and as highly effective biocontrol agents against agricultural pests."

The new species has been named *Pleurocordyceps cornusynnemata*, after its unique, horn-shaped structure.

But it is not alone with its hyperparasitic lifestyle. Also known as "metaparasites" (although we could think of a different definition for that word), it is particularly well known within wasps. In this case, a caterpillar is infected by a parasitic wasp, which in turn is infected by a second species of parasitic wasp.

In other twisted relationships, there are plants known as ghost flowers that indirectly parasitize trees by tapping into the network of fungi that runs through the soil. By doing this, they don't actually need to make their own energy and so have even lost the ability to produce chlorophyll.

But sometimes it doesn't stop there. In one extraordinary case, a fungus has been found infecting a fungus that infects a fungus that infects a tree.

It's parasites all the way down, baby.



The Darker Side of Science

DR PIGEON IS READY TO SEE YOU NOW

Far from pecking about in the streets, pigeons are being put to work in a variety of scientific jobs.

Scientists have been using pigeons to better understand how birds' vision works while on the wing, in the hope of improving the way in which drones can fly.

They did this by giving homing pigeons little headsets and backpacks, before filming them as they soared across the landscape as they returned to their roost. They found that rather than keeping their eyes steady as they flew, the pigeons made slow, subtle eye movements.

The researchers suspect that this is because the pigeons are compensating for the visual motion while flying, potentially as they try to resolve finer details of the landscape to aid in navigation. This new information could help better design drones, which up until now have had fixed cameras.

Pigeons have been employed to do all sorts of other jobs too. During World War I and World War II, military pigeons were specifically bred and trained to carry messages by the Australian, French, American, UK, and German forces.

Soldiers on the front lines would place messages in little canisters attached to the carrier pigeon's legs, and the birds would then return to their home coop. When they landed, the pigeons tripped a wire that sounded a bell or buzzer to alert the monitoring soldiers.

But these birds weren't confined to the trenches. They joined the artillery division and were carried in tanks to be released through portholes, and were recruited into the navy to be taken aboard an aircraft carrier (to limited success). The most extreme pigeons were drafted into the Air Force.

These daredevil pigeons were carried in airplanes to rapidly return messages mid-flight. Depending on the aircraft they were flying, the airmen in charge had to learn to throw the pigeons either up or down in order to keep the pigeon out of the propeller and away from the airflow that might suck the pigeon into an untimely death. Project Pigeon even tried to **train birds to guide bombs** during WWII.

Pigeons have also been trained to become doctors, sort of. It turns out that the birds can be taught how to successfully identify **cancerous breast tissue** from microscope images. They can distinguish between cancerous and non-cancerous tissue at a variety of magnifications, compression levels, and even in black and white.

After just two weeks of training, the pigeons were about 85 percent accurate in their diagnoses, and when these were pooled into a "flock-sourcing" approach that combined to a rather impressive 99 percent accuracy.

Not so bird-brained after all.



THE LIGHTER SIDE OF SCIENCE