

CURIOS

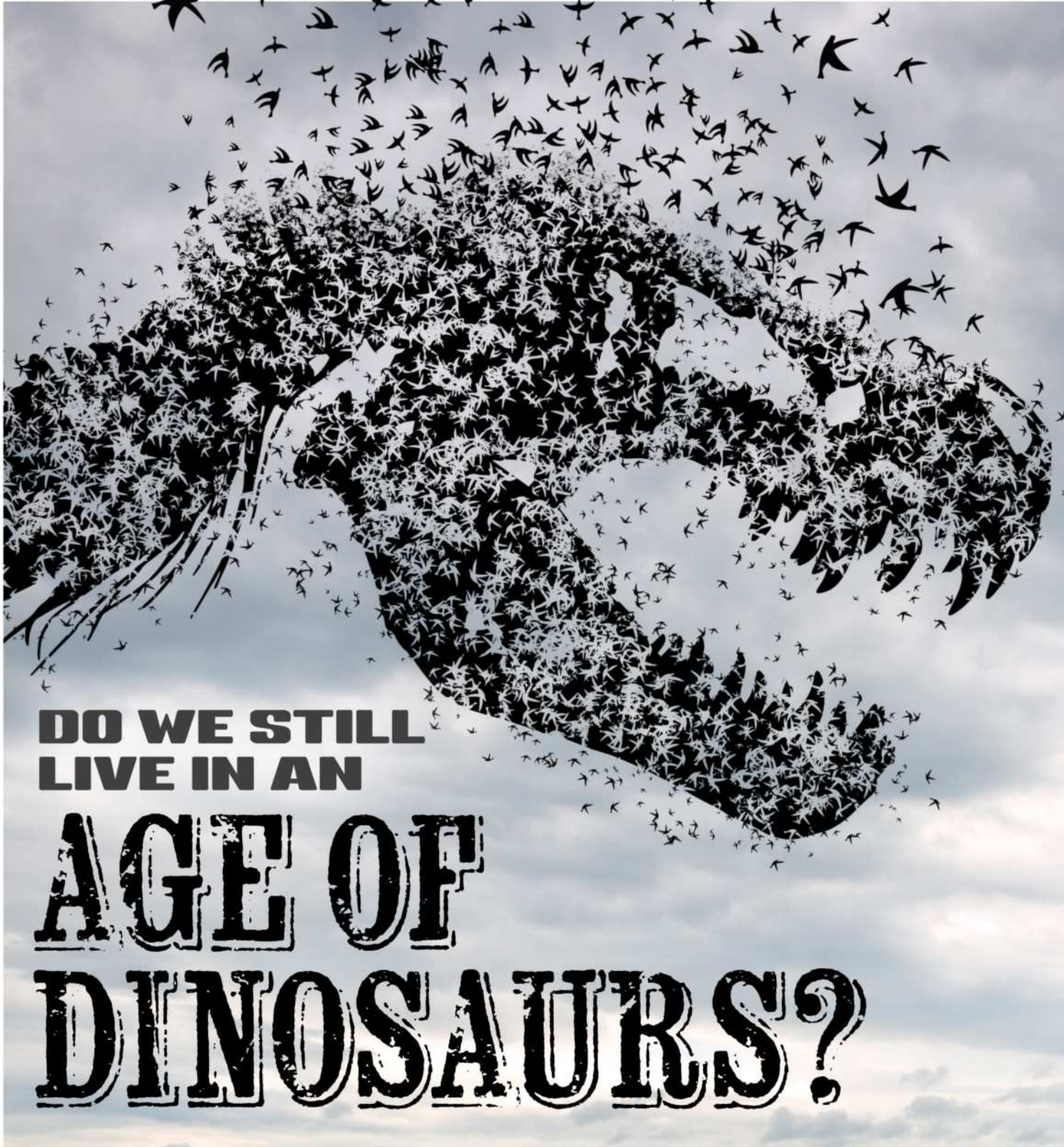


DO ANIMALS USE MEDICINE?

HOW DO YOU BEGIN
SEARCHING FOR ALIEN LIFE?

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LIVE IN AN

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NEWS BITES



Follow Ariane 6 Launch Live With IFLScience!

On July 9, the European Space Agency (ESA)'s brand new heavy-lift rocket Ariane 6 will fly for the first time – and IFLScience will be right there reporting live from the historic launch. Join us at the launchpad in Kourou, French Guiana, as we follow the exciting journey of this brand-new rocket to space. The latest in next-generation rockets, Ariane 6 has been a long time coming and is mostly comparable to SpaceX's Falcon Heavy. The versatile rocket can launch multiple satellites in a single flight or provide the heavy lift to launch a mission to the Moon. The engine in its upper stage can also ignite and re-ignite four times. Ahead of launch, IFLScience **spoke** to ESA director Dr Josef Aschbacher about plans for the rocket and why it's a big deal. Put July 9 in your diary and follow us on socials to be there when it all happens.



Summer Sci-Fi Blockbusters

It's not a secret that here at IFLScience we love a ridiculous disaster movie, especially when it stars a weather phenomenon gone rogue. This July, *Twisters*, the unexpected sequel to the delightful 1990s *Twister*, is set to storm (yes, we went there) the screens as people who should know better are back trying to test a new tornado tracking system out in the field. Storm chasing social media stars and reckless science ensues. July also sees the 55th anniversary of the historic Apollo 11 first Moon landing and the release of *Fly Me To The Moon*, a big-budget comedy-drama set against the high-stakes Space Race of the 1960s. As NASA gears up for the first Moon landing, a lack of public backing means bringing in a hotshot marketing whizz to drum up support, culminating in filming a backup "Moon landing" in case the real mission fails. Of course, **we know it doesn't** – but it's a fun what-if.

New Star In The Sky

We're about to get a new "star" in the sky by the end of this decade courtesy of NASA and a first-of-its-kind mission. This will see a bread box-sized "artificial star" satellite launched into orbit that will "shine" by pointing lasers at telescopes back on Earth. Using these lasers, it can mimic any type of star or supernova across the cosmos. It will be placed in what is known as geosynchronous orbit, meaning its speed will match Earth's spin so it will appear fixed in the sky – in its first year, that will be somewhere above the US. The artificial star will allow astronomers to calibrate telescopes and more accurately measure the brightness of nearby stars. The precise measurements may even help us pin down the speed of the universe's expansion. Alas, it will be too faint to see with the naked eye but easy enough for moderate-sized telescopes.

Bee Logical

Wild bumblebees are capable of logical reasoning, new research has found – a first for inferential reasoning in insects. "Critically, inferential reasoning is a type of logical reasoning that allows organisms to solve problems with incomplete information," lead researcher Dr Gema Martin-Ordas **said**. "This is the first time that this ability is shown in invertebrates, specifically in insects, and questions whether language or big brains are required for this ability." Inferential reasoning is one of the markers of human cognition and is usually considered language-dependent. However, these little guys' determination to puzzle out getting a sweet treat shows that they're capable of complex logical reasoning, too.



Noah's Ark For Corals

As the world is currently experiencing a **fourth global coral bleaching event**, scientists are building a "Noah's Ark" for rare, threatened coral species, not dissimilar to the Svalbard Seed Vault, more commonly known as the Doomsday Vault. The Netherlands' Royal Burgers' Zoo ("burger" is Dutch for "civilian") has just placed the first corals from the World Coral Conservatory project in its ark/aquarium. Burgers' Ocean holds 2.1 million gallons of water and has the largest living reef in Europe. The corals from the Seychelles will be protected here, but will hopefully be able to leave the "ark" one day, with the plan to return them to their natural environment in years to come.



Two Years Of JWST

This month is the second anniversary of the first science from JWST, when it sent back those **first incredible images** and changed astronomy and the way we view the universe forever. Since then, it has revealed the wonders of the cosmos in ways better than even the most ardent JWST researcher could hope for, and NASA and ESA are set to celebrate by releasing even more stunning views, though the targets are still a secret. Last year, the team released an **incredible image** of the Rho Ophiuchi cloud complex, the nearest star-forming region to Earth. All of JWST's images are available to view **here**.

WHAT'S UP?



The Perseids

AKA the best meteor shower of the year

Name: The Perseid meteor shower

Appearance: An abundance of shooting stars

Location: The night sky, best seen in the Northern Hemisphere

Go on then, tell us why they're the best out of all the meteor showers.

If we're measuring "best" by the sheer frequency of meteors seen, the Perseids easily take the title – at its peak, you can see up to 100 meteors per hour. Then there's the fact it often produces fireballs, it happens in the summer so you don't freeze your tits off watching them, and it's also the only meteor shower to have delayed the launch of a space shuttle.

Ok, so it's pretty impressive. But what's with the name?

It's to do with where they appear to originate in the sky – the constellation Perseus, named after the hero from Greek mythology.

So, if they don't come from there, where do they come from?

A rather hefty periodic comet called 109P/Swift-Tuttle, which visits

the inner Solar System every 133 years. It's not the most considerable cosmic body, as it leaves a trail of debris behind it. Every year, the Earth passes through this field of dust and as the fragments collide with our atmosphere, they fall apart and create the colorful streaks of light seen in the sky.

Is there any folklore surrounding the shower, like with comets?

Yes, although it's less bad omens and more bonkers. The Romans, for example, thought that the peak of the shower was the god Priapus ejaculating over the fields in order to fertilize them every year.

When can we see this year's "ejaculation"?

First: please don't call it that. Second: this year's Perseids will be active from July 17 through to August 24, although the peak is set to fall on August 12. Any time between midnight and 5:30 am, get yourself somewhere with minimal cloud and light pollution, and you'll be in for one dazzling display.

OUR COVER STORY



DO WE STILL LIVE IN AN AGE OF DINOSAURS?

We talk about it like they all went extinct.

By Rachael Funnell

Image Credit: James Rodrigues, xxmmxxi/Stock

Were you to visit a wealthy philanthropist's dinosaur island, you'd no doubt feel cheated to find yourself faced with an ostrich. It might not be as fearsome as *Tyrannosaurus rex*, but John Hammond wouldn't technically be conning you out of your price of entry. After all, birds are dinosaurs.

The "wonderchicken" was among the first crown birds to emerge from the dinosaur lineage, living just before all the other dinosaurs were wiped out 66 million years ago. What defines it as one of the oldest known birds is that it shared a common ancestor with all birds alive today, touching a group that's home to more species than mammals. If that's the case – did the "age of dinosaurs" ever really end?

All birds are dinosaurs, but not all dinosaurs became birds

If you think of a pigeon whilst holding a figurine of *Brachiosaurus*, the concept that birds are dinosaurs seems laughable – and with good reason. Those long-necked vegetarian giants hail from a group of dinosaurs known as Sauropodomorpha, one of the three main clades of dinosaurs. You also have the Ornithischia, whose name literally means "bird-hipped". Somewhat ironic, because this group doesn't contain birds either.

Take a look at the third main clade, Theropoda, and things start to get interesting when it comes to the "birds are dinosaurs" idea. Among that diverse group of bipedal animals – which means walking on two legs, just like a pigeon – we have the Tyrannoraptorans, encompassing *T. rex* among many other Theropod groups and species.

One of those is the Aves, a crown group of warm-blooded vertebrates that includes birds and their closest relatives. One of its oldest members is *Archaeopteryx* – a small flying dinosaur that also qualifies

as a bird. It's considered a **link between reptiles and birds**, as well as being one of the most important fossil finds in palaeontological history.

As we continue along the Aves family tree, we encounter Anseriformes, better known as waterfowl, and Galliformes, which includes gamebirds like pheasants and chickens. Eventually we come to Neoaves – an incredibly diverse group that contains almost every other living bird you can think of (bar ratites – those flightless, long-necked big boys).

***IF YOU WANT TO SOUND REALLY SMART
YOU CAN DECRY YOUR HUMBLE PIGEON
A PENNARAPTORAN TYRANNORAPTORAN
THEROPOD SAURISCHIAN DINOSAUR.***

It's not the easiest family tree to visualize, but handily, it is one that Field Museum palaeontologist **Dr Jingmai O'Connor** went to the trouble of mapping out on a chalkboard for **WTTW**. Follow that chalk demonstration and you'll see clear as day that yes, birds are dinosaurs, and if you want to sound really smart you can decry your humble pigeon a Pennaraptoran Tyrannoraptoran Theropod Saurischian dinosaur. Good luck down at the pub with that one.

Animals of a feather, flock together

That groundbreaking discovery of *Archaeopteryx* marked the first time we'd found an avian dinosaur with feathers back in 1861, however, we now know that feathers weren't unique to this group. The first non-avian feathered dinosaur cropped up in 1996 at a time when we were still arguing whether birds were dinosaurs or not. It was called *Sinosauropteryx*, a compsognathid dinosaur (think the little green dino in *Jurassic Park*) that didn't sit within the Aves, and it blew that little "birds

aren't dinosaurs" argument right out of the water.

Finally, the world had the tangible connection it needed to point at and go, "Look! Feathers on a dinosaur!" In the modern world, feathers are unique to birds – we don't find them anywhere else in the animal kingdom – but we can now see that they inherited their plumage from dinosaurs.

That first fossil had proto feathers that looked more like a hair. Modern feathers have a complex structure of barbs, barbules, and hooks that enable feathers to be pulled apart and zipped back up, but proto feathers weren't quite so fancy. Just a single barb of a feather, they don't look much like what we know to be feathers today, so people debated at the time of its discovery if they counted. Two years later, the fossil of the theropod dinosaur ***Caudipteryx*** was described and – being more closely related to birds than *Sinosauropteryx* – it had modern feathers.

***OVIAPTOR WAS ONE OF THE FIRST KNOWN
FEATHERED DINOSAURS TO INCUBATE ITS EGGS,
WHICH WERE COLORFUL – TWO VERY BIRDY
CHARACTERISTICS. THEY ALSO HAD LONG NAILS,
AND TEETH, AND
COULDN'T FLY. NOT SO BIRDY AFTER ALL.***

What makes a bird a bird?

So, if all of these "bird-like traits" only emerged among the theropods, where do you draw the line? Where is it in the Tree Of Life that bird-like theropods become actual birds?

It pays to remember that the idea of species is – to some extent – a human construct. We can only build these groups based on the information available to us, and that becomes much harder when dealing with extinct animals. It comes

down to looking at shared traits, but that gets more confusing the closer to that line you look.

Take *Caudipteryx*, for example. It was an Oviraptorosaur that was one of the first-known feathered dinosaurs that's also said to have incubated its eggs, which were colorful – two very birdy characteristics. Then again, they also had long tails, teeth, and couldn't fly. Not so birdy after all.

"If you consider diversity to be a major marker of success, then technically dinosaurs are still the most successful, diverse group of amniotes on our planet."

The fact is the differentiations we make don't match up to what happens in evolution, and in nature species don't suddenly morph from one thing to another. There was a time when flight was used as a deciding factor in the switch from dinosaurs to birds, but we now know that flight cropped up several times among dinosaurs.

O'Connor describes "What makes a bird a bird?" as one of the **most complex palaeontological questions you can ask**, but we did it anyway.

"When you look at the fossil record, essentially you have a problem where you can't really say what makes a bird a bird when you're looking at non-avian dinosaurs, and also early birds, because you can see that most bird features, like bird features today, were actually features that were present in non-avian dinosaurs very closely related to birds and birds inherited these features, so it's not unique to them," she told IFLScience.

"A lot of avian evolution occurred within theropods, so these are features that

were not present in all dinosaurs, but they evolved in theropods, and they become concentrated around the theropods most closely related to birds. You're not going to see colored eggs, or you're not going to see feathers forming a wing-like arrangement in *Tyrannosaurus*, which are a little bit further back. But if you're looking at the dinosaurs really close to birds, they're going to have colored eggs, they're going to have feathers, like modern birds, forming little wing-like arrangements that we don't know what they were using them for."

"So, it's like the evolution of birds is something that occurred both in dinosaurs, and then also during the unique evolution of birds in the Cretaceous, which occurred for 90 million years."

Do we still live in an age of dinosaurs?

It's certainly empowering to think your pet budgie could make such a mighty claim, but the answer hinges on whether you measure dominance by diversity or impact. Given who's to blame in the latter scenario, we know which answer we prefer.

"Mammals were much less diverse when they first appeared in the Jurassic, and became more successful into the Cretaceous, but at the same time birds outnumber dinosaurs at least two to one, if not much higher than that," said O'Connor. "We roughly estimate there's about 4,000 species of mammals. A conservative estimate for bird avian diversity is 11,000, but there are estimates that are even more than double that."

"If you consider diversity to be a major marker of success, then technically dinosaurs are still the most successful, diverse group of amniotes on our planet," O'Connor said. "In terms of impact, I guess you could argue that humans are making a greater impact – not necessarily a good impact – but in terms of what is really making up our ecosystems, the species diversity, dinosaurs are still dominant." ●





Image Credit: By Joyofmuseums - Own work, CC BY-SA 4.0, via Wikimedia

GOGOTTES OF THE FONTAINEBLEAU DUNES

Never seen a gogotte before? Also known as concretions, some of the most mesmerizing examples come from the Fontainebleau region in France. Fontainebleau was covered in water around 30 million years ago, and when it disappeared, it left behind a layer of quartz. Silica-rich water from the environment then flowed through the layers and the silica bonded quartz like glue, turning loose sand into hard sandstone. The result is swirling mineral formations whose unique shapes were sculptured over millions of years' worth of geological and chemical processes.

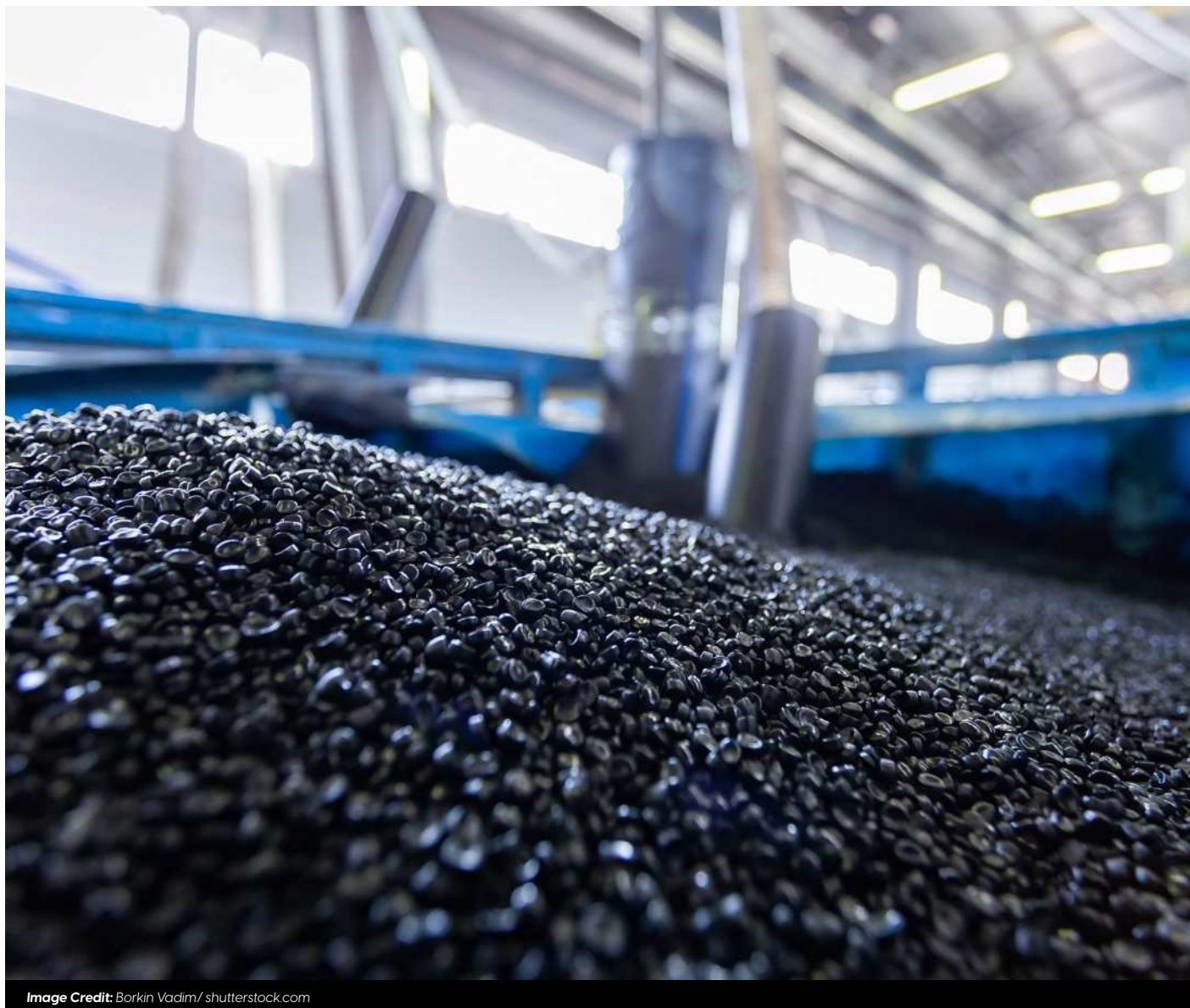


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JUST BECAUSE YOU'RE RECYCLING, DOESN'T ALWAYS MEAN IT'S SUSTAINABLE

Sponsored by:

**MILLIPORE
SIGMA**

By Dr Beccy Corkill

Keeping water pure is important in many aspects of society, from protecting drinking water and for hygiene, to less obvious situations, such as the water that scientists use in their experiments. In laboratories, untreated water can cause contamination in scientific experiments, which can lead to wasted hours and potentially have a negative monetary impact.

Laboratory water purification systems are complex with dedicated purification processes all along the system, from tap water to the final ultrapure water product. One element of the system involves cartridges containing a specialized membrane that removes minerals. The water can also undergo irradiation with an ultraviolet (UV) lamp to remove bacteria. Once filtered, the water is stored in a tank, ready for when a scientist is in need. Additional purification filters may be applied to remove even more ions and organic molecules if a scientist needs an even higher level of water purity.

While water purity is important, there is another concern that is constantly looming over everyone's heads: how to make these processes more sustainable.

When it comes to water purification systems and the exhaustion of water purification cartridges, one thing that people may think about first is **recycling**. Recycling is one of the more common solutions laboratory technicians and professionals turn to when considering waste management of any consumables, including those involved with water purification.

There have been many public messages about recycling, so much so that many people **overlook** the rest of a product's life cycle, which includes waste reduction and reusing.

The US Environmental Protection Agency uses the **waste management hierarchy** framework to evaluate its sustainability processes, such as the best way to reduce a product's environmental footprint. This framework lists source reduction as the most preferred action, which is followed by recycling and energy recovery. This means that global corporations should look at ways to reduce the number of disposable products they create and reconsider their product design to see how they can improve its environmental impact.

How can science companies make the water purification process more sustainable?

During the water purification process, cartridges become exhausted over time. These should eventually be replaced before the water quality falls outside of the desired range.

MilliporeSigma, the US and Canada Life Science business of Merck KGaA, Darmstadt, Germany, looked at its water purification systems to identify ways to make them more sustainable. They conducted a Life Cycle Analysis (LCA) of the Elix® 100 water purification system to gain knowledge of the environmental impact of the systems, which revealed that 79 percent of the global warming potential of

this product occurs during product use. This means that even when a good recycling system is in place, it is not getting to the heart of the problem.

In the past, there was a well-intentioned program whereby the cartridges were recycled, but it raised concerns about increasing the overall footprint rather than reducing it. This was due to shipping the cartridges (often by air) to the recycling centers, the mixed materials in the cartridges making them very difficult to recycle, and a lack of customer engagement.

In light of all of this, MilliporeSigma's most recent generations of water purification systems have been designed to be more sustainable by prioritizing the areas that create the largest environmental impact: electrical and water consumption during the usage phase of the system.

As an example, for Milli-Q® IQ 7003/05/10/15 water systems, the product is designed to have up to 35 percent energy savings and to recover 50 percent of water that would normally be wasted. In addition, the size of the cartridges was reduced without sacrificing performance, which reduced the plastic for purification cartridges by 33 percent, and 50 percent of the plastic is sourced from local suppliers who are audited for sustainable supply chain practices. Furthermore, they introduced more sustainable packaging, and changed key purification components that originally contained mercury (i.e. the UV lamps) to be mercury-free, all in all allowing an even further reduction in chemical waste.

As the climate is in a state of turmoil, product design changes like the above can have a big impact and help protect the environment. By redesigning the whole system, MilliporeSigma have demonstrated how companies can look at the whole life cycle of their products to find ways to reduce their environmental impact in a multi-pronged approach that doesn't rely solely on recycling. To find out more, follow this [link](#). •





Image credit: the8monkey/iStock

HOW DO YOU BEGIN SEARCHING FOR ALIEN LIFE?

*AND DO WE EVEN KNOW WHAT DEFINES
LIFE ON OTHER PLANETS?*

By Rachael Funnell

From the brain-exploding Martians of *Mars Attacks!* to the wonderful diversity of *Men In Black*'s extraterrestrial entourage, the possibility of alien life is a concept that has captured the imagination of our entire planet. Most of us only get to explore it at the movies – but for some scientists, the search for alien earths is at the core of their career.

One such scientist is **Professor Lisa Kaltenegger**, an astronomer who quite literally wrote the book on **Alien Earths**. That was why we were so excited to catch up with her at **CURIOS Live** to find out what the search for life elsewhere in the universe actually entails, and how we even know what to be on the lookout for.

What drew you to the search for alien earths?

LK: One of the fun things about my research was diving into the question, what is life? The best definition we have right now is that life is an enclosed physical system. What that means is you have a membrane or a kind of cellular structure, and the key point there is

that you want to be able to concentrate chemistry. Because, if you want to make something like DNA, or RNA, and you're like this huge ocean, the water will dilute everything.

So, you want a kind of vesicle, and you want to go with Darwinian evolution – to be able to have heritage, knowledge, and to be able to reproduce, but there we are really starting to get into a slippery slope. Because there are animals that cannot reproduce, and so, would we say that that is not alive? Of course we would say it's alive, but it's really interesting how our best laid definition starts to break down. And then another question is, what about fire? It takes wood in like nutrition, it seems to move, it grows, but it doesn't give information to the next tiny fire that it spawns.

What does the definition of life mean for an astronomer?

LK: For an astronomer, if there's a tiny thing that moves on the surface of a planet, it's not going to help me if the planet is around a different star far, far away. I need a biosphere that changes the air or the surface of the planet in a major way.

Thinking about outside, you have the green grass, the forests, that's the colour of our world. And also, the oxygen we breathe, and then some of the methane is made by life. So what astronomers are looking for is, in a way, a little bit divorced from this fundamental idea of how could we define any life, any tiny structure that qualifies as life. Currently, we need huge signs of life to spot it over cosmic distances.

On our own planet, life does that. The biosphere changed our planet completely, several times. So, when we look at another world, there are things we can look for and spot that would tell us if anything's breathing there too.

What are the key characteristics we look for in habitable exoplanets?

LK: The combination of oxygen with a reducing gas like methane, because oxygen plus methane makes CO₂ and water in the long run. So, if you still see oxygen when

there's methane there, that means both are produced in big quantities. For methane, it could be geology, but for oxygen, we have no other explanation than life.

At a certain distance from a star, it's too hot. Then it gets warm, and then it's too cold. There's just the right distance where it's warm, and that's what we call the habitable zone. It's basically where, if you plop an Earth there, the water on the surface would be liquid, and it would give you oceans and rivers. But does that mean that life can only live there? Actually, it doesn't, because if you freeze things over there could be a subsurface ocean, like we hope on the icy moons in our Solar System might have subsurface oceans that could harbor life, but we don't know. We have to go there, drill in the ice, and check.

Why did you write *Alien Earths*?

LK: The best way for me to [learn] is to actually explain this to anyone, because that means I understand it. [It's a chance to see] all the puzzle pieces I'm working on, and where there are pieces that I might have missed, or where I should go into more depth. It also allowed me a beautiful opportunity to just to go into my most favourite sci-fi and try to figure out if these planets could exist, which things could exist, and which could not.

The key point for me was, hopefully, it's going to make you look up, because one out of five stars have a planet in this right distance – a place that's not too hot, or not too cold, and that's a rock. Our galaxy alone has 200 billion stars. So, there are billions and billions of possibilities that we have now found, or think are encountering, where there could be – potentially, we don't know yet – somebody else also looking, and wondering, if they're alone. ●



Sign up to stream the full interview now, or subscribe to the We Have Questions podcast to listen along in a few weeks.

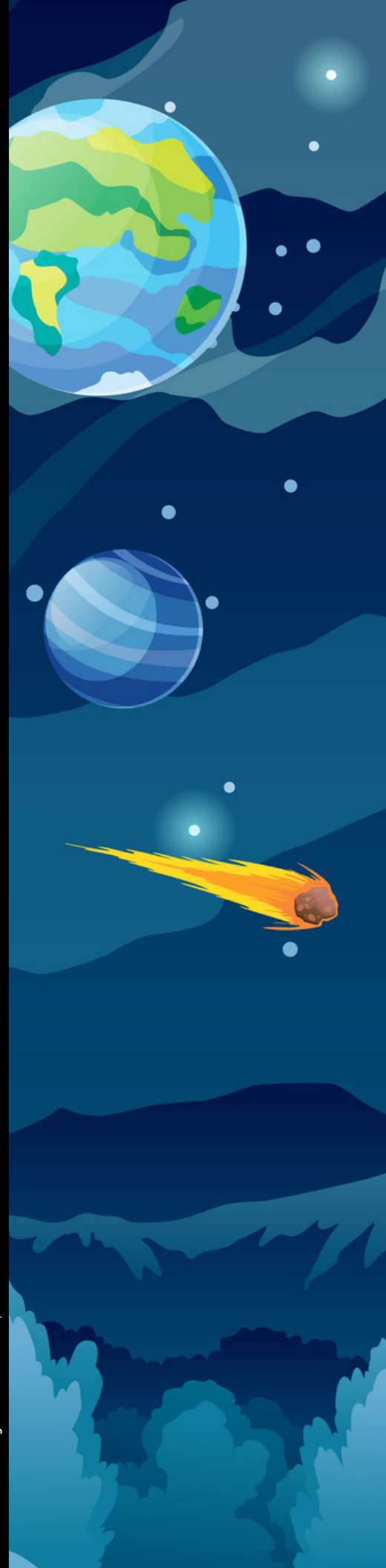


Image credit: the8monkey/istock

SCIENCE FACT OR FICTION:

DO ANIMALS USE MEDICINE?

Medicine is a marvel – but is it the preserve of the human race, or do other species partake in the practice? Maddy Chapman investigates.





(bitter leaf) seemingly to treat parasite-related diseases.

In a **study** published just a few weeks ago, researchers, including Huffman, monitored chimpanzees in Uganda and analyzed extracts from 13 plant species they suspected were used by them for self-medication. Eighty-eight percent were found to be antibacterial, while 33 percent had anti-inflammatory properties. Combined with behavioral observations, these findings “provide further evidence for the presence of self-medicative resources in wild chimpanzee diets,” the team concluded. In other words, it seems more likely that the animals specifically seek out these natural “medicines” than that they are drawn to them by chance.

WOOLLY BEAR CATERpillars – THOUGHT TO BE THE FIRST RECORDED SELF-MEDICATING INSECT – ARE BELIEVED TO DELIBERATELY EAT POISONOUS PLANTS TO RID THEMSELVES OF PARASITES.

When we’re feeling peaky we might pop to the pharmacy for a remedy to help get us back on our feet, or visit a doctor for an expert opinion – we may even make ourselves a hearty bowl of chicken soup (there’s more **science behind it** than you might think). Other animals don’t have the same luxuries, but that’s not to say that they’re not hiding a few tricks up their sleeves to help with healing.

Of course, no monkey is making for the medical center, nor are lions sipping Lemsip or alpacas popping Advil, but a rudimentary form of medicine may be common – ubiquitous even, some argue – in the animal kingdom.

Do animals use medicine?

“Every species on the planet self-medicates in some way or another,” **Michael Huffman**, a primatologist now at the Institute of Tropical Medicine at Nagasaki University, told IFLScience, highlighting the myriad examples of the practice in primates and other mammals, as well as bird species.

Often referred to as zoopharmacognosy, this self-medication in animals tends to involve plants or other non-nutritional substances – such as soils and insects – being ingested or applied topically to combat disease. Think of the natural world as a fully stocked medicine cabinet at any animal’s disposal.

Self-medication, or at least what appears to be self-medication, has been observed in the animal kingdom – particularly among the great apes – for decades. However, there was some initial skepticism as to whether these species were truly medicating themselves and if so, whether it was effective. After all, a chimp swallowing a leaf could be doing it just because, and not in some ingenious attempt to treat a parasite.

In the years since, research has started to accrue in favor of self-medication in animals – and Huffman has played a big part in that. His **work with chimpanzees** in Africa, for example, revealed instances of wild chimps consuming the plant *Vernonia amygdalina*

“Although self-medication in non-human animals is often difficult to document systematically due to the difficulty of predicting its occurrence, there is widespread evidence of such behaviors as whole leaf swallowing, bitter pith chewing, and fur rubbing in African great apes, orangutans, white handed gibbons, and several other species of monkeys in Africa, Central and South America, and Madagascar,” **Dr Isabelle Laumer**, from the Max Planck Institute of Animal Behavior, told IFLScience. Topical application of medicinal compounds, on the other hand, is rarely witnessed – though recent research has changed that.

“Active wound treatment with a substance has only recently been documented for the first time in a great ape species,” said Laumer.

In a 2022 study, chimpanzees were reported applying insects to their wounds, and occasionally those of other members of their

troop, for the **first time**. We don't yet know how effective this seeming self-medication is, Laumer explained: "Further research is needed to investigate the efficiency of this behavior."

Then, earlier this year, Laumer was first author of a study detailing the case of Rakus the **Sumatran orangutan**, who was caught chewing the leaves of the Akar Kuning plant (*Fibraurea tinctoria*) – used in traditional medicine to treat dysentery, diabetes, and malaria – before applying the juice to a facial wound, which healed without infection. The behavior was repeated several times and later the wound was covered with solid plant material. It was the first documented case of active wound treatment using a biologically active plant by a wild animal.

Examples of what may be self-medication also exist outside of primates. There is evidence to suggest that **goats may self-medicate** using plants with anthelmintic

properties to counter gastrointestinal worms. Meanwhile, parrots, and other animals, eat clay, possibly to neutralize toxins in their diet.

Even creepy crawlies get involved: Some **ants use a mixture** of tree resin and formic acid in an antimicrobial cocktail (there's a pun to be made there, but we'll spare you) to protect their colonies from disease. And **woolly bear caterpillars** – thought to be the first recorded self-medicating insect – are believed to deliberately eat poisonous plants to rid themselves of parasites or to boost their own immune systems.

These examples are just the tip of the iceberg of animal self-medication – there's plenty more where they came from. There's even some evidence that non-human species are partial to **recreational drug use**, such as black-handed spider monkeys with a taste for **boozy fruit**.

From creature to clinician: How do animals acquire self-medication?

All these animals are decidedly different – and not all of them famed for their intelligence. So how did they come by these self-medicating behaviors? Are they instinctual? Do they learn them? Is it our old friend natural selection at play again?

In the case of Rakus the orangutan, it could simply be a happy accident, Laumer told IFLScience. "Individuals may accidentally touch their wounds while feeding on *Fibraurea tinctoria* and thus unintentionally apply the plant's juice to their wounds. As [the plant] has potent analgesic effects, Rakus may have felt an immediate pain release, causing him to repeat the behavior several times and subsequently apply solid plant matter."

"But it may also be that Rakus has learned this behavior from other orangutans in his birth area," Laumer added.



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Learning could play an important part in propagating self-medication behaviors in some species, Huffman agrees.

"For all species, some aspect of self-medication is innate," he told us. "But for social species that live in groups and are raised by their mothers, there are many aspects of the behavior that needs to be learned; what plants are used, what part [of] the plant, where are these plants in their habitat etc."

IF WE LOOK TO [ANIMALS] FOR CLUES ABOUT THE MEDICINAL PROPERTIES OF PLANTS AND OTHER NATURAL MATERIALS, OUR OWN DRUG CABINETS COULD BE ALL THE RICHER FOR IT.

This may be the case for apes. Take chimps: We know them to be **capable of learning** and **teaching**, meaning it's likely that knowledge of self-medication could be passed between generations. But for other animals, it might be a different story.

"You should never underestimate the power of natural selection," Mark Hunter, a professor of ecology and environmental biology at the University of Michigan, told Joel Shurkin for a feature in **PNAS**. If eating a plant or putting its leaves on a scrape confers benefit to an animal, then those that happen to do it may be more likely to survive and pass on their genes – and possibly behaviors with them.

"It does not take a smart organism to develop an instinctive behavior," Hunter added.

Nature's pharmacy: What can we learn from animal "medicine"?

They might not have invented vaccines or mastered brain surgery, but there's much

we can learn from animals – even when it comes to medicine. If we look to them for clues about the medicinal properties of plants and other natural materials, our own drug cabinets could be all the richer for it.

THE EXISTENCE OF SELF-MEDICATION IN OUR CLOSEST RELATIVES COULD POINT TO HOW SUCH BEHAVIORS EVOLVED IN HUMANS.

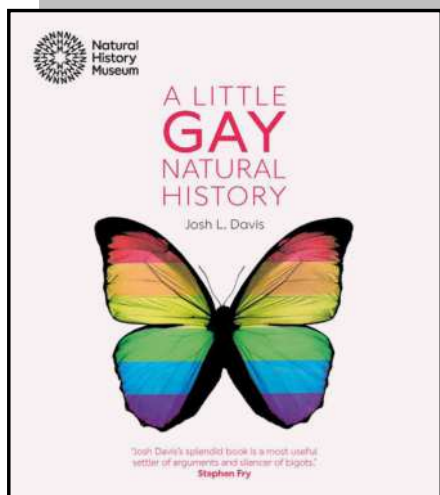
In a world with a growing antimicrobial resistance problem, coming by new medicines is imperative, and no mean feat. Could the silver bullet we've been searching for be lying in the hands of an orangutan or the belly of a caterpillar? It can't hurt to look.

If we don't learn about new medicines we may at least be able to learn about ourselves. The existence of self-medication in our closest relatives could point to how such behaviors evolved in humans – who have been experimenting with wound healing since at least **2200 BCE**.

"As forms of active wound treatment are not just a human universal but can also be found in both African and Asian great apes, it is possible that there exists a common underlying mechanism for the recognition and application of substances with medical or functional properties to wounds and that our last common ancestor already showed similar forms of ointment behavior," Laumer added.

But perhaps, above all else, the knowledge that other animals often act as we do we should serve to deepen our understanding of and respect for the other species with which we share our planet. As Huffman put it: "Always we should learn to appreciate that animals, like humans, are capable of taking care [of] themselves, and we need to leave nature intact for the health of all animals and ourselves." •





CAN ANIMALS BE GAY?

In this excerpt from *A Little Gay Natural History*, author Josh Davis of London's Natural History Museum outlines the unique opportunities domestic sheep and Japanese macaques have provided to study sexuality in animals.

When talking about the queerness of animals, scientists frequently refer to an animal displaying homosexual "behaviour" or gay "activity". This is because it is impossible to ask an animal about their sexuality and difficult to follow a single individual its entire life to observe its mating habits, making it exceedingly hard to know if an animal is truly gay or not. If we were to use human definitions for animals, then most would not be classified as gay or lesbian but something more akin to bisexual, but even this becomes problematic when trying to assign sexuality onto an individual animal. The domestic sheep (*Ovis aries*), however, offers us a unique opportunity.

Sheep were domesticated some 10,000 years ago in the Middle East, so people have been living alongside them, intimately observing their behaviours, for an incredibly long time. This, coupled with their sheer numbers (estimated to be in the region of

1 billion animals), means that humans have had more opportunity to observe them than many other living creatures. Farmers take a keen interest in the sex lives of their livestock and have long noted that some rams are simply uninterested in ewes. This is sometimes put down to a "low libido", with vets even offering injections to try to remedy it. The more straightforward explanation is that they are simply queer.

Studies have found that roughly 8 percent of all rams show a consistent preference for other rams, even when given the opportunity to mate with ewes in heat. This suggests that sheep may be the first known animal, apart from humans, in which genuinely homosexual individuals have been identified. Some of these experiments have, however, been met with controversy. Because rams need to do their job and breed, the farming industry has spent time and money trying to identify gay tendencies and treat them. Experiments have looked at biological signatures in blood, such as hormone levels, and studied the brain structure of gay sheep. Nothing suggests that any of this would apply to humans, but this creeps uncomfortably close to the medicalization of queer folk, the potential for a "cure" and even eugenics. Studying homosexual animals can have political and societal consequences of which those doing the research need to be acutely aware.

In recent decades, our understanding of queer animals has also expanded as our knowledge of the natural world has deepened. Japanese macaques (*Macaca*

fuscata), a species of monkey living from the wintery mountains to the subtropical forests in the Japanese archipelago, have also consistently indulged in queer activity.

They typically form groups, known as troops, consisting of roughly 30 individuals, although occasionally up to 100 depending on the availability of food. These troops are organized around different matriline, in which the power and dominance is passed from mother to daughter. Studies over the past four decades have found that some female macaques show a consistent preference for mating with other females, even when there are sexually active males on the scene. The researchers found that females court each other before mounting in up to eight different postures, in a kind of monkey *Kama Sutra*, whilst heavily thrusting and gazing intently into each other's eyes. The scientists concluded that these females were having sex with each other purely for pleasure and, as they also mated with males, that they were seemingly genuinely bisexual in nature.

Now this does not mean that sheep and macaques are the only animals that could be considered to have a sexuality that we would define as homosexual or bisexual. It is highly likely – if not almost certain – that there are plenty of other animals out there where individuals have a consistent preference for members of their own sex, it is just that sheep and primates are both intensely studied animal groups. The more we look, the gayer the world undoubtedly is. ●

AUTHOR
Q&A

JOSH DAVIS

AUTHOR OF *A LITTLE GAY NATURAL HISTORY*

Science isn't immune to bias, and we see this in the language used around non-heteronormative plant and animal behaviors and anatomy. We spoke to Josh Davis about why language matters, and the crucial distinction between sex and reproduction.

How has sex been misunderstood in science?

It's been thought that the only purpose of sex is reproduction, and this has resulted in not only a lack of interest in queer behaviors but also even when it comes to looking at the behavior or anatomy of females. This has resulted in all sorts of historical biases that still impact us today.

If you go into natural history museum

collections, there is a male skew in the specimens. It might seem inconsequential, but it can have an impact on the research that's being done. If you're only ever focusing on males, you miss a whole 50 percent of animals and plants that are out there, and once you start to accept that sex isn't just about reproduction, you open up other avenues to explore and interesting questions that you can answer.

What changes would you like to see?

When researchers and writers talk about non-heteronormative behaviors, the terminology used is quite often morally loaded. It's quite often judgment-laden, which I always find very interesting. It sort of speaks to the idea of how we like to assume or think that science is objective, but when you're actually looking at these research papers, you find a lot of biases in the language they're using.

For example, they'll describe homosexual matings as "a sham mating", or they will talk about gay behaviors as "aberrant".

One of my favorite ones is a quite famous paper from the 1980s about homosexual behavior in butterflies, and it talks about the "moral lowering of lepidoptera", which is amazing. To think that was published in scientific journals, and not that long ago.

And so, I would like to see a bit more of a consideration about the language being used, and a bit more of an understanding that it does matter. It does have an impact. It does influence how people perceive these things and how people view them.

Favorite fact from your research?

There's a type of tree called the Saharan Cypress, and it reproduces in a way that's not seen in any other plants, and only maybe three or four animal species. It's called androgenesis, which is effectively the opposite of parthenogenesis.

Parthenogenesis is where females pass on their genetic information to their offspring without any input from males. For Saharan Cypress trees it's effectively the opposite, which absolutely blew my mind. The male trees are the only ones that pass on their genetic information to their offspring without any input from females. It's baffling, we still don't really understand how it works, it's so unusual. That honestly changed everything I thought I knew about biology.

What do you hope readers will take away from your book?

Historically, homosexual behavior in animals has been treated as a bit funny and a bit of a joke – quite often the butt of the joke. I would like to think that people can read this and understand that, actually, these non-heteronormative behaviors are super interesting on their own. It is common, it is normal, and it is an interesting field of research in its own right. ●

A Little Gay Natural History is published by The Natural History Museum and is available now.

At the mouth of the Catatumbo River, an electrical storm unlike any other on Earth takes place for around half of the year. Lasting as long as nine hours per night, the Catatumbo lightning reigns down at rates of **280 flashes per hour**, igniting the night sky with dramatic forks of electricity.



EARTH'S MOST SHOW-STOPPING ELECTRICAL STORM

What's the longest lightning storm you've ever seen? For the people of Venezuela, seeing an electrical display that goes on for up to nine hours isn't out of the ordinary. Here, at the mouth of the Catatumbo River, specific conditions for heat and humidity give rise to one of the most dramatic lightning displays on Earth.

Known as the **lightning capital of the world**, it takes place where the Catatumbo River meets Lake Maracaibo, which is why it's also known as the beacon of Maracaibo. The region holds the world record for the most lightning on Earth, experiencing around 250 lightning flashes per square kilometer every year, which adds up to around 1.6 million bolts annually.

It's a remarkable display, but one that comes at a cost for the 20,000 or so sailors living in the lightning capital, sometimes in tin shacks. "A lot of people die each year," Ángel G. Muñoz, a physicist and researcher at the National Oceanic and Atmospheric Administration (NOAA), told **NASA**. "The lightning can be so continuous that you see everything around you."

The lightning occurs with such frequency because of the way hot air rises at speed in the region, meeting with moist air to form cumulonimbus clouds that are associated with extreme weather like downpours, hailstorms, tornadoes, and lightning. Ice crystals above the lower portions of the clouds meet with warm air, creating static that builds up until it's discharged in the electric zigzag we know as lightning.

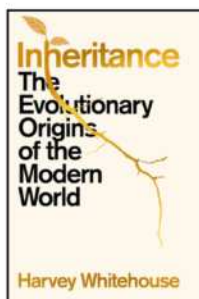
The power contained within this weather system is monumental, with NASA stating you could illuminate all of South America with just 10 minutes' worth of Catatumbo lightning. Harnessing energy from lightning is an idea that's intrigued scientists since Benjamin Franklin's day, but nobody's yet found a way to make it a viable source of energy.

The "river of fire" created by Catatumbo lightning has been used for centuries as a way marker for sailors **navigating the ocean**. Following the Maracaibo beacon was as good a heading as any, with the electric storm so illuminating that night is turned to day for those within striking distance.

Due to its deadly intensity, many have come to fear extreme lightning, but among the Indigenous people in the region it's known as "ploi", which translates to "curiosity". Come rain or shine, the nocturnal lightning is a near-constant that's become a symbol of strength and fortitude. ●



READ



Inheritance

Book by
Professor Harvey
Whitehouse

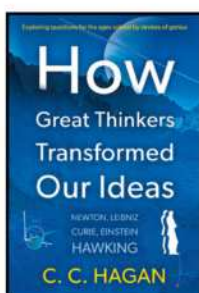
Where does
religion come from?
Why do humans
form societies?

And why do we
constantly innovate

new technologies? In *Inheritance: The Evolutionary Origins of the Modern World*, Professor Harvey Whitehouse reveals how a handful of ancient instincts have been shaping human behavior for 12,000 years – from the emergence of the first nation states, to the birth of the world's great religions.

Available **now**.

THINK



How Great Thinkers Transformed Our Ideas

Book by C
C Hagan

Isaac Newton helped
the world grapple with
physics, Albert Einstein
gave us the theory of

general relativity, and Stephen Hawking shaped our understanding of cosmology, but how did the mindsets of society and philosophy change during the 300 years that their scientific ideas spanned? Dive into a slice of history with this exploration of history, science, philosophy, and theology from lawyer and author C. C. Hagan.

Available **now**.

DISCOVER



Birds: Brilliant And Bizarre Exhibition at Natural History Museum, London

If you've read our July cover story then you're clued up to the fact that birds are dinosaurs. That's how the Natural History Museum, London kicks off its exciting new exhibition, from the very first *Tyrannosaurus rex* fossil dug up, through to the most peculiar adaptation of the dinosaurs' only extant relatives. We caught up with Senior Curator of Birds Dr Jo Cooper to find out more about what you can see at the exhibition.

See **our video**, then **visit the exhibition**.

SCIENCE IN MEDIA



ASK



The Big Questions Season 4 Podcast from IFLScience

The Big Questions is back bringing some of the most curious questions in science to your ears with interviews from our regular hosts Dr Alfredo Carpineti and Rachael Funnell as well as a few more members of the IFLScience team. Highlights this season include: How did dinosaurs have sex? How will the Solar System end? Is evolutionary biology sexist? Will a new species of human evolve on Mars? And can we make dogs live longer? We've pinned down the experts to find out, so kick back and get caught up with our latest series.

Available on all good **podcast platforms now**.

INVADE



Killer Klowns From Outer Space Game from Teravision Games

Based on the '80s **cult classic movie**, *Killer Klowns From Outer Space* is a zany take on asymmetrical multiplayer horror, offering you two experiences in a world under siege from extraterrestrial Killer Klowns: step into the giant shoes of the invaders and plan your own alien invasion to harvest the humans, or gather a team of survivors to counter the attack.

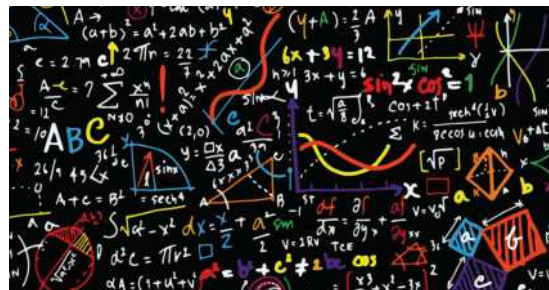
Available **now**.



DATES TO REMEMBER

How would you like to reduce your single-use plastic, celebrate math, technology, and neuroscience, and possibly see some stunning fireballs? If any of that sounds like your bag, then you're in luck – this July you can do all of the above and more. It's also the point in the year when Earth is at its farthest point from the Sun.

JULY

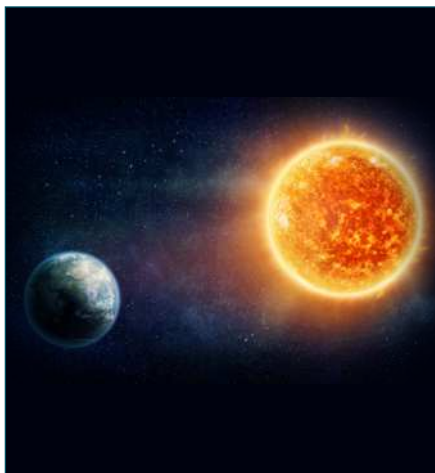


Plastic Free July

The world has a plastic problem – will you help to tackle it? This month is Plastic Free July, a global initiative that helps millions of people be part of the solution to plastic pollution. The movement has inspired more than 100 million people from around the world to reduce their consumption for the month. In doing so, it strives to protect our planet and all the organisms that call it home – **including us** – from the perils of plastic pollution. For handy tips and resources on how to limit single-use plastic waste at home, work, school, and in your community, check out the **Plastic Free July** website.

8 Math 2.0 Day

Math 2.0 Day is not just a celebration of the wonderful subject of **math**, but also of technology, and how the combined power of the two can help improve our world. Without math, life as we know it would be very different – we have the field to thank for everything from smartphones to the weather forecast – so it's only right we celebrate it, alongside tech, on July 8.



5 Earth at Aphelion

Happy Aphelion Day! In astronomy, aphelion is the point in the orbit of a planet, comet, or other body where it is most distant from the Sun. In the case of Earth, this will happen on July 5, when our planet is about 152 million kilometers (94.5 million miles) from its star.



22 World Brain Day

July 22 is **World Brain Day** – an annual observance aimed at promoting awareness and education for neurological disorders that affect people across the globe. This year, the theme is Brain Health and Prevention, which will champion quality neurology while highlighting the importance of investing in early detection and effective management strategies. "World Brain Day 2024 serves as a rallying point for global efforts to prioritize and safeguard brain health," explains the World Federation of Neurology. "By spreading awareness, fostering collaboration, and advocating for preventive measures, we can collectively pave the way for a healthier future for all."



31 Alpha Capricornids peak

Fans of fireballs, get excited for the Alpha Capricornids meteor shower peaking later this month. The shower is not very strong and meteors are infrequent, but the Alpha Capricornids often produce bright yellow, fireball-class meteors that make quite a spectacle. This year, they will be whizzing through the sky from July 7 to August 15, putting on their best show when they peak on July 31. And it's good news for North and South Hemisphere dwellers alike: the shower will be seen equally well on both sides of the equator.



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

Choose how you end each issue. For those who prefer the darker side, Holly Large explores what can happen when AI hallucinates. If you like your science lighter, find out how you can help NASA scientists learn more about clouds.

AI HALLUCINA- TIONS

AI hallucinations – which some researchers would rather refer to as AI “bullshit” – are when generative AI, often in the form of chatbots, produces a result that’s incorrect or misleading and presents it as fact. For example, when cognitive scientist Douglas Hofstadter asked GPT-3, “When was the Golden Gate Bridge transported for the second time across Egypt?”, rather than responding that that had obviously never happened, the bot told Hofstadter it’d happened in October 2016.

**THERE’S THE POTENTIAL
FOR AI HALLUCINATIONS
TO HAVE A DARKER SIDE,
ONE THAT’S BECOMING
MORE OBVIOUS WITH
THE INCREASING
PREVALENCE OF AI TOOLS
IN DAY-TO-DAY LIFE.**

There are multiple reasons why this can happen, such as when there are issues with the data that an AI model is trained on – it’s incomplete or biased, for

example – or that the model is highly complex.

Of course, if a chatbot tells you that dogs can live to 100 or that clouds are in fact flying sheep, that’s probably going to be more amusing than it is harmful. However, there’s the potential for AI hallucinations to have a darker side, one that’s becoming more obvious with the increasing prevalence of AI tools in day-to-day life.

In **May 2023**, a lawyer had to apologize after it was discovered that case precedents submitted to the court as part of a personal injury suit had been generated by ChatGPT. Whether or not AI should be used in this way is an issue all on its own, but the problem here was that the chatbot had presented judicial decisions that had never actually happened as factual.

There are also concerns over what hallucinations might mean when AI is used in healthcare, as it’s possible that it could give false positives or negatives – and that can be the difference between telling someone they’re healthy when they’re not, and vice versa.

The solution? Turns out they can’t be completely stopped, but using high-quality, relevant data, refining models, and making sure a human is keeping an eye on things could go a long way.



**The Darker Side
of Science**

CITIZEN CLOUD SCIENCE

Ever fancied working for NASA? Or maybe you just really love looking up at the sky? Thanks to a citizen science program, now you can combine both to help scientists understand more about clouds.

**DON’T WORRY IF YOU’RE
NOT CONFIDENT IN YOUR
IDENTIFICATION SKILLS;
THE WIZARD TAKES
YOU THROUGH IT.**

As well as looking like a floating mass of delicious cotton candy, clouds are an essential part of Earth’s climate system. They affect temperature on a global scale, by absorbing, reflecting, or scattering radiation from the Sun, but we also feel their more local effects when they bring rain, snow, and even thunder.

For scientists, that means that keeping an eye on clouds is pretty important. Trouble is, they usually only have one view of them – top-down, from the satellites orbiting

the planet. Add to that the fact that clouds change fairly rapidly, and it’s difficult to keep track.

That’s where us folks on the ground come in. As part of GLOBE, a citizen science program sponsored by NASA, you can log the clouds you see and help out scientists using just a phone or a tablet.

This involves downloading the **GLOBE Observer** app, which features the wonderfully named “Clouds Wizard” – sadly not a little ball of fluff with a star-covered pointy hat – to help accurately document what you see.

As well as confirming the location, date, and time on your device are correct, making an observation includes detailing the overall cloud cover you can see, as well as what the current weather conditions are like.

There’s also the option to log what types of clouds are visible, but don’t worry if you’re not confident in your identification skills; the Wizard takes you through it. After that, the final step is to take some photos and just like that – you’re now a NASA citizen scientist.

And if the knowledge you’ve contributed to science isn’t quite enough, you also earn badges for every observation milestone you hit. Who doesn’t love a gold star, after all?



**THE LIGHTER SIDE
OF SCIENCE**