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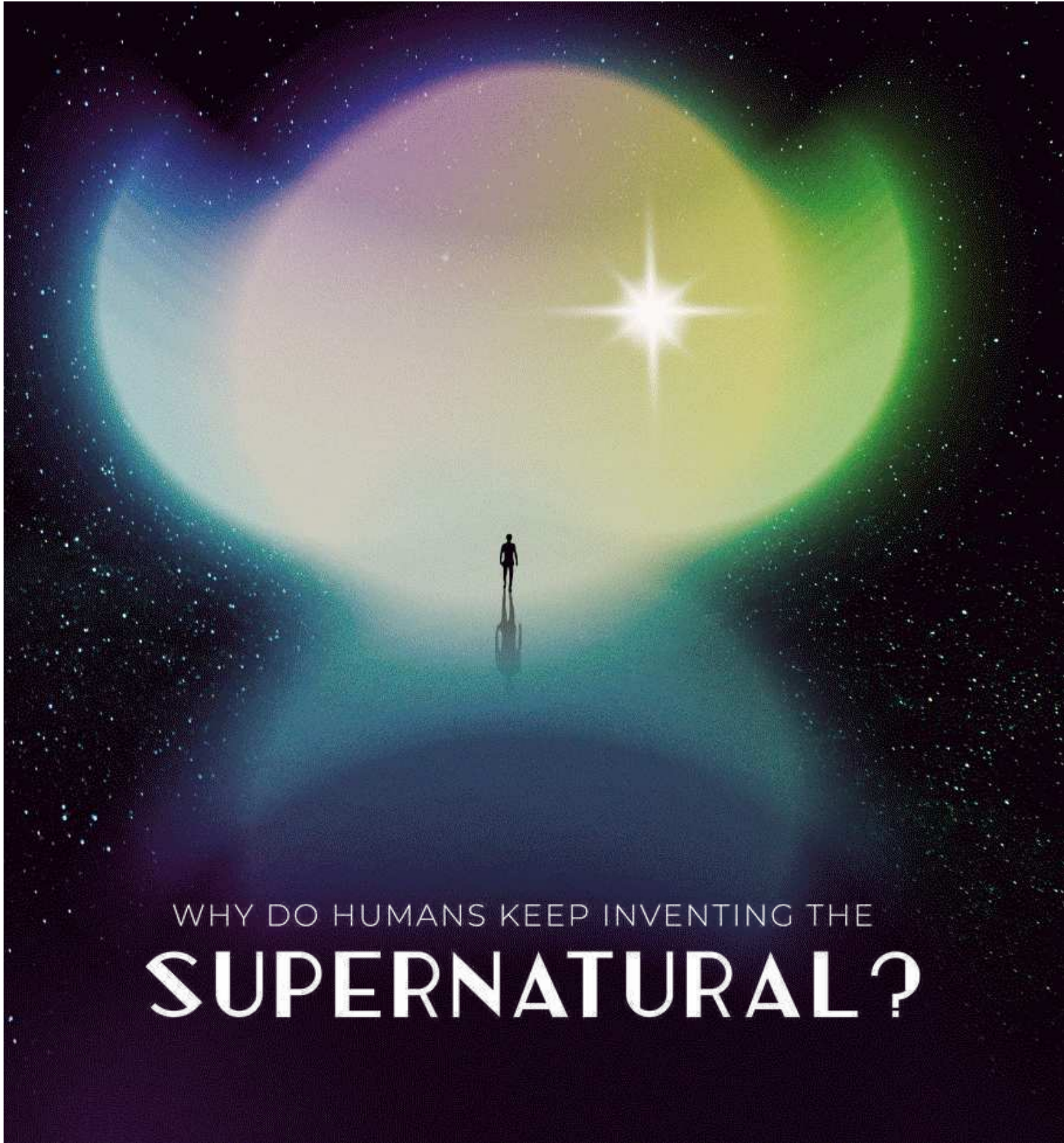


HOW DO WE KNOW
ASTROLOGY ISN'T REAL?

WHERE IS THE BEST PLACE TO
WAIT OUT A ZOMBIE APOCALYPSE?

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January 2023

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NEWS BITES



2023 In Space

2023 is set to be an exciting year for space missions.

This year should see the first NASA-Boeing crew flight test to demonstrate the ability of Boeing's Starliner capsule and the United Launch Alliance's Atlas V rocket to safely carry astronauts to and from the International Space Station, opening up SpaceX's monopoly on NASA's commercial crew program. Three lunar lander missions are set for launch, with NASA aiming to deliver a payload to the lunar surface, India's Chandrayaan-3 rover mission, and Russia's postponed Moon lander mission, Luna 25. This is also the year NASA launches its Psyche mission to study the eponymous "holy grail" of asteroids said to be worth a potential \$10 quintillion in heavy metals. Speaking of asteroids, after seven years, NASA's OSIRIS-REx is due to return to Earth with samples of asteroid Bennu late this year. And also speaking of long-haul missions, the European Space Agency will launch its mission to study Jupiter and its three largest moons. Expect incredible close-up photos... in eight years when it arrives in 2031.



What To Watch In 2023

Superheroes are still big business in 2023, kicking off with *Extraordinary*, a new comedy series from the makers of *Killing Eve* coming to Disney+ in January, where everyone over 18 gets their superpower, except for Jen, a shy 25-year-old who is still waiting for hers to kick in. The *Star Wars* juggernaut rolls on with its latest TV offering, *The Acolyte*. Described as a "mystery-thriller", the show is set in the final days of the High Republic and sees a former Padawan seek out her Jedi Master to investigate a series of crimes. Sci-fi blockbuster movies are not slowing down either, with the creepy AI-gone-wrong *M3GAN*, *Ant-Man & The Wasp: Quantumania*, *The Super Mario Bros. Movie*, *Dungeons and Dragons: Honor Among Thieves*, and *The Hunger Games: The Ballad Of Songbirds & Snakes* all appearing on the big screen.



Vote For Your Favorite!

Time to cast your vote in the Wildlife Photographer of the Year People's Choice Award! Voting is now open for 25 stunning wildlife images awaiting your careful judgment. Having been whittled down from more than 38,000 entries from 93 countries, the final 25 include foxes nuzzling, a pregnant pygmy seahorse, a frog with ruby eyes, and even a basking polar bear surrounded by flowers. Which one captures your heart, or tickles your funny bone? You can vote for your favorite online **here**. Voting closes on February 2, 2023, and the winner will be announced on February 9.

Noisy Neighbors

Why are noisy neighbors so annoying? It's not just you, the short, thudding "impact sounds" of footsteps stomping above genuinely are more irritating than longer more continuous noises, scientists have even tested it! With the increasing density of urban areas, scientists are investigating how the perceived annoyance of these sounds may be affecting our health, including heart problems and sleep disturbance. Got a noisy neighbor you want to rat out? You can take part in the **online survey** until March 2023 and vent your frustration on your heavy-footed foes – for science!



Moonwalking

How do you learn how to walk on the Moon? With difficulty, frankly, due to our pesky gravity, but NASA is giving it a good go. Two astronauts have been testing out NASA's mock-up spacesuits and carrying out moonwalk simulations in a lunar-like environment in the San Francisco Volcanic Field in Arizona. Oh, and they did them at night in the near-dark, just to make it feel more Moon-like. The mission is designed to help NASA engineers create the tools and technology for astronauts to carry out science on the lunar surface for 2025's Artemis 3 mission which will see the first woman and person of color set foot on the Moon.

Maya At The Met

For the first time in a decade, a major exhibition of Maya art is going on display in the US. The Metropolitan Museum of Art in New York City is showing **Lives Of The Gods: Divinity In Maya Art** from now through April 2, 2023. The rarely seen treasures, dating from 250 to 900 CE, include huge imposing stone stelae and tiny carved jade, shell, and obsidian ornaments that tell stories of the ancient people and cities of the Maya civilization. Recent advances in reading Mayan hieroglyphs mean, for the first time, the artists' names will be labeled alongside their work.

WHAT'S UP?



Meet A Real Titan

Kneel, puny human

Name: *Patagotitan mayorum*

Appearance: Long, chonky, an absolute unit

Location: Coming to London!

What's this? For the first time ever in Europe, one of the largest dinosaurs that ever walked the Earth is going on display. The most complete gigantic dinosaur ever discovered will star in the new *Titanosaur: Life As The Biggest Dinosaur* exhibition at the Natural History Museum, London, UK.

Just how big are we talking?

Patagotitan dwarves the museum's most famous resident, Dippy the *Diplodocus*, being four times heavier, or about nine African elephants. The skeleton reaches a whopping 37 meters (121 feet) long and is 5 meters (16 feet) high.

Family connections:

Patagotitan is a member of the Titanosaurs, a subgroup of sauropods – huge long-necked herbivores that walked on four legs – that include some of the largest land animals

ever. Among its members are *Dreadnoughtus*, *Argentinosaurus*, and *Saltasaurus*, all of which were found in South America. It lived around 101 million years ago, during the early Cretaceous.

Where is it coming from?

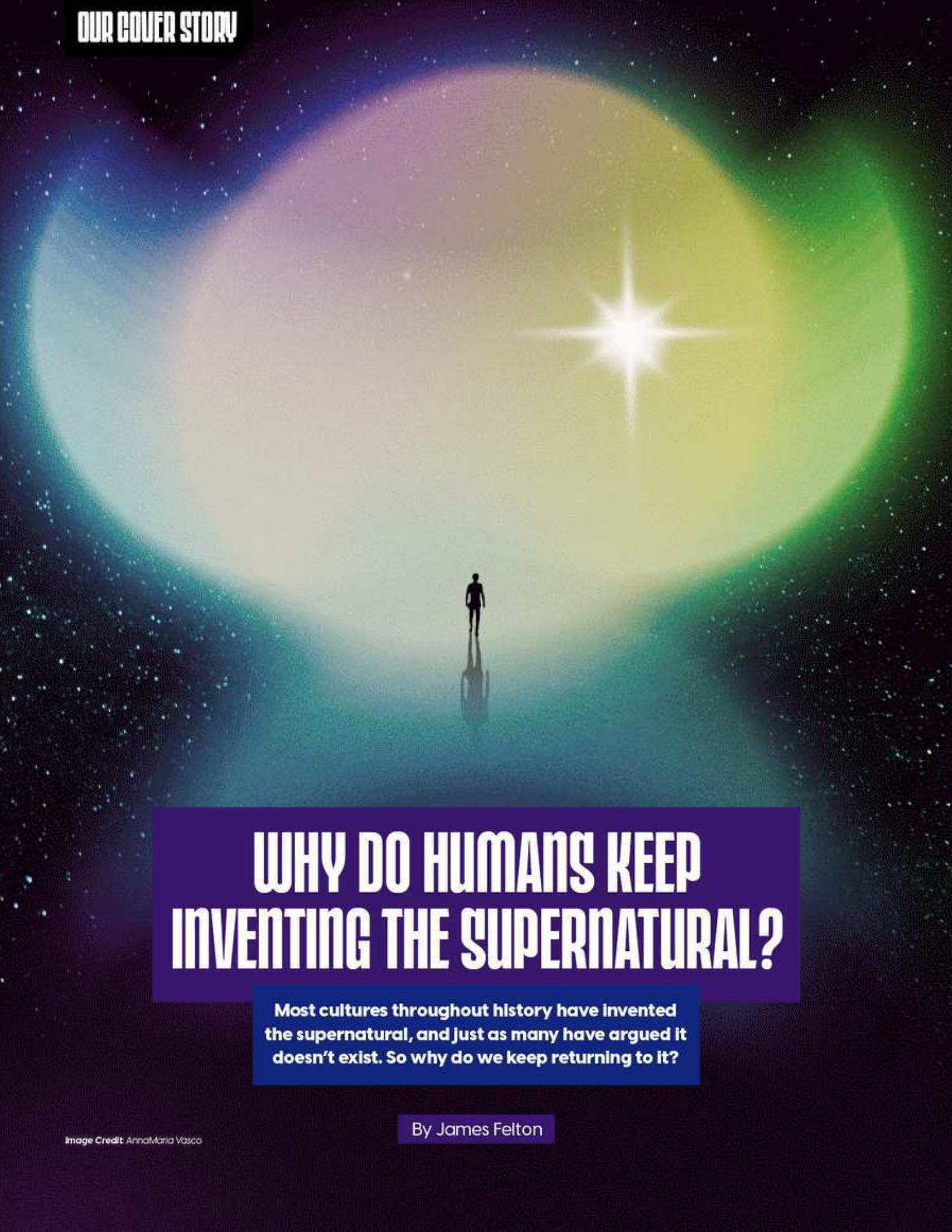
P. mayorum was discovered in 2010 in Patagonia after a ranch owner came across a 2-meter (6.6-foot) thigh bone sticking out of the ground. It's on loan from the Museo Paleontológico Egidio Feruglio (MEF) in Trelew, Patagonia, Argentina.

Are the bones real?

In the end, the remains of six almost fully grown individuals were found. These were cast by experts at the MEF and form the skeleton that is going on tour. This is pretty standard for large dinosaur skeletons as complete remains are extremely rare.

When can I see it?

Titanosaur: Life As The Biggest Dinosaur opens in London in March 2023 through January 2024. You can book your tickets **online now**.

A person stands on a reflective surface, looking up at a large, colorful nebula in space. The nebula is a mix of purple, blue, and green, with a bright star in the center. The person's reflection is visible on the surface below them.

WHY DO HUMANS KEEP INVENTING THE SUPERNATURAL?

Most cultures throughout history have invented the supernatural, and just as many have argued it doesn't exist. So why do we keep returning to it?

By James Felton

There is an old quote by Voltaire which goes "If God did not exist, it would be necessary to invent Him". Unless all religions, including the ones that specifically rule out the existence of other gods, are correct, then inventing gods is something we have done many times over during humanity's stretch on Earth.

Pretty much every culture around the world has developed some sort of belief in the supernatural or embraced an organized religion. Excluding physics-denying explanations (ghosts violate pretty much everything that we know about physics, and the Large Hadron Collider has so far not turned out any evidence for an all-seeing god), why is it that this keeps happening?

Why is that man running at me with a rock?

As strange as it may seem, a belief in the supernatural may have been useful to early humans, or at least the belief arose thanks to other useful evolutionary advantages that early humans picked up as they began to **try and make sense** of the world.

As our brains evolved, we began to develop what psychologists call the Theory of Mind, or the capacity to realize that people other than ourselves have motives, intentions, and (as the name suggests) minds. Evolutionarily speaking, this was pretty useful to us. Simply speaking, you stand a better chance of survival if you can figure out whether another human approaching you at speed is here to offer you a nice shiny rock they've found and are excited about, or bludgeon you to death with the aforementioned shiny rock.

Those that possessed theory of mind were more likely to survive, passing this useful trait to the next generation. But one problem that came with this new ability is our tendency to apply it to several things that don't have minds at all.

The triangle, the circle, and the slightly smaller triangle

In 1944, a group of psychologists showed volunteers a simple, short animation. The video showed a triangle, a circle, and another slightly smaller triangle against a white backdrop. The only other object in view was a larger rectangle with a "door" that could be opened and closed by the shapes passing through it.

The movement speed was varied, while the objects performed various actions such as leaving the rectangular "house" and moving around it, or jostling up against one of the other shapes. After the video, the participants were asked to describe what happened in it. With the exception of one volunteer (who described the physical movement of geometric shapes), all the participants, of course, anthropomorphized the hell out of the shapes. One triangle was labeled an "aggressive bully" that was fighting the other smaller triangle for the affections of a circle, which was sometimes said to be sleeping around. They even labeled one of the triangles "dumb, stupid" and "apt to get confused", in a move that would have Pythagoras rolling around in his grave.

People, in short, will ascribe motivation and character to just about anything given half the chance, and even when presented with a few shapes will exclaim with confidence "that thick oval over there definitely wants to bang that rhombus".

So, where do gods come into this?

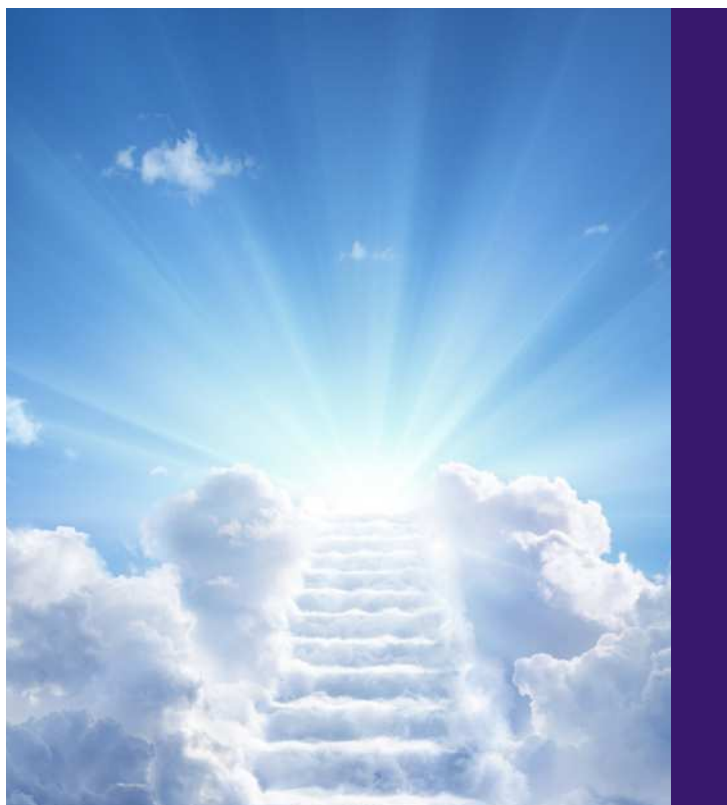
How does our belief that a triangle is a three-sided bullying jerk lead to belief in a god? Well, according to the theory put forward by psychologist Justin

Barrett, our overactive tendency to ascribe agency to objects and concepts without agency (for instance, the Sun, thunder, or the wind) **may have led us** to see a particularly fierce storm and assume it to be angry, or evidence of divine intervention (hence Sun and thunder gods).

As such, belief in these gods can be seen as a (largely harmless) by-product of a generally useful feature of the human brain. People who have this overactive tendency to ascribe motive to inanimate objects and concepts are more likely to survive and pass it along. There are fatal consequences to not recognizing that a lion's motive is it is going to kill you, but the only downside to believing the wind is angry at your lack of respect is you may look a bit silly if other people don't go along with it.

So, why organized religion?

It's a long way from those early superstitions to you sitting in church on a Sunday and hearing about how wearing mixed cloth will earn you an eternity spent in hellfire. Psychologists, sociologists, and



anthropologists have attempted to explain the rise of organized religion and the possible benefits it has for society, ensuring its continuation.

Explanations range from the functional (religion, with its enforced values, encourages cohesion) to the sinister (one psychologist, Matt J. Rossano, **suggests** that implying you are being watched by a supernatural agent will help you stick to society's agreed code).

As pleasing as that explanation might be for any atheists out there, it's not the whole picture. People are not just religious out of fear of an ever-watching god. For religion to persist as it has, there must still be something in it beyond this fear, or the benefit of survival (long after it's the case that it would be helpful for us to ascribe motive to the wind).

What's in it for me?

Imagine the scene from *Scarface* where he snorts a pile of blow before taking on the authorities with a machine gun. Now picture the same scene, but this time Al Pacino is frantically running down a line of prayer stools, kneeling on each one in prayer.

OK, praying isn't quite on par with doing blow, but **research has found** that religious experiences (as reported by Mormon volunteers scanned inside fMRI machines) activate regions of the brain including

the nucleus accumbens, an area that is "a common pathway for chemically altered euphoric states associated with many drugs of abuse, including cocaine and methamphetamines". The research into the effects of religion on people, though not extensive, does find other tangible benefits to it. Religion, as uncomfortable as it may be for rational beings moving away from the superstitious, has benefits for the religious.

RELIGION, IT TURNS OUT, REALLY IS THE OPIUM OF THE MASSES. KARL MARX JUST MISSED THE FACT THAT IT WAS ALSO COCAINE.

"Most studies have shown that religious involvement and spirituality are associated with better health outcomes, including greater longevity, coping skills, and health-related quality of life (even during terminal illness) and less anxiety, depression, and suicide," one group of researchers reviewing the literature **concluded** in 2001. **Others have found** that people who consider themselves religious tend to score better in terms of mood, well-being, and pain intensity than non-religious people.

Religion, it turns out, really is the opium of the masses. Karl Marx just missed the fact that it was also cocaine. •

Image Credit: Bottom: duncan1990/Stock. Background: AnnaMaria Varco





Image Credit: Sve82/Shutterstock.com

HERE BE FRIED EGGS

A lot of money has gone into blasting off to space of late, but if your astronomical interest piques at the prospect of alien life, you needn't look any further than Earth's oceans for some wacky species. Case in point: the fried egg jellyfish, *Cotylorhiza tuberculata*. Also known as egg-yolk jellies, for obvious reasons, their rounded eggy bells can pulse for active swimming, though they spend most of their time motionless. Animals such as crabs like to hitch a ride on these jellies, safely cruising on the non-stinging end.



Image Credit: kanyakits/iStock

WHERE'S THE BEST PLACE TO WAIT OUT A ZOMBIE APOCALYPSE?

THE LIVING DEAD HAVE TO STAY INTACT TO BE A THREAT, SO WHERE'S THE BEST PLACE TO WAIT IT OUT?

By Rachael Funnell

Allow us to set the scene: the Centers for Disease Control and Prevention (CDC) has been on the radio (TV is lost to you now), a body-invading pathogen has given rise to a deadly pandemic that causes humans to become bloodthirsty savages. The living dead have arrived, and they WANT YOU to let them feed on your life force. The only downside to their evil plan? They're dead, and dead things don't last forever.

If we were to suspend disbelief and ignore all the science that tells us zombies aren't real (that is, if you ignore the near-dead insects being marched around by **body-snatching fungi**), what does it have to say about how long the living dead could realistically last in the elements? If we brave survivors really did just go to The Winchester, have a nice cold pint, and wait for it all to blow over, how long can we expect that lock-in to go on for?

We wanted to know, and so we got on the phone to the lovely folks over at the **Institute of Human Anatomy** in Salt Lake City, USA, to find out.

28 Days Later showed us a breed of zombie that's quick on its feet. What do they need to be running around like that?

Justin Cottle: If we're talking bare minimum, first you need joints that are capable of movement. Then two, you need muscles that are capable of producing that movement. And then three, you need an operating nervous system that can send the proper signals to the muscles to produce that movement.

Jonathan Bennion: And this is all assuming that no decay occurred in the muscle tissue because after somebody dies, one of the first things that happens is some of the contractile proteins within the muscle tissue start to degrade.

We take it for granted how amazing it is just to contract and coordinate skeletal muscles. We've got to get a signal from our motor cortex to initiate a movement. It's got to go down our spinal cord and out to the various nerves. If you're talking about running, multiple nerves go to the quadriceps, the hamstrings, the posterior calf muscles, the anterior calf muscles, and all the stabilizers in the ankle. Assuming it's still intact, all of that would have to occur for a zombie to actually be sprinting down the road after you to get your brain.

If you were somewhere hot and humid, how long is it going to take for all that to fall apart?

JC: Here, details matter. Are we at 100 percent humidity, or are we at 80 percent? And humidity is not just an issue because of water content, but also because where there's humidity there tends to be a lot of life forms. There are going to be more microbes. Depending on the humidity, I would say a zombie is lasting hours to maybe two days, at most, in a hot place.

JB: Then there's the other extreme. We've seen bodies that have been preserved in ice. It really depends, but I think in those two extremes... as far as freezing cold where the **body gets frozen**, that would definitely slow the decay process.

If a zombie apocalypse was declared tomorrow, where are you going?

JC: I'm rewatching *Game Of Thrones* and it's funny to me that everyone is trying to run from the White Walkers. They're coming from the North, so if it were me, I would like to sneak around them, get behind them so I could be in the cold place. I would want to go colder, because if it's colder, those joints and muscles are going to be tight and not working well. I will happily put on an extra coat or two – which, by the way, is a good buffer for scratching and biting – in order to combat the zombie hordes.

JB: Some sort of northern cold fortress, if I could find one.

What's your favorite zombie variety?

JC: If we're talking about things I find intellectually interesting, versus what would I rather be in? I think I would probably choose George A. Romero-type zombies. Like back in the '70s, before they're just full-on sprinting. I don't want *World War Z*, that seems terrifying. I don't want *I Am Legend*, that's just horrifying on a huge level. I want my zombies slow, and very, very cognitively incapable. But I think the zombies from *The Last of Us* are by far the coolest.

JB: That's funny. I was actually going to say *World War Z*. I love that idea of using some sort of science or pathogen that makes you invisible to the zombies, so they don't want you. They are pretty aggressive, though. So if you haven't figured out how to inoculate yourself with a virus that doesn't kill you then you're dealing with very aggressive and fast zombies.

So, where are you going? •



SCIENCE FACT OR FICTION:

HOW WE KNOW ASTROLOGY ISN'T REAL

Astrology isn't just implausible, it's been scientifically tested many times despite the slipperiness of adherents' claims, and it seldom performs well, Stephen Luntz writes.





Astrology (not to be confused with astronomy) still has plenty of fans, some of whom even base major life decisions on planetary movements. Yet it's also so widely disreputable, it's the most common point of comparison to dismiss something as baseless. However, not everyone who holds astrology in contempt knows why. Although physics and astronomy have undermined any plausible mechanism by which astrology might work, it is social



sciences such as psychology that have bridged the gap between incredulity and demonstrated failure.

It wasn't always like this. Johannes Kepler, one of the greatest astronomers of all time, was an astrologer as well, and probably wouldn't have made his discoveries without his astrological investigations. Until Kepler published his work in the 17th century, planets were widely thought to travel on crystal spheres, possibly pushed by angels, so the idea they controlled events on Earth wasn't such a leap. Consulting a doctor also often came with a side serving of astrology.

***"THE FAULT, DEAR BRUTUS, IS NOT IN
OUR STARS, BUT IN OURSELVES"***
- WILLIAM SHAKESPEARE,
JULIUS CAESAR

Even then, however, not everyone was convinced – in a play written when Kepler's work was just beginning, Shakespeare had Cassius say: "The fault, dear Brutus, is not in our stars, but in ourselves". The more we learned about the heavens, the less sense astrology made. The discovery that stars lie

at vastly different distances, with the closest thousands of times further away than any planet, makes constellations a handy fiction. How then could a planet's movements "through" the Zodiac have any significance? Moreover, known forces all weaken with distance, yet astrologers treat Venus and Saturn as wielding equal, albeit different, influence over our lives.

These and other astronomical lessons justifiably encouraged skepticism among those aware of such things, but on their own do not amount to disproof. After all, the argument for Earth's "continental drift" suffered decades of ridicule primarily for lack of a plausible mechanism, only for one to be found at mid-Oceanic ridges. Carl Sagan refused to sign a statement by leading astronomers called "Objections to Astrology", in part because the absence of a mechanism alone was insufficient to prove it false.

How do you test astrology?

Many scientists, with varying views on astrology's merits when starting, have set out to test its claims. Doing so, however, runs up against one of the key issues that made people suspicious of astrologers even before Galileo and Newton: the vagueness and contradictions in astrologers' claims.

***SUCH CLAIMS ARE HARD TO TEST,
SINCE MOST PEOPLE CAN SEE A BIT OF
THEMSELVES IN VAGUE AND LARGELY
COMPLIMENTARY DESCRIPTIONS,
SUCH AS THOSE TYPICALLY
PROVIDED BY HOROSCOPES.***

If a dozen astrologers all make different predictions based on planetary motions, it's a fair bet some will be right. Even if testing proves they on average did no better than chance, those who picked right will announce they are the true keepers of the sacred knowledge, and the rest are charlatans and fools.

That hasn't stopped scientists from trying, though. When predicting events for the year ahead, astrologers have consistently failed

to outperform people merely extrapolating from the past. Beaten on this account, astrology's defenders moved to safer ground, claiming their practice tells us about personality, but not fate.

Such claims are even harder to test, since most people can see a **bit of themselves**, or their loved ones, in vague and largely complimentary descriptions, such as those typically provided by horoscopes.

Nevertheless, scientists have found innovative ways to add a little rigor. A few such studies do appear to provide support for astrology's claims. Even in these cases, however, a deeper look tends to encourage skepticism.

An attempt to see whether personality variations between twins could be explained by astrology **claimed success**, for example, but a **second look** found an abundance of flaws in the study. When these were removed, the effect

disappeared. Three Indian psychiatrists provided the birth dates, times, and places of 150 people, half of whom had been diagnosed with mental illness, to four astrologers. Based on birth details and gender alone, the astrologers were **challenged to predict** which birthdates belonged to those who had been diagnosed, their symptoms, and the state of their mental illness at the time. The astrologers did perform better than chance in predicting who had suffered mental illness at some point, and who was suffering at the time. They failed, however, at predicting specific symptoms. More significantly perhaps, the astrologers showed little agreement with each other in their predictions, normally a requirement for science.

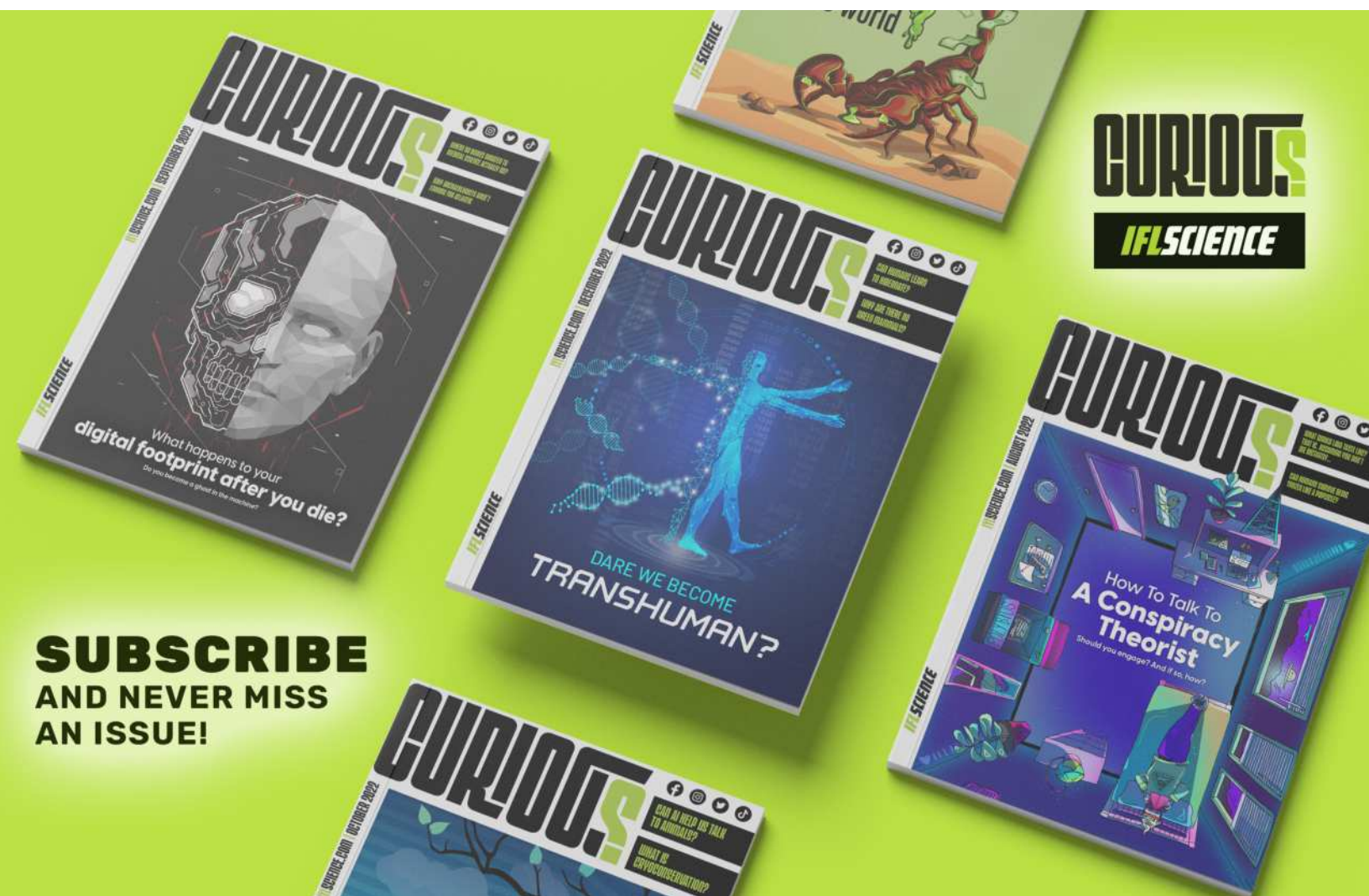
More frequently, studies that report astrological influences fail the replication of results. A famous example was the so-called "**Mars Effect**", when astrologer and psychologist Michel Gauquelin claimed

French athletes were more likely than the general population to be born when Mars is rising or peaking. Similar tests have found no such effect in the United States.

Big data steps in

Some astrological claims, however, can be tested using enormous databases. One such **study** looked to see whether the star signs people marry are randomly distributed, or if they match astrologers' compatibility advice. "If there is even the smallest tendency for Virgos to fancy Capricorns, or for Libras to like Leos, then we should see it in the marriage statistics," the University of Manchester's Dr David Voas said in a **statement**. By Leos, Voas presumably meant those born between July 23 and August 22, rather than those who share their name with a famous actor.

Despite a 20 million-person sample size he referred to as a "giant magnifying glass", Voas found no patterns at all.



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Indeed, even the more plausible astrology-adjacent claims tend to fail such large sample tests. People who scoff at the power of planets may have no trouble with reports of the influence of the full Moon. Yet before becoming an Australian parliamentarian, Professor Andrew Leigh conducted a study to see if lunar cycles correlated with births, deaths, or even conceptions. Over a 29-year period, even modest effects were **ruled out**.

A meta-analysis of **37 studies** testing the influence of the Moon on everything from crisis calls to mental hospital admissions showed lunacy is a misnomer. The few studies that reported a link had failed to control for other cycles, or failed other basic forms of analysis.

If even the Moon, close enough to rule the tides, has no measurable effect, it is hard to see how the planets could exert an influence.

All in the timing

Complicating matters is the fact that the timing of your birth can influence your fate in ways that have nothing to do with astrology. Rates of schizophrenia are **higher among people** born in early spring, at least far from the equator. Several studies have indicated this is due to fetal **vitamin D deficiency** during a key stage of development. The fact it occurs during different months in Tasmania and Scotland proves the issue is the amount of sunlight, not the stars behind the Sun at the time.

Athletes are **more likely to be born** just after the cut-off point for sporting age brackets, January or July. At elementary school, being the oldest by even a few months makes it easier to excel at sport, and it seems the effect lasts. Astrologers, however, might argue Capricorns and Cancers are just naturally athletic, although, strangely, that only applies to those born in the latter part of the horoscope period.

Can astrology be a self-fulfilling prophecy?

There is, however, one entirely plausible way astrology could influence our lives; if our beliefs make it so. Some online

dating websites ask for people's star signs, presumably because at least a few of their users are paying attention. If people read enough columns telling them they're incompatible with those born in particular months, it might indeed reduce the chances of them ending up with such a person, making it slightly surprising Vaos found no such effect.

One prominent **study** that claimed to show evidence for astrology reported that people whose Sun was in certain signs were more extroverted than those in the other six signs. Numerous papers by the senior author of the original study, Hans Eysenck, have since been classified as "unsafe" because of errors and **possible manipulation** of data, so when Jan van Rooij of the University of Leiden attempted to replicate the work it wouldn't have been surprising if he found nothing. However, van Rooij **added a twist** by asking the subjects how familiar they were with astrology. He found that those who knew the characteristics assigned to people of their sign did indeed match the predictions, while those who did not know what was expected of them showed no such pattern.

Nevertheless, most tests of astrology don't even find that sort of indirect effect.

Moreover, advances in astronomy have offered some opportunities to test astrology on top of psychological ones. Neptune, for example, was discovered because of its gravitational tug on Uranus. Astrologers quickly adopted it and assigned significance to its position in the sky when people were born. Yet not one of them made a prediction of a previously undetected planet, based on observing some shift in the collective psyche every 13.7 years as Neptune moves to a new Zodiac segment.

Astronomers are on the hunt to find a possible **Planet X** based on the movements of comets and other outer-Solar System objects whose orbits may have been shaped by its gravity. Don't hold your breath for astrologers finding its location first based on working backward from social observations. •



PIGEON CHAIR

In this excerpt from *What If? 2*, xkcd cartoonist and scientific ponderer Randall Munroe answers the burning question: How many pigeons would it require to lift the average person and a launch chair to the height of Australia's Q1 skyscraper?

In a 2013 study, researchers at the Nanjing University of Aeronautics and Astronautics led by Ting Ting Liu trained pigeons to fly up to a perch while wearing a weighted harness. They found that the average pigeon in their study could take off and fly upward while carrying 124 grams [4.4 ounces], about 25 percent of its body weight.

The researchers determined that the pigeons could fly better if the weights were slung below their bodies, rather than on their backs, so you would probably want pigeons to lift your chair from above rather than support it from below.

Let's suppose your chair and harnesses weigh 5 kilograms [11 pounds] and you weigh 65 kilograms [143 pounds]. If you used the pigeons from the 2013 study, it would take a flock of about 600 of them to lift your chair and fly upward with it.

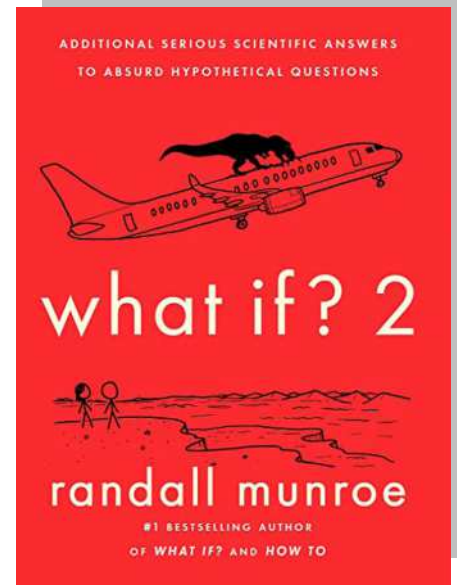
Unfortunately, flying with a load is a lot of work. The pigeons in the 2013 study were able to carry a load 1.4 meters [4.5 feet] upward to a perch, but they probably wouldn't have been able to fly too much higher than that. Even unencumbered

pigeons can only maintain strenuous vertical flight for a few seconds. One 1965 study measured a climb rate of 2.5 meters per second [5.6 miles per hour] for unencumbered pigeons, so even if we're being optimistic, it seems unlikely that pigeons could lift your chair more than 5 meters [16 feet].

No problem, you might think. If 600 pigeons can lift you the first 5 meters, then you just need to bring another 600 along with you, like the second stage of a rocket, to carry you the next 5 meters when the first flock gets tired. You can bring another 600 for the 5 meters after that and so on. The Q1 is 322 meters [1,056 feet] high, so about 40,000 pigeons should be able to get you to the top, right?



No. There's a problem with this idea. Since a pigeon can carry only a quarter of its body weight, it takes four flying pigeons to carry one resting pigeon. That each "stage" will need at least four times as many pigeons as the one above it. Lifting one person may only take 600 pigeons, but lifting one person and 600 pigeons would take another 3,000 pigeons.



This exponential growth means that a nine-stage vehicle, able to lift you 45 meters [148 feet], would need almost 300 million pigeons, roughly equal to the entire global population. Reaching the halfway point would require 1.6×10^{25} pigeons, which would weigh about 8×10^{24} kilograms [1.8×10^{25} pounds] – more than the Earth itself. At that point, the pigeons wouldn't be pulled down by the Earth's gravity – Earth would be pulled up by the pigeons' gravity.

The full 65-stage craft to reach the top of the Q1 would weigh 3.5×10^{46} kilograms [7.7×10^{46} pounds]. That's not just more pigeons than there are on Earth, it's more mass than there is in the galaxy.

A better approach might be to avoid carrying the pigeons with you. After all, pigeons can get up to the top of the skyscraper themselves, so you might as well send them ahead to wait for you there instead of having their friends carry them up with you. If you could train them well enough, you could have them glide along at the appropriate height, then grab you and tug you upward for a few seconds when you reach their altitude. Keep in mind that pigeons can't grab and carry things with their feet, so they'd need little harnesses with aircraft-carrier-style hooks to intercept you.

With this arrangement, it's possible you could fly yourself to the top of the tower with just a few tens of thousands of well-trained pigeons. ●

AUTHOR
Q&A
 WITH
RANDALL MUNROE
 ENGINEER, CARTOONIST, AND AUTHOR OF *WHAT IF? 2*

In his new book of curious questions, *What If? 2*, engineer and cartoonist Randall Munroe explores the kind of odd thoughts that are prone to plaguing us in the shower such as: What would happen if the Solar System was filled with soup out to Jupiter? And how many calories does Mario burn in a day? We spoke to the author about the unexpected side effects of doing comics about science and math.

How did xkcd come about?

I went to college for physics, but I spent a lot of time during lectures doodling in my notebooks, a mix of science-related drawings, charts, and stick figure jokes.

Eventually, I scanned some of the drawings and put them on my website so I could send them to friends. I was surprised when total strangers started sharing them around, but it was really nice to discover how many other people shared my interests in these random topics and laughed about the same stuff I did.

Tell us a little about *What If? 2*

One of the unexpected side effects of doing comics about math and science was that people started sending me weird questions to answer. The messages would usually say something like, "my friend and I have been arguing about this science question, and we don't know how to calculate the answer, but it seems too silly to bother a real scientist with. So, we decided we'd ask you!" I always loved these questions and spent a lot of time answering them. Eventually, that turned into *What If?*, my book of answers illustrated with stick figure comics. Publishing that book led to even more people sending me their questions, especially parents sending questions from their kids.

Do you have a favorite absurd hypothetical question from the book?

A lot of my favorite questions come from little kids; they often seem to ask much better questions than adults. I think adults tend to try to make their questions sound smart and scientifically interesting, whereas little kids just ask simple, straightforward questions they want to know the answer to. Maybe my favorite came from a five-year-old named Amelia, who asked "what if the solar system was filled with soup out to Jupiter?" Answering the question involves some fun calculations and a journey into black hole physics. (Spoiler: It doesn't end well for Earth!)

Who is the book for?

Me, I guess! I don't really have a specific reader in mind when I'm going through the questions people send in; I just look for ones that make me curious about the answer. Once I've figured out the answer, I try to illustrate it in a way that shares the neat stuff I've learned. I've met little kids who know every chapter of my books, and people who say they use the book to bond with their retired engineer parents. It's really sweet. I guess the question "what would happen if you poured soup into the Sun?" doesn't really have a specific age group.

What do you get up to when you're not drawing and answering absurd hypothetical questions?

I spend a lot of time going down research rabbit holes, reading weird scientific papers or Wikipedia articles that don't have anything to do with what I'm supposed to be working on. But often that stuff turns out to be useful for some question someone asks later on. And even when it doesn't, it's fun to learn about. I also like photography – I spend a lot of time taking pictures of planes, space, birds, eclipses ... really, just anything up in the sky. The sky is full of neat stuff! •

What If? 2 is published by
Riverhead Books and is
available to buy now.

RRP \$30.



Winter transforms Abraham Lake in Canada into nature's frozen lava lamp as bubbles of methane are thwarted on their way to the water's surface. Though they be pretty, they be fierce, packed full of a potent form of greenhouse gas.

FROZEN BUBBLES FORM IN CANADA'S ABRAHAM LAKE

If you can brave the freezing temperatures of Abraham Lake in January, you'll be rewarded with one of nature's great curiosities as you walk above thousands of frozen bubbles. The diaphanous spheres are beautiful, but they also pack a punch, formed from a highly flammable and potent form of greenhouse gas.

The bubbles of methane form on the bed of the lake where microbes feed on decomposing organic matter, like dead animals and plants, releasing gases. Methane doesn't like to stay trapped in water, so it forms bubbles that float to the surface. In summer, they are released, contributing to Earth's methane emissions, but in winter they can get trapped on their way to the surface.

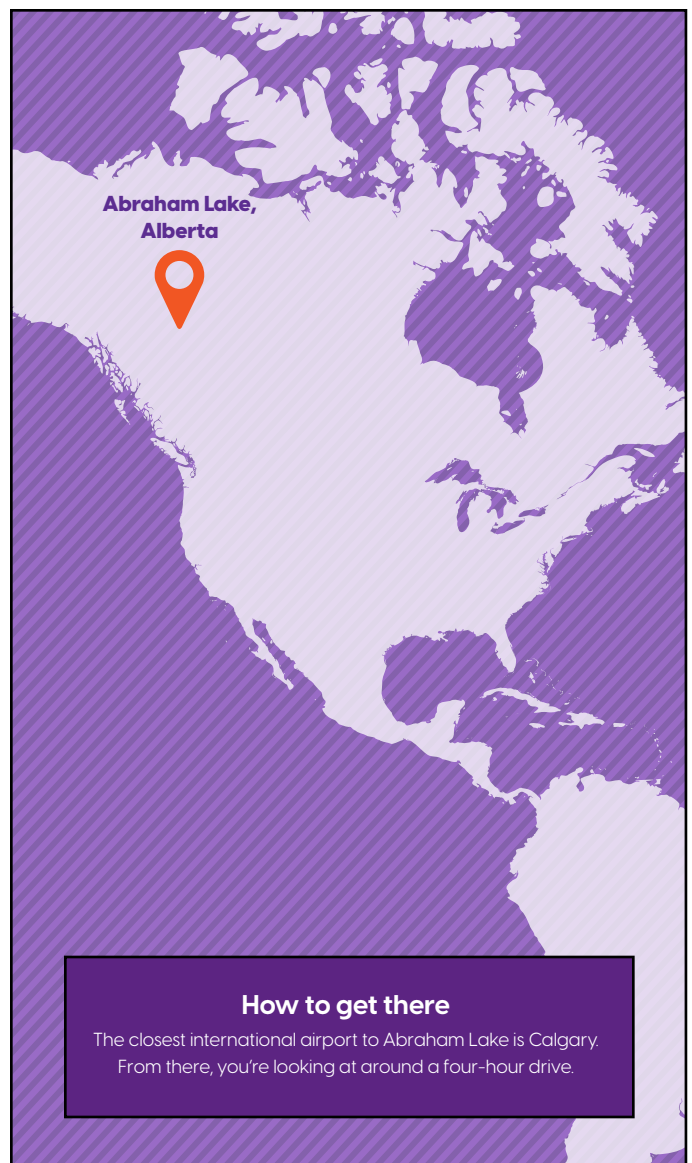
There are some **cool videos** online that demonstrate what can happen when these frozen bubbles release their methane burps in the presence of fire, so leave your lighters at home.

The bubbles eventually go out without much of a bang when the temperature warms in spring and the ice melts. Provided no unsuspecting passersby have chosen the moment of melt to light up a cigar, the gas will seep silently out of the ice and into the atmosphere. Here, it becomes a bit of a problem.

Abraham Lake isn't alone in burping out methane during its annual thawing. There are lakes all over the globe doing it, but some of the greatest concentrations of stored methane sit in Arctic ice, which is under threat from the ongoing climate crisis.

So, if you find yourself in Canada at this frosty time of year for the country, take a stroll across nature's frozen lava lamp. These bubbles are a remarkable quirk of nature, and a reminder that there's work to be done if we're to have frozen microbe burps to admire in the future.

The best time to see the frozen bubbles is in January and February. Strolling on ice always comes with its challenges, but there are **online guides** to help you explore safely. ●



How to get there

The closest international airport to Abraham Lake is Calgary. From there, you're looking at around a four-hour drive.

WATCH

Star Wars: The Bad Batch, Season 2

Series on Disney+

Streaming January 4 is the second season of Disney+'s *Star Wars: The Bad Batch*. Months on from the events of the first season, the sequel follows Clone Force 99,



aka the Bad Batch, as they navigate an ever-changing galaxy following the fall of the Republic. The series is a spin-off of *The Clone*

Wars and sees an intrepid squad of clones – Hunter, Wrecker, Crosshair, Tech, Echo, and sidekick Omega – tackle treacherous mercenary missions. Each has a unique genetic mutation, which will be explored further in season 2.

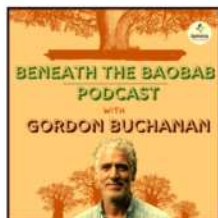
Available to stream on Disney+ from January 4.

DEBATE

Beneath The Baobab

Podcast with Gordon Buchanan

Species extinction is now a bigger and more pressing issue than ever before, with up to an eighth of the world's species at risk. In *Beneath the Baobab* from Jamma International, wildlife filmmaker Gordon Buchanan gives a platform to conservationists from across the globe to debate and discuss complex, controversial, and nuanced topics such as trophy hunting, culling, and human-wildlife conflict.



Available on Apple Podcast, Spotify, and other podcasting platforms.

LISTEN

My Fave Queer Chemist Podcast

Podcast from Bec Roldan and Geraldo Duran

Why not kick off the new year with an episode of *My Fave Queer Chemist*? Hosted by University of Michigan PhD candidates Bec Roldan and Geraldo Duran, the podcast platforms LGBTQ+ chemists, who share their experiences of being queer and working in chemistry. "Chemistry! Queerness! The Trials and Tribulations of Graduate School! MFQC spills the tea on it all," the podcast's site reads. Alongside celebrating the achievements of LGBTQ+ chemists and highlighting the challenges they've met along the way, MFQC aims to educate on "the ins and outs of queer culture" through a science-y lens.



Available on Apple Podcast, Spotify, and other podcasting platforms.

READ

This Mortal Coil: A History of Death By Andrew Doig

Book from Bloomsbury

You may well be sick of gloomy January but if you've room for a little more of the morose we have just the thing to indulge your morbid curiosity. In his first book, Andrew Doig takes a deep dive into the history of death (this book really does do what it says on the tin), exploring why we died in the past, why we die now, and what may cause us to die in the future. Ever wondered why we don't still die from plague, or why cancer and dementia are leading causes of death? *This Mortal Coil* has the answers.



Available in paperback from January 19.

SEE

M3GAN

Film from Universal Pictures

What at first seems an innocuous tale of childhood companionship and technological accomplishment turns out to be anything but in Universal's latest sci-fi horror, *M3GAN*. The eponymous M3GAN is a marvel of artificial intelligence (AI), designed to befriend, teach, and most importantly protect eight-year-old Cady. But all is not as it seems. Things soon take a dark turn as the incredibly life-like AI gains increasing autonomy and becomes progressively more violent in her quest to become the Mary Poppins of the information age.



In cinemas January 6.

SCIENCE IN MEDIA





DATES TO REMEMBER

New year, new you, new dates to remember. January gets 2023 off to a flying start with plenty of awesome science to get involved with. As we say hello to a new year, we also welcome in Veganuary, celebrate science fiction, and get the opportunity to check out the year's first meteor shower.

JANUARY 1-31



National Mentoring Month

Every January is National Mentoring Month: a month dedicated to celebrating and expanding the mentorship movement for young people in the US. The campaign was launched in 2002 by MENTOR, a nonprofit organization that has provided millions of young people with invaluable mentorship opportunities since its inception 30 years ago. "By harnessing our collective voice, MENTOR advocates for mentorship, legislative priorities, and raises awareness for how one conversation, one experience, and one mentor can change a young person's life." You can find out more about the campaign and its **importance in STEM** on **MENTOR's website**.



Veganuary

The first month of the year is Veganuary – the annual challenge run by a UK nonprofit that encourages people to try veganism for 31 days. In 2022, 629,000 people from more than 220 countries and territories got involved, numbers which – the organizers hope – will only increase in 2023. By supporting people in their bid to ditch meat and dairy, Veganuary aims to evoke corporate change and promote a healthier future for ourselves and our **planet**. You can find out more **here**.

1-31

National Sci-Fi Day

Good news sci-fi fans, National Science Fiction Day is back! January 2 offers the chance to embrace your inner (and outer) nerd and celebrate all things science fiction, on the anniversary of the birthday of renowned sci-fi writer Isaac Asimov.

2



Quadrantids Peak

Catch the first meteor shower of the year in early January, as the Quadrantids reach their peak on January 3-4. Unfortunately, the nearly full Moon (on January 6) will block out fainter meteors, but lucky stargazers may still be able to catch a glimpse of larger space rocks whizzing by.

3

14

World Logic Day

Yes, there's a day for everything, and today is UNESCO's World Logic Day. The ability to think logically and rationally is one of humanity's defining features and yet, as the last couple of years has demonstrated, it appears to be falling out of favor. Challenge your friends, family, school, or co-workers to some logic puzzles and celebrate an important tool in the development of the sciences.



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

Choose how you end each issue. For those who prefer the darker side, Francesca Benson explains how putting a microphone in your toilet could save your life. If you like your science lighter, Maddy Chapman discovers how music playlists can help beat the January blues.

LISTEN TO YOUR TOILET

Ever wanted to analyze your bowel movements without having to gaze into the porcelain throne or share the view with a doctor? A new machine-learning audio sensor might do the trick.

Maia Gatlin, a researcher at the Georgia Institute of Technology, has described a new way of using your stool as a tool for diagnosis by placing a microphone in your loo in her aptly named "The feces thesis: Using machine learning to detect diarrhea," presented at the 183rd Meeting of the Acoustical Society of America.

Gatlin and her team trained the algorithm on pooping audio from online sources (is this something people are putting out there on the Internet?) that was transformed into a spectrogram, with different toilet activities being categorized using different spectrogram features.

On the surface, this concept may seem comical, but the motivations behind it are very serious. According to the **World Health Organization**, diarrhea kills roughly 525,000 children under five years old annually – the second leading cause of death and a major cause of malnutrition for this age group. Monitoring bowel diseases is tricky and

sensitive, so this could be a good way of identifying the condition without revealing any identifiable or personal information.

SCIENTISTS THINK THERE IS PLENTY OF UNTAPPED POTENTIAL FOR GATHERING HEALTH DATA FROM THIS UNLIKELY SOURCE, IF PEOPLE COULD JUST GET OVER THEIR AVERSION TO THE DISTASTEFUL DEPOSITS.

"The hope is that this sensor, which is small in footprint and noninvasive in approach, could be deployed to areas where cholera outbreaks are a persistent risk," Gatlin said in a **statement**. "The sensor could also be used in disaster zones (where water contamination leads to spread of waterborne pathogens), or even in nursing/hospice care facilities to automatically monitor bowel movements of patients."

This isn't the first "smart toilet" concept to be floated. Researchers have previously harnessed artificial intelligence to **study images of stool samples** as they go down the pipes, with others **capturing samples** to screen for pathogens and even analyzing your "anal print".

Scientists think there is plenty of untapped potential for gathering health data from this unlikely source, if people could just get over their aversion to the distasteful deposits.

BEAT THE JANUARY BLUES

January may be widely considered the saddest month of the year but, thanks to the power of music, it doesn't have to be. Researchers from Hong Kong University of Science and Technology have designed a blues-busting app that uses music to counter melancholy. And it could be just the tonic to help you fight those Blue Monday blues.

Music can illicit strong **emotional responses**, it can improve memory and mood, distract us from negative thoughts, and it may even have a therapeutic effect.

BY CURATING INDIVIDUALLY TAILORED PLAYLISTS, THE APP AIMS TO HELP LISTENERS IMPROVE THEIR EMOTIONAL STATE, LEAVING THEM MORE POSITIVE AND FOCUSED.

"As humanity's universal language, music can significantly impact a person's **physical** and emotional state," said Man Hei Law, who presented the app at the latest meeting of the Acoustical Society of America, in a **statement**. "For example, music can help people to manage

pain. We developed this app as an accessible first aid strategy for balancing emotions."

By curating individually tailored playlists, the app aims to help listeners improve their emotional state, leaving them more positive and focused.

How can your tunes be so tuned-in to your emotional needs? Users of the app start by taking three questionnaires to assess their current and long-term emotional status. These include a Patient Health Questionnaire, a General Anxiety Disorder screening, and a pictorial assessment to ascertain energy level and mood.

The app then gets to work creating personalized playlists in accordance with your emotions – think Spotify meets Headspace. Playlists reflect one of three themes: consoling, relaxing, or uplifting. Consoling playlists compliment your energy and mood, while relaxing playlists provide positive, low-energy music, and uplifting playlists aim to inject some higher energy.

"In our experiments, we found out that relaxing and uplifting methods can significantly move listeners from negative to more positive emotional states. Especially, when listeners are at a neutral mood, all three proposed methods can change listeners' emotions to more positive," Law added.

Catch us downloading ASAP. January blues, who?



The Darker Side of Science



THE LIGHTER SIDE OF SCIENCE