

CURIOS



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DURING MUMMIFICATION?

CAN FEAR BE FUN?

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NEWS BITES



WE'RE GOING TO EUROPA!

In just a few days, the largest spacecraft NASA has ever built for a planetary mission will launch on its way to study Jupiter's moon Europa.

Considered one of the most likely places to find currently habitable environments beyond Earth, beneath the moon's icy crust is a vast salty liquid ocean – we think. Europa Clipper's mission is to determine if there are places below the icy surface that could support life.

It will, however, orbit Jupiter, not its moon, carrying out around 50 flybys of Europa. To do this, thanks to radiation trapped in Jupiter's magnetic field, Clipper has to be tough. It will have a similar shield of titanium and aluminum to Juno but is about 5 meters (16 feet) in height, and when its arrays are deployed is just over 30 meters (100 feet) across. Tucked away in its vault it also carries a microchip that holds 2.6 million names, poetry, artwork, and the word for water in 103 languages – you know, just in case it turns out we are not alone when we get there.



Ring Of Fire

On October 2, an annular solar eclipse (also known as a ring of fire) will be visible from well, the Pacific Ocean mostly, so get yourself to the southern tip of North and South America, French Polynesia, Rapa Nui, or Antarctica – or just follow along with NASA as they livestream it. A “ring of fire” eclipse is when the Moon is a bit too far away from Earth to cover the Sun completely, so it leaves a little halo peeking out around it. It will last around 7 minutes, however, 95 percent of the eclipse path will pass over open ocean. Don't be disheartened, a total lunar eclipse – when the Moon turns red – will be seen everywhere in March next year.



Godzilla Turns 70

At 70, some might be considering retiring; but not Godzilla, who has never been more relevant. Making his silver screen debut in the 1954 Japanese movie *Godzilla*, he has stomped his way through almost 40 movies, making him the Guinness World Record holder for longest-running film franchise. He has gone from Japanese antagonist to American protagonist before starring as both last year in *Godzilla x Kong* and the far superior, Oscar-winning *Godzilla Minus One*, returning to his origins as a metaphor for the unstoppable force of nuclear power and its effect on ordinary human citizens. Nuclear weapons have only been utilized twice in history – on Japan by the US in WW2. Despite countries working to limit the number of nuclear weapons, there are still over 12,000 in existence today. In fact, the world **spent \$250 million** on nukes a day last year. Having Godzilla return to his roots is a way of reminding us never to repeat that mistake. Want to know what would happen if a nuclear blast went off today? Well, no you don't, but you can **here**.

Our Planet Live

If you loved the David Attenborough-narrated Netflix natural world series *Our Planet* and you want to know more, then the new *Our Planet Live* experience is for you. A new and immersive live show that features behind-the-scenes stories from the filmmakers, explorers, and scientists who caught the magic on camera with live speakers to entertain and inform, giving an in-depth insight into what goes into making these shows and delving into the natural world like never before. Touring North America from now until April 2025, find out more **here**.



See Planet Earth's Future

What will Earth look like in 2125? You can now get a glimpse of the future and how human actions have shaped our planet in the Natural History Museum, London's new immersive exhibition *Visions of Nature: A mixed reality experience*. Wearing state-of-the-art Microsoft mixed reality headsets, visitors will be able to explore how species have adapted to the threats they face in the 21st century, aided by humanity. Your built-in co-pilot Hope will describe what you're seeing along the way, from the nearly extinct Darwin's frog now making a home in urban Chile to the increase in narwhal-beluga hybrids created by the melting ice sheets. Opening on October 24, find out more [here](#).

Zoom Out

Videoconference fatigue (VF) is real, but this one weird trick will help you bounce back. Yes, that sounds like a dodgy online advert, but according to new research, there is a quick fix to get your groove back: change your background. Essentially the more chill – and still – your background the better. People experienced VF the most with moving or blurred backgrounds as the stimuli interrupts users' attention. A static background was better, but a nature-themed background was best. Light-hearted and fun backgrounds also relaxed participants – as long as they were meeting-appropriate! You can't blame us if HR has a word about that giant photo of your livid cat wearing a **crochet hat** while you present the year's budget.

WHAT'S UP?



Comet Spotting

Time to keep your eyes on the skies

Name: C/2023 A3

(Tsuchinshan–ATLAS)

Appearance: A fuzzy, bright white ball with a tail behind it – if it stays intact, that is

Location: 70.6 million kilometers (43.9 million miles) away from Earth

...Hang on. Haven't we seen this comet before??

Yes – at least if you had access to a telescope. That's how it was first discovered back in early 2023, before it vanished from view in July this year.

Where did it go?

Somewhere, but also nowhere; Tsuchinshan–ATLAS hasn't actually disappeared. It's just been on its summer holidays, destination: the Sun. As it got closer towards perihelion – the point during the comet's orbit at which it's closest to the Sun – it simply became too hard for us to see.

So why are we getting excited about it now?

We're getting hyped because Tsuchinshan–ATLAS is now,

assuming it's survived perihelion (some scientists think it could break up), on its way towards Earth, and it'll potentially be bright enough in the sky that it'll be visible to the naked eye.

How bright will it be?

Here's the frustrating part – comets are fairly unpredictable beasts, which means we'll simply have to wait and see. When Tsuchinshan–ATLAS was first found, there was talk of it being as bright as 1997's Comet Hale-Bopp, famous for its dazzling twin tails. Since then, expectations have mellowed out a fair bit, but one of the more optimistic takes is that it'll be brighter than the star Vega in the night sky.

When will it arrive – and what's the best way to see it?

Tsuchinshan–ATLAS will be at its closest approach to Earth on October 12. If it's as bright as the optimists predict, then head outside at twilight with a stargazing app in hand and you should be able to see it with your eyes alone – unless it's cloudy, of course.

WHY DO WE HAVE PHOBIAS?

Is it evolution or anxiety, and can you ever get rid of them?

By Benjamin Taub



It may not be a pleasant sensation, but fear plays a vital role in helping us identify danger and steer clear of potentially life-threatening situations. Phobias, on the other hand, are irrational fears that, at their worst, prevent people from engaging in everyday life. Unlike regular trepidation, then, the intense panic triggered by these sometimes baseless terrors seems so unnecessary, raising the question as to why phobias exist in the first place.

While it's possible for a person to develop a phobia of anything from beards (pogonophobia) to flowers (anthophobia), the vast majority of terror is reserved for dangerous-looking animals – particularly snakes and spiders – as well as heights, deep water, and needles. From an evolutionary perspective, it's easy to see where such fears come from, given that venomous creatures, falls, oceans, and sharp objects have been claiming lives since time immemorial.

"IT'S TRUE THAT, PREHISTORICALLY, CLOWNS WOULDN'T HAVE BEEN AROUND, BUT CLOWNS, IN MY MIND, REPRESENT A BROADER CATEGORY OF FEARS THAT CHILDREN OFTEN HAVE – FEAR OF COSTUMED CHARACTERS."

However, while a certain level of respect for all of the above is healthy, phobias represent a pathological level of anxiety that significantly impacts a person's quality of life. Yet while losing your job over the fear of encountering a tiny spider might sound ridiculous to some, research suggests that our brains may be hardwired to obsess over certain animals.

For instance, studies have shown that certain neurons react much faster to

images of snakes than to pictures of monkeys, indicating that our vision may be primed to pick out serpents in our environment. Separate research has revealed that young infants are more likely to show signs of arousal when viewing pictures of **snakes or spiders** than when looking at fish, while another **important study** demonstrated that baby monkeys tend to develop a fear of snakes if they see adults acting afraid around serpents, but that they don't develop a flower phobia when they see their parents freaking out near floral images.

"WE KNOW THAT ONE OF THE WAYS THAT THE MEDIA KEEPS US ENGAGED IS THROUGH FEAR."

"We call these prepared fears," phobia expert **Martin Antony** – professor of psychology at Toronto Metropolitan University and co-author of *The Anti-Anxiety Program* – told IFLScience. "Through evolution, we've developed mechanisms to develop those fears more easily than others."

In other words, many of our most common phobias can be traced back to the mortal threats faced by our prehistoric ancestors, who developed a particular aversion to snakes and spiders as a vital defense mechanism. Extending the notion of prepared fears to certain other phobias – clowns and needles, for instance – Antony says that even these modern terrors may have their roots in our evolutionary past.

"It's true that, prehistorically, clowns wouldn't have been around, but **clowns**, in my mind, represent a broader category of fears that children often have, which is the fear of costumed characters," he muses. "So where would that come from? Well, it might be that kids are predisposed to fear strangers or people who look unfamiliar and maybe could do harm to them, and I can imagine that has some evolutionary value."

Likewise, Antony says that while our prehistoric ancestors wouldn't have received injections, "they would have wanted to avoid having their **skin pierced** by things," thus placing needle phobias in the "prepared fears" category. Similarly, he explains that "fears of contamination that we see in people with OCD [obsessive compulsive disorder] would have some evolutionary value."

Unusual phobias

So if arachnophobia, coulrophobia (fear of clowns), and trypanophobia (fear of needles) all serve an evolutionary purpose, how do we explain less common yet equally **debilitating phobias** of things like knees (genophobia), balloons (globophobia), or getting peanut butter stuck to the roof of your mouth (arachibutyrophobia)?

"I wouldn't say you can't develop a fear that doesn't have evolutionary value, but I would say it's more unusual and more difficult to develop those unprepared fears," says Antony. Generally, these more unusual phobias stem from influential life experiences, becoming ingrained via one of three main "learning pathways".

"SOME OF US ARE JUST PREDISPOSED GENETICALLY TO BE MORE ANXIOUS, MORE REACTIVE THAN OTHERS."

The first and perhaps the most obvious of these is what Antony calls "direct learning", referring to out-and-out traumatic experiences. "So you get into a car accident, you develop a fear of driving; you get bitten by a dog, you develop a fear of dogs, that kind of thing," he says.

Yet the seeds of many phobias are sown far more subtly. For instance, the second pathway, known as observational learning, involves watching others act fearfully around a particular stimulus. In some cases, this can be sufficient

to transfer that sense of panic to an impressionable onlooker.

Then there's instructional learning, which involves language and messaging. "So this includes learning from things that parents say, things that you see in the media, things that you see on television or social media, that may contribute to fear, and we know that one of the ways that the media keeps us engaged is through fear," says Antony. Indeed, with so many horror and disaster movies, not to mention a hefty focus on terrifying news stories, it's no wonder that so many of us have phobias.

"THE GOOD THING IS YOU DON'T REALLY HAVE TO KNOW HOW YOUR PHOBIA STARTED. IN THE END, WHAT WE'RE MOST INTERESTED IN IS NOT WHAT TRIGGERED THE FEAR INITIALLY, BUT WHAT'S MAINTAINING IT CURRENTLY."

At the same time, however, we all have different levels of susceptibility to these cues, with some of us being more resilient to fear than others. Numerous factors contribute to this, including our stress levels, previous experiences, and even genetics.

"Some of us are just predisposed genetically to be more anxious, more reactive than others," says Antony. "It's not like some people are genetically predisposed to fear snakes and other people have a spider genetic predisposition. It's probably more of a general effect making us more [or less] vulnerable to the effects of these learning experiences and giving us a greater [or lesser] tendency to develop fears."

But there is a cure!

"I'll also just mention that a lot of people have no idea why they're afraid," says Antony. Indeed, most people with phobias can't trace their fear back to a particular traumatic episode, and it's likely that in many cases, the trigger can be found in a subtle event from one's early childhood that has long since been forgotten.

"But the good thing is you don't really have to know [how your phobia started]," he continues. "In the end, what we're most interested in is not necessarily what triggered the fear initially, but what's maintaining it currently... and that's typically people's avoidance of the situation [that they fear]."

By rearranging one's entire life to minimize the possibility of encountering heights, or running away screaming whenever a tiny spider enters the house, we reinforce the idea that these things are fear-worthy and that getting away from them brings relief. One of the most effective ways to overcome a phobia, therefore, is through exposure therapy.

As the name suggests, exposure therapy involves facing one's fear head-on in a controlled environment and is so successful that it's not uncommon for patients to completely lose their phobia in a single session. "People stay in the situation [they're afraid of] until they learn that nothing bad happens," explains Antony. "Until they learn, typically, that they can be in that situation and not be afraid."

Like monsters under the bed, phobias control us because we continue to tell ourselves there's something to be scared of, and some vanish after we stop believing in them. Go on, then, take a peek. Perhaps the only thing we have to fear is fear itself – or phobophobia, to use the technical term. ●





Image Credit: Isabelle Ohara / Shutterstock.com

THE CORPSE FLOWER

One of the planet's most alien-like plants has to be the eyebrow-raising giant, *Amorphophallus titanum*. Affectionately known as the corpse flower, it has harnessed the apparent stench of dead bodies to lure in flies for pollinators. It's a potent aroma that out of context would have you fleeing in disgust, but people have queued for hours to get a whiff of this rare bloom. And you see that spotty tree-like thing next to it? Yeah, that's actually a leaf. Find out more about these incredible plants [here](#).



Image Credit: Wirestock Creator / Shutterstock.com

WHAT HAPPENS TO EYES DURING THE MUMMIFICATION PROCESS?

AND WHY IT SOMETIMES INVOLVES ONIONS.

By Rachael Funnell

The mummification process is perhaps one of the most talked about aspects of ancient Egyptian life. It highlights the morbid curiosity shared by those of us alive at a time when funerary practices have gone in a different direction. It's also a skewed view, offering us insights into the death rituals of only the ancient very rich.

The complex process of mummification is one we're still trying to understand, not least because trying to step into the mindset of people living thousands of years ago is tricky when you're burdened with the cultural norms of the 21st century. We know a bit about what they did to their skin, we know a bit about what they did to their organs, but that got us wondering – what happened to the eyes?

We sat down with Egyptologist **Dr Campbell Price**, Curator of Egypt and Sudan at the Manchester Museum and author of *Brief Histories: Ancient Egypt*, to find out. And I must say, I wasn't expecting the onions.

Do you get asked about mummification a lot?

CP: Yeah, this is something people are just morbidly fascinated by. I often think, why are we asking these questions? I guess it's because in the modern, generally secular West, and in other parts of the world, we don't have so much contact with death. So, it's a mystery, and we just want to know more about the ins and outs of decomposition, treating a body.

What happens after thousands of years? Why did they do it? These questions are coming not from an ancient Egyptian point of view,

when all of this would have been fairly straightforward, it would be part of the culture. We're looking from a sort of superior vantage point, we think.

Why did they do it?

CP: The process of mummification was a ritual, aimed at changing the body into something else. Transforming the body, not necessarily preserving the body. And it really only applied to the rich. For the top percent of society for most of Pharaonic times, a greater proportion were being mummified.

The core parts of the ritual, or the process, of mummification are not recorded by the ancient Egyptians. The actual ins and outs of it, the rituals, the incantations, the spells, the amulets and where to put them, the wrapping of the body, which was very important and very expensive, that is alluded to in an ancient text, but we have to rely on Greek and later Roman writers who go to Egypt and have the same morbid fascination of the outsider to ask the people they encounter for the details.

The rules were much less standard than people imagine. Often, the internal organs will be partly or wholly removed from the chest cavity, and the brain will be extracted through the nostrils, but generally, it's about evisceration and dehydration. So, a sodium compound known as natron is applied, which dehydrates the skin, and that was maybe applied for 40 days, so that removes all the moisture from the body. The body is mainly liquid, and then the skin is treated with oils and resins to make it fragrant and durable, like a wooden effigy. Like a statue, because that's ultimately the aim.

You're turning the destructible, decomposable, biological body into something fit for eternity, for the existence of a deity. For the existence of an immortal God, and that is the bit we haven't got right, I think, in our understanding of mummification.

And what about the eyes?

CP: The basic biological facts of it are, if you apply a dehydrating agent to the body, that removes all the liquid in the body. That includes the eyes, which are mainly water, as is most of the flesh. So, the eyes simply shrivel up and retreat to the back of the eye sockets.

There doesn't seem to be any attempt to make a special intervention to preserve them, because you're using a dry desiccant. So, in a way that tells us something that relates to what I've just said: you're turning the body [into something else]. You're not preserving the person as they were, and this is really fundamental to appreciate how we've misunderstood Egyptian mummification.

If you read accounts by medical people from the 20th century talking about preservation of the eyeballs and the ancient Egyptian mummy, they seem baffled that the ancient Egyptians weren't doing this. Given you're using a desiccant, it would be very difficult just chemically speaking to preserve the eyeball.

In some cases, there were active interventions. We know, for example, of the mummy of one of the pharaohs from around 1100 BCE, Ramesses IV. When he was unwrapped, an onion was found in each of the eye sockets. So, there had been an attempt to shape that part of the face.

In other later cases, stone eyes and white and black stones were added. This was judged to be a kind of a sophisticated attempt at approximating life, [but] it's not approximating life at all. It's approximating a statue, because statues have inlaid eyes made of stone, the same kinds of stone.

They are literally treating the body as a divine statue. This causes us discomfort because we want to think of the dead not as objects, but as people, as our loved ones. But the evidence from ancient Egypt seems to suggest that they were very powerful objects. Statues were ways of materializing gods, and that was what you were making when you were treating a mummified body. ●



Want more questions? Head to the We Have Questions podcast where episodes are released monthly. October's episode: What's It Like Working In A Human Tissue Bank?

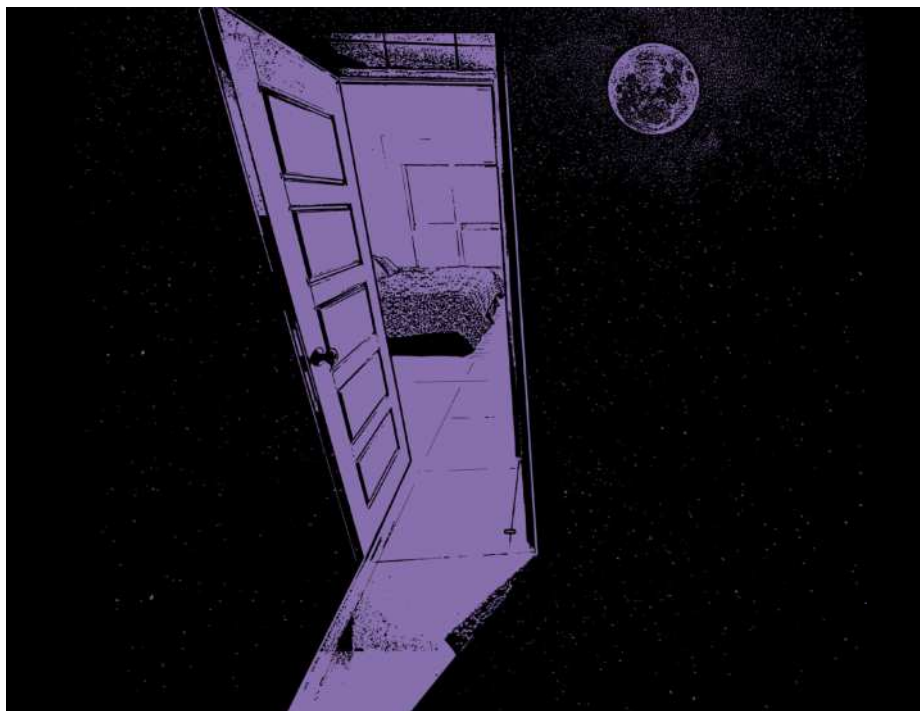
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SCIENCE FACT OR FICTION:

CAN FEAR BE FUN?

From horror movies to haunted houses, why do we do it to ourselves? Rachael Funnell finds out.





IFLScience recently had a bright idea: why don't we cram ourselves into a car, hop on the road, and spend the night in the most haunted castle in Britain? It was a pitch that was met with mixed emotions. For myself and my colleague, Science Writer Dr Russell Moul, it sounded like a blast. Meanwhile, Custom Content Manager Dr Beccy Corkill and Senior Video Editor Chris Carpineti went a little green around the gills (even if it was, in fact, mostly Beccy's idea).

The decision to spend the night at a castle that boasts an above-average number of ghost sightings, as well as its own in-house torture room, shone a light on the different ways people respond to frightening stimuli. That we're going anyway is surely a testament to the fact that even the more hesitant of haunted house visitors can't resist the allure. So, why do we do it to ourselves?

Peek-a-boo

From the minute we can interact, humans begin toying with ways to feel fear. Just look at everyone's favorite jump-scare baby game, peek-a-boo. Tell a kid you're a monster and chase them through the house and what do they do? Giggle! (Well, provided you actually know them.)

These are both early examples of the slightly paradoxical relationship humans have with fear. Ask anyone and they'll tell you it's a negative emotion, but quiz the queue outside the movie theater on fright night and they'll say it's precisely what they're seeking.

Not everyone is chomping at the bit to watch the latest **horror flick**, however, and while some people are giggling their way through the haunted house experience, others are screaming. So, are we **gore-glorifying** thrill-seekers just a big bunch of weirdos, or is it normal to enjoy feeling fear?

"Absolutely," cognitive scientist **Marc Andersen** at Aarhus University told IFLScience. "People tend to forget how there are so many other phenomena outside of horror [that can elicit fear]. People who say that they don't like horror will often like a good thriller, or listening to a true crime podcast; it's really just levels. It's rare to find someone that doesn't like any kind of fear at all."

Andersen should know, having set up the **Recreational Fear Lab** with associate professor in literature and media at Aarhus University, **Mathias Clasen**. It's an institution that comes with a suitably

bad-ass logo, conducting research that provides insights into human behavior and our intriguing relationship with fear.

"Our mission is to conduct scientific investigations of what we call recreational fear: activities that are about deriving pleasure from being frightened," explained Clasen. "It's a really interesting phenomenon because it's not only incredibly pervasive, it's something that you'll see everywhere once you start looking for it, and it's also scientifically neglected."

"MAXIMUM ENJOYMENT IS FOUND AT THE PEAK OF THE RAINBOW, WHICH IS WHEN THE FEAR LEVEL IS JUST RIGHT."

Recreational fear

Everything from taking up extreme sports to going on rollercoasters can fall under the umbrella term of recreational fear, and what scratches the itch for one person may not work on another. Ironically, the optimum "sweet spot of fear" resembles the cute spot of meteorology.

"There's a sort of rainbow-shaped relationship between fear and enjoyment if you plot the two in a coordinate system," said Clasen. "If people are engaged in a recreational fear activity that is too scary for them, enjoyment goes down. But if it's not scary enough, enjoyment is also low. Maximum enjoyment is found at the peak of the rainbow, which is when the fear level is just right."

The *Black Mirror* episode "Playtest" was a great demonstration of how fun fear can turn bad when we get the balance wrong (well, right up until it *really* got crazy). Creating a good horror experience means not tipping that scale, so getting a firm understanding of where the line is could have all kinds of applications in the entertainment sector.

2024 alone has seen the release of highly acclaimed flicks such as *Longlegs*, *A Quiet*

Place: Day One, and *Sting* – a movie all about that favorite of phobias: spiders. Evidently, a lot of time and money are spent on horror, begging the question: why is there so much demand?

ACTING OUT FICTIONAL SCENARIOS CAN PREPARE US FOR THE REAL DEAL. VOLUNTEERING TO HAVE THE BEJESUS SCARED OUT OF US CAN BE A SIMILARLY MENTALLY STIMULATING EXPERIENCE.

Why do we enjoy being scared?

A lot of things in life that we perceive as being fun are actually very beneficial. Play from a young age teaches us all sorts, from better motor skills to **higher intelligence**, and the benefits are reflected in **humans' enduring history with gaming**.

Acting out fictional scenarios can prepare us for when the real deal comes along. It figures, then, that volunteering to have the bejesus scared out of us can be a similarly mentally stimulating experience.

"Our working hypothesis is that it has to do with learning," said Andersen. "Some of the science that we were inspired by comes from play and curiosity research, and those fields suggest that the rewards that are associated with play and curiosity in children – and adults – have to do with you being able to consume the information that you surround yourself with."

"Children tend to be interested in phenomena that somehow moderately deviates from what they know already. So, things they can't quite predict yet, but that they have enough sense of that they might be able to learn about."

"We think essentially that horror and fear work the same way in that if you get

exposed to a manageable amount of fear – whatever that may be given your knowledge, skill sets, and competencies – then that's where you can extract enjoyment. It's really mediated by you learning about that situation or that scenario and gaining control over it."

FEAR CAN TIP SO EASILY INTO EXCITEMENT BECAUSE THE CHEMISTRY THAT GOES ON BEHIND OUR OLD FRIEND "FIGHT OR FLIGHT" IS EQUALLY INVOLVED IN THE ONSET OF POSITIVE EMOTIONAL STATES.

Control is crucial

Control can be pivotal when it comes to hitting the sweet spot or overshooting into all-out terror. Think of it like the thrill you get from surviving the scary bit in a movie,



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AND NEVER MISS AN ISSUE!

which you knew was fictional all along, versus how you feel when you're home alone and suddenly think you might not be.

Fear can tip so easily into excitement because the chemistry that goes on behind our old friend "fight or flight" is equally involved in the onset of positive emotional states. High arousal is shared by good and bad feelings, but what comes next is often at the mercy of our surroundings.

HAVE A BAD RUN-IN WITH A COSTUME CLOWN AT A KID'S PARTY AND YOU MAY GO ON HATING THEM DESPITE KNOWING THEY'RE NOT ALL SERIAL KILLERS.

"A major factor in how we experience fear has to do with the context," write Assistant Professors of Psychiatry at Wayne State University **Arash Javanbakht** and **Linda Saab**. "When our 'thinking' brain gives feedback to our 'emotional' brain and we perceive ourselves as being in a safe space, we can then quickly shift the way we experience that high arousal state, going from one of fear to one of enjoyment or excitement."

So, the context of your horror movie sleepover can help your brain decide which drawer to file your fear in, but where is all that terror coming from to begin with?

The foundations of fear

The source of our screaming is the amygdala, a region of the brain that activates when we see a threat, like an axe-wielding clown. That clown unleashes a cascade of physiological changes that should make us better at escaping it, from dilated pupils and bronchi to an elevated heart rate, respiratory rate, and blood pressure. That gets our blood pumping,

better fueling our muscles so we can leg it, all thanks to the amygdala.

Embarrassingly, it gets shown up sometimes.

Another part of our brain known as the hippocampus can see beyond that clown's cheap rubber mask as the home of higher-level processing of precious context. This enables us to know the difference between coming face-to-face with actual John Wayne Gacy, or bumping into Tracie, the performing arts grad just trying to earn some Halloween bank.

How good we are at differentiating between perceived and real threats comes down to experience, but it can go either way. Have a bad run-in with a costume clown at a kid's party and you may go on hating them despite knowing they're not all serial killers. Depending on the severity of the event, these kinds of personal experiences contribute to phobias, and if you want more on those, might I suggest flicking back to

Our Cover Story?

But what about Chris?

If, like Chris, the prospect of spending the night in a haunted house is not one that sparks joy, you're not alone. As the team over at the Recreational Fear Lab has established, there's no one-size-fits-all when it comes to the sweet spot of fear, and it doesn't have to look like a bunch of ghosts and ghouls and torture rooms. Spooky season is about fun (and the occasional opening of a **gateway to hell**), so don't feel forced to squeeze yourself into someone else's idea of Halloween hilarity.

And on that note, Russ and I need to go strongarm some colleagues into a car. Want to find out how we get on? We'll be releasing a **The Big Questions** special with more insights from the Recreational Fear Lab and audio straight from the castle, so check it out on October 31... if you dare. ●



100 PUGS: WHEN ASTRONOMICAL UNITS GET WEIRD

In this excerpt from *How To Kill An Asteroid*, science journalist and volcanologist Robin George Andrews highlights the importance of educating the public about the danger of asteroids without fearmongering. And a little whimsy can go a long way.

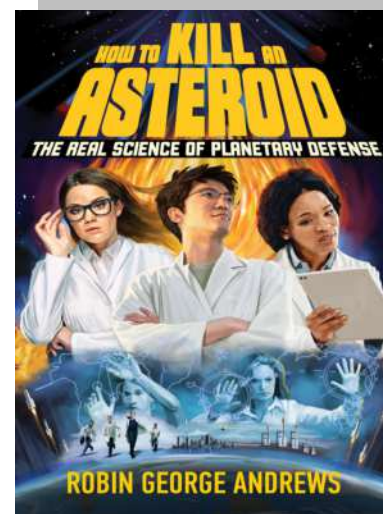
Aaron Reich will never forget the time he measured an asteroid with giraffes. He could have used any metric – hippos might have worked, wolves would have been fun, and axolotls would have been just as useful. But when an asteroid was about to make a routine flyby of the planet back in 2022, his gut told him to deploy the giraffes. And so, on June 1, as 2022 KP3 was primed to zip past us, the Jerusalem Post ran the headline: “Asteroid the Size of a Giraffe to Skim Past Earth This Week.”

Reich is a writer who loves space but hates fearmongering. That’s a good combination. Tabloids around the world, particularly the notorious British ones, love to generate headlines that make anxious people feel compelled to buy papers or click links. In the last decade, online articles about asteroid flybys have been used to grim

effect, making many think that we are always on the precipice of spaceborne destruction. So, thought Reich, why not put a tongue-in-cheek spin on things? Why not make it clear that asteroid flybys are commonplace and nothing to be feared, and bring them to everyone’s attention in a novel way? Thus, the giraffe metric was born – and his article got clicks aplenty.

I asked him about the confusion that emerged online that June, with people wondering how exactly he was determining the size of a giraffe. He laughed and rolled his eyes. From that first piece, he put out hit after hit, measuring harmless asteroids using a massive menagerie, from pandas to platypuses. One story from 2023, in which he described a “corgi-sized meteor as heavy as four baby elephants,” went viral on social media.

“I think the pug one might be my favorite,” he told me. This was in reference to a 2023 article in the Jerusalem Post titled “2 Asteroids the Size of 100 Pugs to Pass Earth Tuesday.” The article goes on: “As stated earlier both asteroids have a diameter that at most measures to around 100 pugs in width, assuming those pugs were stacked on top of each other, paws to shoulders, forming some sort of adorable wheezing leaning tower of pugness.” After noting that asteroid impacts are “far less liked than pugs,” Reich wrote that “rather than one of these asteroids, you are far more likely to be hurt by an actual grumble of 100 pugs rushing towards you at much slower speeds.” News you can use, as they say.



“I try to encapsulate the zeitgeist,” he explained. Although not strictly animals, he compared one asteroid to Oscar statuettes to coincide with the awards ceremony. If he ever runs out of animals, he told me, he can always turn to Pokémon, all of which have verified dimensions. As a journalist, I was curious: What did his editors, who thankfully allowed it to happen, initially think of his approach? “At first they were a bit concerned, but after a bit, they happily embraced it.”

Like David Rankin, Reich shares a widespread hope in the astronomic community – for one of these hypersonic space rocks to hit Earth. They only have two conditions: it must be small enough to cause no harm, and, unlike the Ontario meteor, it needs to survive its encounter with the atmosphere. It’s all well and good to try to use DART or a nuclear device to deflect an asteroid, but how it responds to such an attempt depends entirely on its constitution: its rigidity, its mechanical strength, whether it is properly glued together or loosely bound by the silk of a gravitational web.

We need to get to know asteroids better. And for that, we need to find their traitors, their turncoats, those coming over to our side and offering us their secrets. We need meteors to become meteorites. And, more importantly, we need someone to go and find them – even if they happen to land in a treacherous place. ●

AUTHOR
Q&A

WITH

ROBIN GEORGE ANDREWS

AUTHOR OF *HOW TO KILL AN ASTEROID*

In *How To Kill An Asteroid*, Robin Andrews shows us how scientists are working to protect humanity from celestial danger, more specifically, killer asteroids. From the origins of the planetary defense movement to watching NASA's historic DART mission succeed from mission control, it's a wild, but hopeful, ride.

What was a surprising fact about asteroids you encountered?

So the focus of the book is not on the sorts of hefty asteroids that can bring civilization crashing down, but on the far more common smaller asteroids – those in the tens to hundreds of meter length range. These are all over the place in space and, crucially, tens of thousands of them hang about in orbits close to Earth's own. They're hard to find. Those that are 140 meters [460 feet] long, or bigger, are dubbed "city killers", and for good reason. A direct hit on any metropolis wouldn't just damage it – it would obliterate it.

And, it turns out, city killer-size asteroids are supremely weird. They aren't monolithic, rigid

blocks, but more akin to a fleet of boulders flying in very close formation, barely held together by their own gravity. If you want to deflect one, you need to hit it hard – but not too hard, because then it breaks up and then you potentially have multiple smaller (but still deadly) Earthbound asteroids to deal with. That's weird! And also incredibly inconvenient for those defending the planet.

Cooler location you visited in preparation for the book?

Oh man, Meteor Crater in Arizona was especially great. It's a giant bowl carved out by a 50,000-year-old-ish impact. It was made by an iron-rich meteor just 40 meters [131 feet] across. That is absolutely tiny, and yet it gave the planet this deep scar while flinging debris tens of kilometers away and vaporizing anything closer. It's one thing to write about asteroid impacts, and quite another to see the crater left behind by one close up – especially when it was made by the very size of asteroid that planetary defenders are most concerned about.

But, to be honest, it'll be difficult to beat being at DART's mission control during that spacecraft's last few hours. Watching it hit the asteroid Dimorphos dead-on, and seeing all these scientists scream with joy, high-five, burst into tears, and leap into the air was an experience I'll never forget. Spacecraft are rarely supposed to perish. DART had to hit its target and die, and when it did, it did so with perfection and incredible drama. As a consequence, millions of people alive today, and billions yet to be born, are safer off. DART showed us that

we can stop an entire category of disaster before it ever transpires – and I got to see it happen. Lucky me!

What would you like space agencies to do next?

Planetary defense is still a young field, but it's growing remarkably quickly, as it should. Space agencies around the world should take a leaf out of NASA's (relatively new) book, I'd say: make planetary defense a separate issue to planetary science, and then invest big in it. Who doesn't want to contribute to efforts to protect the planet from murderous asteroids?

What would you like the public to know about planetary defense?

That not only is it real, but it's being done right now. Before the end of the decade, two incredible observatories are going to come online: the Vera C. Rubin Observatory in Chile (which is essentially a colossal digital camera that will spot all sorts of things in the night sky, from supernovae to comets) and the space-based Near-Earth Object Surveyor (an infrared telescope that is specifically designed to hunt for elusive asteroids). Once they do, in about another 10 years, almost all the city killer asteroids close to Earth's orbit will have been found. And then we'll know if, for at least a century, humanity is in danger of being afflicted by a cosmic collision or not. If we are, then DART shows that, with a concerted effort, we can knock it out the way. Isn't that just wonderful?

I hope everyone enjoys the book and comes away feeling optimistic about our species. But, in particular, I hope younger readers get a kick out of it. The way science is taught in schools is rarely ideal: learn the fundamentals first, then get to the cool story built out of those fundamentals. That approach puts a lot of kids off from going into science. But imagine if you went to a primary school, or secondary school, and told these apathetic students that, if you stick with it, one day you could literally be a defender of the planet. Who wouldn't want to at least look into that possibility? ●

How To Kill An Asteroid
is published by WW Norton & Co
and is available October 1.



Beneath the City Of Light sits a vast network of underground tunnels. Once a means to build Paris's foundations, parts of it were repurposed as an ossuary to house millions of corpses. The move of so many bodies came in response to an accumulation of human remains that the city's cemeteries weren't equipped to handle. That is, until they found a subterranean solution for dealing with their dead.

THE CATACOMBS OF PARIS

An ossuary is a place for bones, and it can be anything from a chest to a **building** or a quarry – just ask Paris. Back in the time of the Romans, when Paris was still known as Lutetia, limestone was extracted from the landscape to build the city's foundations. As Paris unfolded, the subterranean quarry grew and expanded in a sprawling network of underground tunnels from which rock was extracted with the help of a central well.

All that digging meant pillars had to be established to stabilize the rock, but without proper regulation, some questionable excavation took place. This led to several collapses in the city center, and so the quarries were closed for business in **1776**.

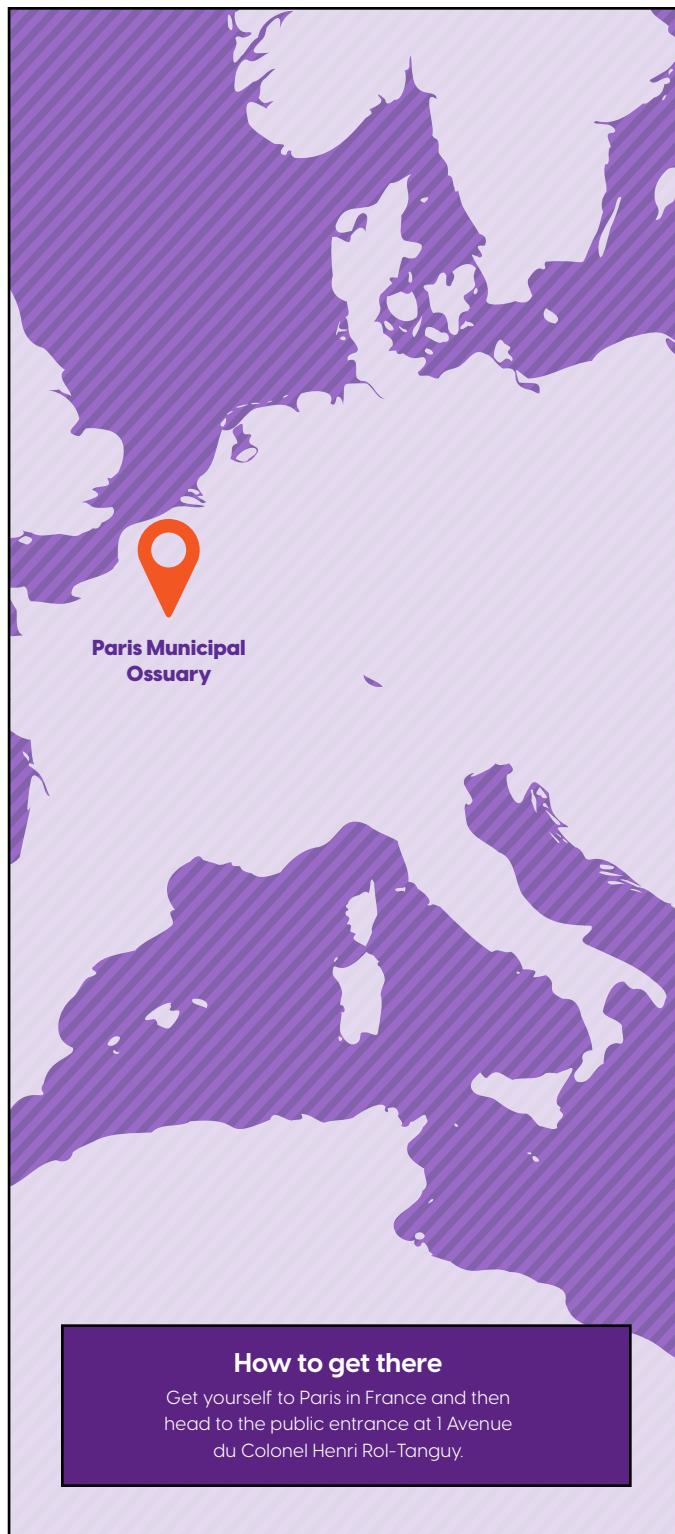
So, what to do with all that negative space? For a long time, not much, but in the 18th century an opportunity came to a head. The city was creaking beneath the weight of more bodies than they had cemetery space to process, and it soon seemed that a sensible way to deal with the dead was to take them underground. Over the course of 12 years, the city would move between 6 and 7 million corpses into part of the quarry – some of which were just bones at around 1,200 years old.

At first, the remains were just loosely piled, but the interior was transformed when Inspector Louis-Étienne Héricart de Thury got involved. He oversaw the careful organization of the bones into rows and structures, and established mineralogy and pathology cabinets for displaying curiosities.

The adjustments and adornments to the ossuary were intended to encourage visitors to think more deeply about death, something humans are no stranger to since the advent of **Memento Mori**. The city itself has long had an interesting approach to the dead, as demonstrated in the **Paris Morgue** where corpses were put on public display.

The ossuary became a hive of scientific activity, piquing the interest of archaeologists, botanists, speleologists, and naturalists. Their work uncovered the largest fossil gastropod ever found (*Campanile giganteum*), the modern palaeontological classification of invertebrates, and that fish kept in the basin of the Samaritan Fountain would go blind when left there.

The tunnel segments' official name, the Paris Municipal Ossuary, came into effect on April 7, 1786, but their Roman roots quickly inspired the catacomb connection. The Paris Catacombs are often erroneously thought to account for the entire quarry network, but just a small section of this was repurposed for the ossuary. It wasn't until 1809 that it was opened to the public, and today you can visit a **1.5-kilometer** (0.9-mile) circuit that descends 20 meters (66 feet) into the ground. ●



WATCH



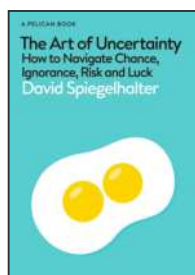
Firebrand

Film from MBK Productions and Brouhaha Entertainment

Henry VIII's shenanigans have earned him an eternal spot in the halls of infamy, but have you ever wondered why he seemed to have such a pathological predisposition for tyranny? Some have suggested it may have been the result of a brain injury he got in a **jousting accident**. Whatever the cause, the subsequent deterioration and paranoia that marked the end of his life is the dramatic backdrop to a new film about Katherine Parr – the King's last wife who had to navigate his erratic behavior (and recorder playing) – during the break from Rome.

Out **now**.

READ



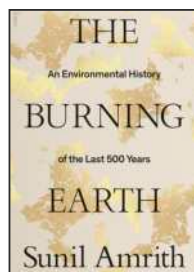
The Art Of Uncertainty

Book by David Spiegelhalter
"Professor Risk" offers an essential guide to living in uncertain times in *The Art Of Uncertainty: How To Navigate*

Chance, Ignorance, Risk And Luck. From peculiar examples – such as why two people will share a birthday in over half of football games and the 17th-century couple from Whitby whose births, marriage, and deaths all occurred on September 19 – Spiegelhalter explores why coincidences occur surprisingly often. An Emeritus Professor of Statistics in the Centre For Mathematical Sciences at the University of Cambridge, he draws on his experiences with the National Risk Register to ask important questions about understanding seemingly random events.

Available **now**.

LEARN



The Burning Earth

Book by Sunil Amrith
It's been a hot topic of debate of late as to whether or not we are living in the Anthropocene, a time in

Earth's history characterized by the influence humans are having on the planet. In this paradigm-shifting global survey, Professor of History Sunil Amrith looks at the back-and-forth between humankind and the planet over the last 500 years. From the advent of agriculture to society and war, Amrith provides an environmental lens through which to look at how the globalization of natural resources has reshaped the Earth. We humans are adaptive and resourceful, but can we find the collective wisdom to save ourselves?

Available **now**.

PLAY



Satisfactory

Game from Coffee Stain

Explore and build in this first-person open-world game that will take you to an alien planet rich in natural resources just waiting to be harvested. Work alone or play with friends as you head out on expeditions to search for new materials, and innovate novel ways to make the most of the environment. Armed with vehicles, jetpacks, jump pads, and more, you'll face down tricky terrains and uncooperative wildlife as you track down valuable natural resources. It's all of the problem-solving of mining with none of the real-world consequences!

Available **now**.

LISTEN



The Big Questions

Podcast from IFLScience

Join us for our Halloween special as writer and producer Rachael Funnell catches up with Denmark's **Recreational Fear Lab**. The research center is dedicated to the scientific investigation of why we humans love scaring the living daylights out of ourselves. The conversation took place ahead of our visit to Britain's most haunted castle, which you can catch on **YouTube** to find out more about the science of fear: what's the physics of ghosts? Does any of that "ghost hunting equipment" actually do anything? And what happens to the human body when you're afraid?

Available on **October 31**.

SCIENCE IN MEDIA





DATES TO REMEMBER

Spooky season is back – and so are all these science (trick or) treats. There's not one but two meteor showers to behold, stunning wildlife photos to visit, and opportunities to raise awareness as Earth Science Week and World Mental Health Day swing around again. Last but *definitely* not least, it's Fat Bear Week at long last.

OCTOBER



2-8 Fat Bear Week
October can only mean one thing: no, not Halloween, it's **Fat Bear Week**! For the uninitiated, it's an annual celebration of the beefiest brown bears Katmai National Park has to offer. They've been gorging themselves on salmon all summer long in preparation for their hibernation, and one's about to be crowned the chonkiest of them all. Who will it be? Cast your votes between October 2-8 to decide. If you can't wait until then, there's always Fat Bear Junior – the same premise but for the chubbiest cubs – on September 26-27.



8/21 Draconids/Orionids
What's better than one meteor shower? Two, of course. Those of us in the Northern Hemisphere will be treated to a dual display of fiery space rocks this month, as the Draconids and Orionids are both set to peak. The former are expected to be at their most spectacular on October 8, followed by the latter on Oct. 21.



10 World Mental Health Day
"It's time to prioritize mental health in the workplace" – that's the theme for this year's World Mental Health Day. Celebrated every year on October 10, the day serves to highlight the importance of looking after what's going on upstairs and stresses the importance of talking about our mental health with our friends, family, peers, and colleagues. This year, wellbeing in the workplace takes center stage – find out how to get involved [here](#).



11 Wildlife Photographer of the Year Exhibition
Wildlife Photographer of the Year is 60! To celebrate, you can experience the wonder of nature for yourself and view the world's best wildlife photography at this year's exhibition. From October 11 until June next year, London's Natural History Museum will be displaying stunning snaps of the natural world, alongside soundscapes, films, and expert insights, highlighting the diversity and beauty of life on Earth and what we can do to protect it. Tickets are available [here](#). Submissions for next year's contest open on **Oct. 14**.



13-19 Earth Science Week
From the houses we live in and the products we use to our roads and transport, geoscience has a huge impact on our daily lives. Earth Science Week is the perfect opportunity to learn more about our planet's processes, to help us better understand and appreciate this lump of rock we call home so that we can look after it in years to come. Find out more [here](#).



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 the grim results of animal zombification. If you like your science lighter, discover more about the epic animal migrations that take place each fall.

ZOMBIE ANIMALS

Thought humans were the only ones that could be turned into **zombies**? Think again – zombification is rife in the animal world.

Take the **emerald cockroach wasp** which injects a mind-altering venom into its cockroach victims. This not-so-tasty cocktail of neurotoxins doesn't paralyze them, but it does make them docile, allowing the wasp to lay an egg on it. Then, when the larva hatches, it proceeds to eat the cockroach alive, its dinner unwilling to put up a fight.

PERHAPS THE G.O.A.T WHEN IT COMES TO MAKING ZOMBIES IS NONE OTHER THAN THE PARASITIC PROTOZOAN, TOXOPLASMA GONDII.

Equally bonkers is the impact of *Massospora cicadina*, a fungus that causes male cicadas to become hypersexual, spreading the fungus to as many others as possible. It also **eats away** at their reproductive organs and

butts, to the point where the latter can even fall off.

But perhaps the G.O.A.T when it comes to making zombies is none other than the parasitic protozoan, *Toxoplasma gondii*. That name might sound familiar to you if you're a cat owner; that's because it reproduces in the feline digestive tract, although it can infect plenty of other animals and change their behavior to boot.

Mice, for example, normally flee at the smell of a cat for fear of getting gobbled up. But, infection with *T. gondii* causes the ultimate switcheroo, with mice **losing their fear** and instead becoming attracted to cat odor – even long after the infection clears. As a result, they can walk right into the lion's den.

It's not just prey animals this parasite affects either; *T. gondii* has been found to change the behavior of **gray wolves** living in Yellowstone National Park, making them more likely to take greater risks. This can have an upside though – infected wolves are nearly twice as likely to end up leading the pack.

Less brain-eating involved than movie zombies, that's for sure, but we still wouldn't want any of these near our noggins.

MIRACULOUS MIGRATION

While people in the Northern Hemisphere are getting the blankets down from the loft and readying themselves for a long stretch cozied up on the sofa come fall, plenty of other animals are about to be far more active – it's migration time.

THEY DO SO WITHOUT EVER HAVING BEEN TAUGHT WHERE TO GO – AND YET, EVERY YEAR, A FRESH GENERATION SUCCESSFULLY MAKES THE 4,800-KILOMETER JOURNEY.

Some of the most impressive journeys are undertaken by gray whales, which have just spent the summer months sucking up amphipods from the sea floor in the Arctic. In October, however, they begin the long trip south to Mexico, cruising down the US West Coast until they reach Baja California.

There, the shallow waters make the perfect place for pregnant whales to birth their calves. By the time they return to the Arctic the following spring, the mother whale will have made one of the longest annual migrations seen in any mammal – a roughly

16,000-kilometer (10,000-mile) round trip.

But while many of the gray whales migrating will have made that lengthy trip before, the same can't be said for monarch butterflies, which also migrate during fall. They do so without ever having been taught where to go – and yet, every year, a fresh generation of monarchs successfully makes the 4,800-kilometer (3,000-mile) **journey** from the northeast of North America to southwestern Mexico.

How do they end up in the right place? It's a question that still doesn't have a definite answer, but there are some popular theories. Some researchers have suggested that they have a compass encoded within their genes, making use of environmental clues like the time of day and the position of the Sun on the horizon to figure out where to go.

And some animals go the opposite way to what you might expect in the fall. While many birds will be migrating north to south, some water pipits will instead travel from the Alps and Pyrenees northwards to Great Britain in search of coastal marshes with insects aplenty – unlike the now snow-covered mountains.

If that's not enough motivation to get up from your blanket cocoon for a snack, we don't know what is.



The **Darker** Side of Science



THE **Lighter** Side OF SCIENCE