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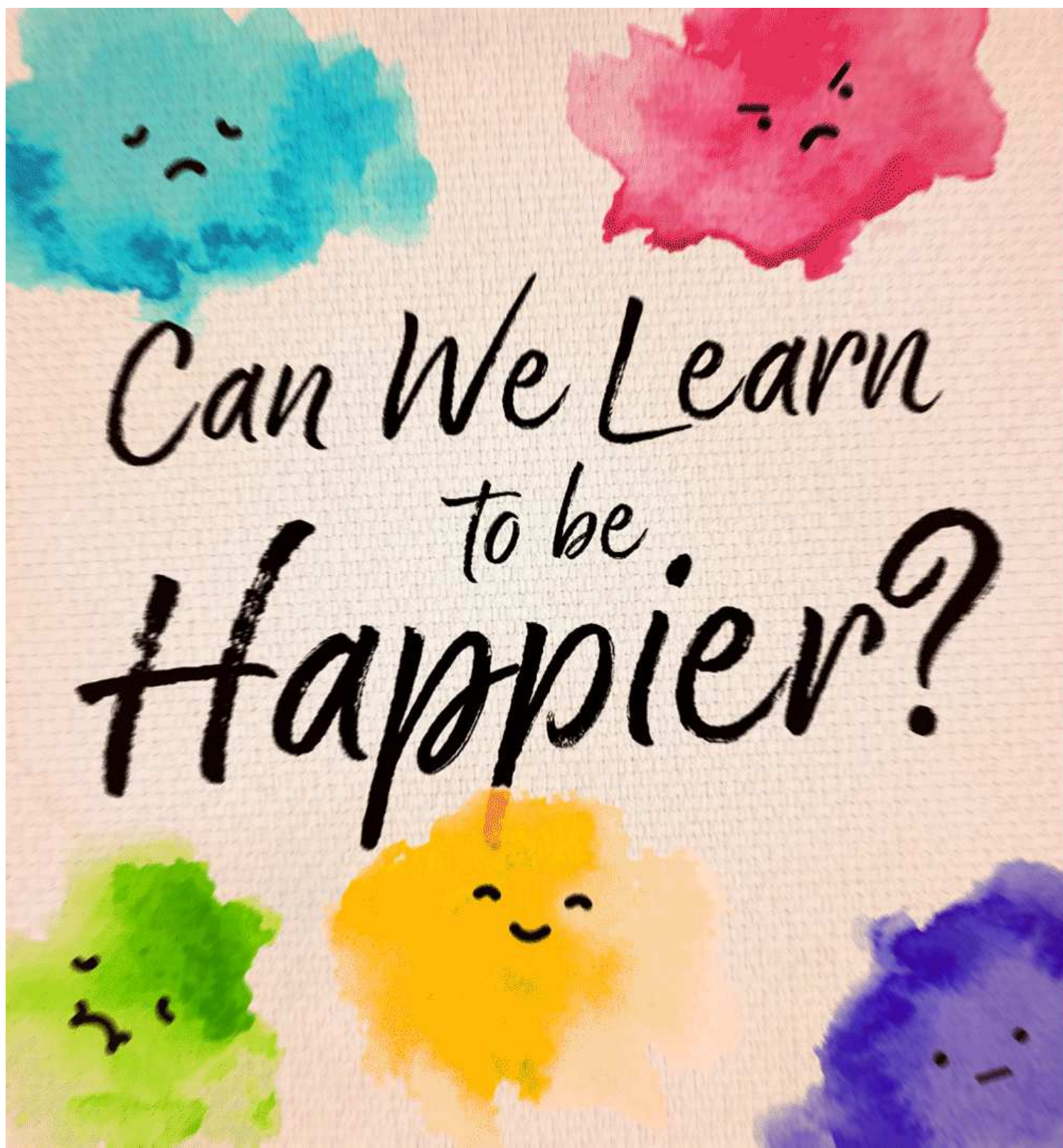


HOW LONG DID
DINOSAURS LIVE?

IS THERE A DIFFERENCE IN THE
MALE AND FEMALE BRAIN?

IFLSCIENCE.COM | SEPTEMBER 2023

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Can We Learn
to be
Happier?

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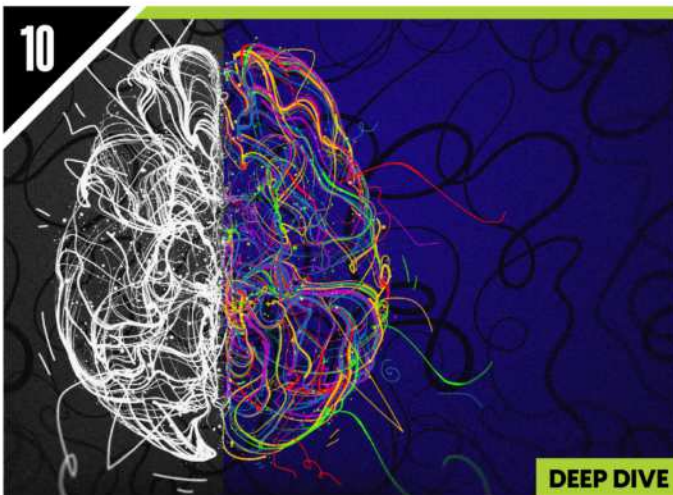


WHERE ON EARTH

PALAU'S JELLYFISH LAKE

Trapped thousands of years ago by changing sea levels, now a subspecies of jellyfish that exists nowhere else in the world thrives in the millions.

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September 2023

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NEWS BITES



You And The Universe

Legendary scientist and communicator Stephen Hawking's estate has announced a brand new children's picture book, using Hawking's words and co-written by his daughter Lucy, to be released next year. The book is an adaptation of Prof. Hawking's **2018 Earth Day message**, which was posthumously beamed to the nearest black hole to mark his passing in March 2018 with the help of the European Space Agency. "We are all time-travelers, journeying together into the future," Hawking said. The book, published by **Puffin in March 2024**, will brilliantly explain some big topics for younger (and older) curious minds.



Movie Month

It's fascinating to trace humanity's biggest fears through contemporary popular culture, particularly the movies. This month's sci-fi offerings focus on rogue artificial intelligence (AI) and UFOs, both of which are topical concerns. Arriving on Disney+ on Sept 22, *No One Will Save You* sees a girl already alienated from her community battling actual extraterrestrials on her lonesome; *The Creator*, released in cinemas on Sept 29, finds humans and AI in the throes of a futuristic war as our hero is tasked with hunting the mysterious "Creator" who has forged a weapon rumored capable of ending the war, and humanity.



Introducing... CURIOUS Live!

Get ready for IFLScience's first free festival of science, CURIOUS Live! Streaming online so accessible to all, CURIOUS Live will take place on October 21 with a full festival line-up of fascinating speakers, interviews, Q&As – and, because it's us, plenty of laughs, some very weird science, and at least one thing that will make you go ewwww. Spanning three festival "stages" – Life, Death, and Creation – hosted by IFLScience's own The Big Questions podcast hosts, prepare to explore fighting crime with plants, queerness in nature, creating civilizations on other planets, history's deadliest diseases, and more, all for free! Plus, ask your own questions and win exclusive merch. Click **HERE** for the full line up, to book tickets and for more details. Put it in your diary now!



This Barbie Is An Astronaut

The first Barbie dolls to fly into space have gone on display at the US National Air and Science Museum – only it turns out another Barbie beat them to it 32 years ago. The pair of "Space Discovery" dolls spent several months on the International Space Station in 2022 as part of an outreach program to inspire girls in STEM by Mattel – but another Barbie made it onto a Department of Defence flight in 1990 thanks to a training engineer's sense of humor. The engineer took to hiding Barbie, wearing a custom-made orange spacesuit, in the shuttle simulator to offer some levity to the astronauts. By the time the mission launched on the space shuttle Atlantis, she had become the crew's mascot and spent nearly five days in space on the still-classified mission. The Smithsonian has recognized she was a pioneer and is planning to update its display.



Out Of This World Photos

The winners of the 15th Astronomy Photography of the Year competition will be revealed on September 14, and as usual, they are out of this world. As the most famous astrophotography competition in the world, hosted by the UK's Royal Observatory Greenwich, over 4,000 entries from 64 countries take us on a sweeping journey through the cosmos. From our Sun and Moon to comets and galaxies, aurorae, stars, and nebulae. You can have a little sneak peek of the shortlisted images [here](#) and the winners will be posted [here](#). If you find yourself in London, you can visit the exhibition in Greenwich, home to the Meridian Line (longitude zero or 0° 0' 0"). Every place on the Earth is measured in terms of its angle east or west from this line.

Want to learn how to take award-winning astrophotos of your own? Check out our guide [here](#).

Concorde, We Miss You

September 26 is the 50th anniversary of the first-ever supersonic passenger plane to cross the Atlantic in record-breaking time. Concorde made it in just 3 hours and 32 minutes, and after flying for 27 years was retired in 2003. One of the reasons its career was cut short was the noise of the sonic boom when it took off, something NASA is trying to rectify with its **X-59 aircraft**, which has been acing flight tests in the Mojave desert. Supersonic travel may be making a comeback soon.

WHAT'S UP?



From Bennu With Love

You Mean, What's Coming Down?

Name: OSIRIS-REx

Appearance: A capsule straight out of a 1960s sci-fi show

Location: Utah desert, USA

What's happening?

NASA is set to make history with OSIRIS-REx, the first-ever US asteroid return sample mission, due to land in the Utah desert this month.

When is it landing?

Scheduled for September 24, if all goes well, the capsule should land somewhere within an area 58 by 14 kilometers (36 by 9 miles) near the Department of Defense's Utah Test and Training Range, about 130 kilometers (81 miles) southwest of Salt Lake City.

Who is Bennu?

Bennu is the **most dangerous** known active asteroid thought to be around 4.5 billion years old, recognized by its distinct **diamond shape**. In 2020, OSIRIS-REx **landed on Bennu's surface** and scooped

up a pristine sample of rocks and dust to bring back to Earth to study.

What's in the capsule?

The goal was to collect 60 grams (2 ounces) of regolith, but NASA estimates 400-1,000 grams (14-35 ounces) of material were collected.

What are we hoping to learn?

Bennu was selected because it's believed to have changed very little since the formation of the Solar System. Studying its properties is like opening a time capsule left over from the birth of the planets. Asteroids like Bennu may have brought water and the ancient building blocks of life to Earth.

Is this the end of OSIRIS-REx?

OSIRIS-REx is just dropping off its precious cargo, the spacecraft is not actually landing. In fact, the newly named OSIRIS-APEX will then be on its way to its next target, the notoriously **dangerous asteroid Apophis**.

OUR COVER STORY

CAN WE LEARN TO BE HAPPIER?

Are there any science-backed happiness
strategies to turn that frown upside down?

By Ben Taub

Image Credit: Inran Chowhury

It's the best thing in the world and the one thing we all want more of. Thankfully, you don't have to be rich, beautiful, or even particularly cool to get it. Elusive though it may seem, happiness is in fact a skill that can be cultivated, and while we can't necessarily control the events that trigger our moods, there are things one can do to become a more cheerful person.

What is happiness?

In case you haven't noticed, life ain't all rainbows and unicorns, and even the most joyous people occasionally have the smiles wiped off their faces by misfortune. Yet experts say that happiness and sadness aren't mutually exclusive, and that true contentment requires an ability to accommodate negative events and emotions.

"Happiness in life as a general overarching characteristic actually includes unpleasant experiences and our ability to channel difficulty and adversity into growth and learning and forming of community and relationships," **Dr Emiliana Simon-Thomas**, science director of the **Greater Good Science Center** at the University of California, Berkeley, told IFLScience.

"If you think happiness means pleasure and entertainment and maximizing material comfort, then you are never going to be happy," she explained. "You will be on what's called the 'hedonic treadmill', and that's connected to a persistent sense of disappointment."

In other words, genuine happiness depends upon much more than just nice experiences, and our overall disposition is shaped by how we orient ourselves vis-a-vis the world on a mental and emotional level. In 2014, Simon-Thomas and her colleagues launched a course to help people learn this skill, and found that participants' subjective happiness and life satisfaction **increased by 5 percent** after 10 weeks of training.

Breaking down the content of this course, Simon-Thomas explained that the

opportunities for adopting new ways of thinking and boosting happiness are spread across three main domains. "One category of change has to do with relationships and social connection; the second has to do with one's threshold for experiencing positive emotions. I call that positivity; and then the third is resilience, or the ability to manage setbacks, difficulties, failures, and adversity."

Connection is the key

It's pretty well established that social connection is the single most important contributor to a person's happiness. Among the wealth of research highlighting this is the **Harvard Study of Adult Development**, which has been tracking the physical and mental wellbeing of a cohort of individuals – including former US President John F Kennedy – for over 80 years.

FACTORS LIKE MONEY, FAME, POWER, OR EVEN THE OVAL OFFICE WERE ALL FAR LESS LIKELY TO BRING LASTING HAPPINESS THAN CLOSE BONDS WITH FAMILY AND FRIENDS.

While many of the study's original participants have now passed away, the findings have unambiguously revealed that deep, meaningful relationships are what make people happy. Other factors like money, fame, power, or even the Oval Office were all far less likely to bring lasting happiness than close bonds with family and friends, and participants that enjoyed such relationships also tended to display lower stress levels and better physical health.

Working on one's ability to relate to others is therefore among the most effective ways of enhancing happiness. "There are a lot of skills that fall under connection," said Simon-Thomas. "Including things like making friendly conversation with people who you don't know, out in your day-to-day life, so that you feel that sense of interpersonal trust and common humanity."

As daunting as that may sound, a recent study found that people who were instructed to **strike up conversations with strangers** on their commute in Chicago consistently rated their journey to work as more enjoyable than those who sat in silence. Learning to break the ice, then, may just be the key to a more joyful life.

TO SURVIVE IN THE WILDERNESS YOU GENERALLY NEED TO BE MORE ALERT TO DANGER THAN TO BEAUTY, SO OUR BRAINS HAVE DEVELOPED TO FOCUS ON THE NEGATIVE OVER THE POSITIVE.

Think positive

Prior to bothering their fellow commuters with a bit of human connection, the participants in the aforementioned study all predicted that talking to a stranger would end in shame and embarrassment. Such pessimism is representative of the so-called "negativity bias" that colors our outlook on life and causes us to forever look on the not-so-bright side.

Clearly, possessing this in-built misery mechanism is a major hindrance when it comes to finding happiness, although from an evolutionary perspective, it makes perfect sense to be down in the dumps. After all, to survive in the wilderness you generally need to be more alert to danger than to beauty, so our brains have developed to focus on the negative over the positive.

Fortunately, the brain is also plastic, which means it's possible to create new neural pathways and alter our habitual ways of thinking. It's an old cliché among neuroscientists that "neurons that fire together wire together," and when it comes to increasing happiness, this cheesy adage is particularly apt.

"The more we practice focusing on one kind of idea, or awareness, the more salient that idea or awareness becomes on a routine basis," said Simon-Thomas. "So we'll think

of things that are positive more readily if we practice thinking about things that are positive.”

For example, learning to savor the more magical moments in life and cultivating gratitude – both of which can be achieved by keeping a diary of all the things one is grateful for – can help us to develop a more joyful state of mind and enhance our potential for positive emotion.

Building resilience

There’s an important distinction to be made between thinking positively and burying one’s head in the sand. Sometimes, life genuinely is just a bit rubbish, and in such instances it’s much healthier to acknowledge and experience those prickly emotions than to just try and put a brave face on – something Simon-Thomas calls “toxic optimism”.

“It would never be my advice as a happiness expert to cover up real harm with some veneer of positivity,” she said. “Optimism has to be grounded in real benefit, not as a strategy to justify harm.”

CULTIVATING GRATITUDE FOR THE THINGS THAT WE APPRECIATE HAS ALSO BEEN SHOWN TO HELP MITIGATE THE EFFECTS OF NEGATIVE EXPERIENCES.

Rather than simply suppressing sadness, then, we need to learn how to relate to trauma, adversity, and disappointment in ways that are adaptive and constructive. Numerous skills and practices can help with this, some of which are as simple as labeling our emotions in real time so that we can better connect to and understand them.

“If we can say, ‘oh, this is sadness’, then right away we connect to ‘oh, I’ve had an experience of loss, and this loss is important to me, and it matters,’” said Simon-Thomas.

Cultivating gratitude for the things that we appreciate has also been shown to help mitigate the effects of negative experiences. “There are several studies that point to the benefits of practicing gratitude and a lesser likelihood of suffering from post-traumatic stress after a potentially traumatic event,” she explained.

“There’s something about exercising gratitude that leaves you with this outlook that there is goodness in your life. And that makes people more capable of managing difficult experiences.”

So, how much happier can we be?

While working on social connection, positivity, and resilience may help us become happier, our overall disposition is also partially governed by genetic factors that can’t be changed. For instance, one study found that a **single genetic variant** controls the way in which the brain’s emotional centers respond to positive stimuli, leading the authors to conclude that heritable factors may account for up to two-thirds of our ability to experience happiness.

It’s also unclear exactly how much improvement one can achieve from happiness training. A recent review found that the vast majority of studies on happiness strategies **lack scientific rigor**, meaning that while there is obvious value in cultivating these skills, better data is needed to properly track their impact.

Realistically, then, no amount of practice is going to transform Eeyore into Tigger, but with a bit of gratitude and social connection, you might just find that life isn’t so bad after all. ●



Image Credit: Court Whelan, iStock

MONARCH MIGRATION MAGIC

Monarchs are the only butterfly species known to make an annual two-way migration like birds, with a round-trip distance of around 8,000 kilometers (5,000 miles). Many have wondered how a small insect could survive such a journey, but a recent study published in **PLOS ONE** has suggested that it may come down to wing color. As the coolness of the large white spots contrasts with the black along their wing, it may create miniature eddies that give the butterflies a boost by reducing drag.



Image Credit: ©The Trustees of the Natural History Museum, London

HOW LONG DID DINOSAURS LIVE?

*BEFORE AN ASTEROID BROUGHT THE DINO PARTY
TO A SWIFT END 66 MILLION YEARS AGO,
THEY WERE THE ROCKSTARS OF ANCIENT EARTH.*

By Rachael Funnell

Big or small, herbivorous or carnivorous, and whether they died of old age, disease, or predation, do we know what a lifespan looked like for dinosaurs?

We asked Professor Paul Barrett, Head of Fossil Vertebrates at London's Natural History Museum, and he told us there's a surprising link between dinosaurs and trees when it comes to figuring out how old they were.

Can we calculate the lifespan of extinct animals?

PB: We can generally work out how long it takes for an animal to reach full size or adulthood, but that doesn't tell us how long they continued to live as adults. And we don't really have a good method for determining how much longer beyond that full-size range they lived. One thing we've noticed with dinosaurs, which probably doesn't hold for other animals, is that they tend to die while they're still growing.

Mammals tend to reach adult size, live a few years, and carry on. For dinosaurs, it looks like they got to reproductive age, started reproducing, and then often died before they reached their full-size potential.

Does that mean a dinosaur in captivity could just keep growing?

PB: Probably not forever. We don't think they had continuous growth like crocodiles who just keep growing very slowly throughout their whole lives. We do know from a few dinosaurs that growth stopped. It's just that in most of the examples we look at, growth is still happening. Eventually, they do reach a maximum size and stop growing, but dinosaurs don't often get to that point. I like to explain it by saying dinosaurs have kind of rockstar life cycles, they basically live fast and die young.

How do we know how fast they grew?

PB: The way that we get that growth rate is by looking at growth rings in bones. We take the bones, slice them up, and look at them under a microscope to look at the different tissues making up that bone. From work that's been done on living animals, we know that some of those tissues were deposited by bone that's growing rapidly, while other tissues are deposited by bones that are growing slowly.

We also get interruptions in growth each year due to seasonal factors, like changes in temperature, day length, etc so you get rings developing within the bones, almost like tree rings. We then count those to get an idea of the number of years that the animal was growing for. So, it's a very similar process to aging a tree. The rate comes from looking at the spacing of those rings. If there's lots of growth going on, the rings are really thick. If there's not very much growth going on, the rings are narrower.

Do we reckon size correlated to longevity?

PB: This is a relationship that holds across all animals, as far as we can tell. Basically, the larger the animal is, the longer its lifespan is, so the big ones were probably around for quite a long time, the smaller ones much less so.

Beyond predation, what were they dying of?

PB: All the kinds of things that you'd expect a living animal to die of: diseases, bad luck, being struck by lightning, hit by a tree, or getting caught up in a flood. But the major

causes of death for living animals are generally starvation or dehydration, due to lack of food and water from seasonal droughts. Then, to some extent, diseases, predation, and really old age, just everything wearing out and not being able to chew or digest things anymore.

SO, PROBABLY EVEN THE REALLY BIGGEST DINOSAURS RARELY BROKE 50.

So, how long do we think dinosaurs lived?

PB: Very large sauropod dinosaurs probably took about 30 to 35 years to reach maximum size, and we assume if they did that maybe they would have lived a bit longer beyond that period so maybe 30, 40, or 50 years for the really big dinosaurs.

Smaller dinosaurs – things like ornithomimid dinosaurs, such as *Dryosaurus* or *Hypsilophodon* – look like they reached their full body size at around four to five years. After three or four years, unless they were really lucky, they were probably dying.

Is this surprising?

PB: We used to think that dinosaurs lived a really long time. If you get back to people writing about dinosaurs 50 years ago, it was assumed that the really giant dinosaurs must have been a bit like giant crocodiles or giant turtles or tortoises, and that they were maybe taking a century to reach those sizes. But one of the big surprises we've had in the last 20 years is that, actually, dinosaurs grew really fast. Like really, really fast, and as a result of that, they wouldn't have been around for 100 years.

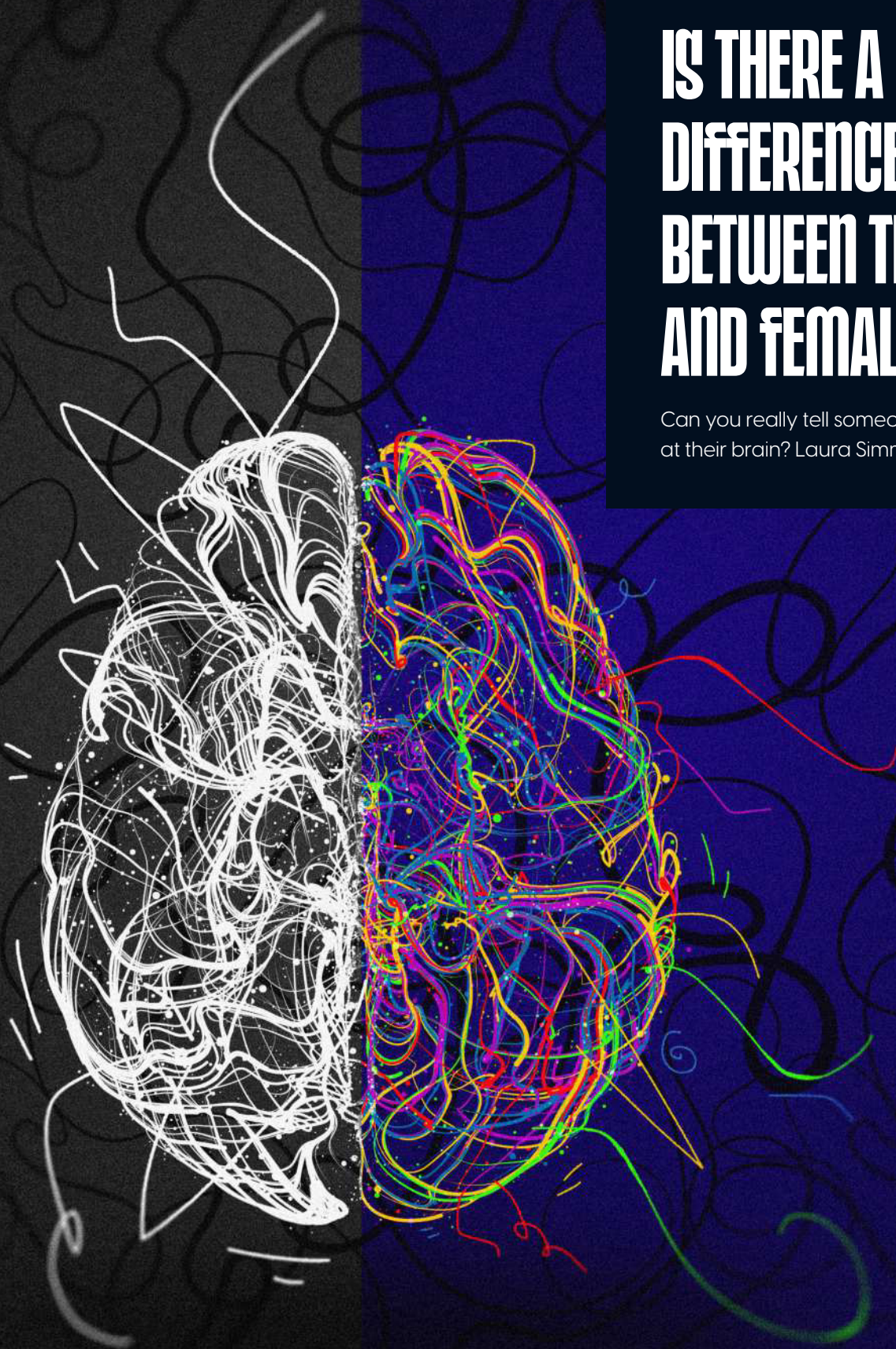
So, probably even the really biggest dinosaurs rarely broke 50. It's a big surprise to people that work on them because you would assume that such a big animal would be around for a long time because huge animals like blue whales and elephants today have human-like lifespans of 70+ years. But these dinosaurs, which – in the case of the really big sauropod dinosaurs – can be 10 times the size of an elephant probably didn't live as long. ●

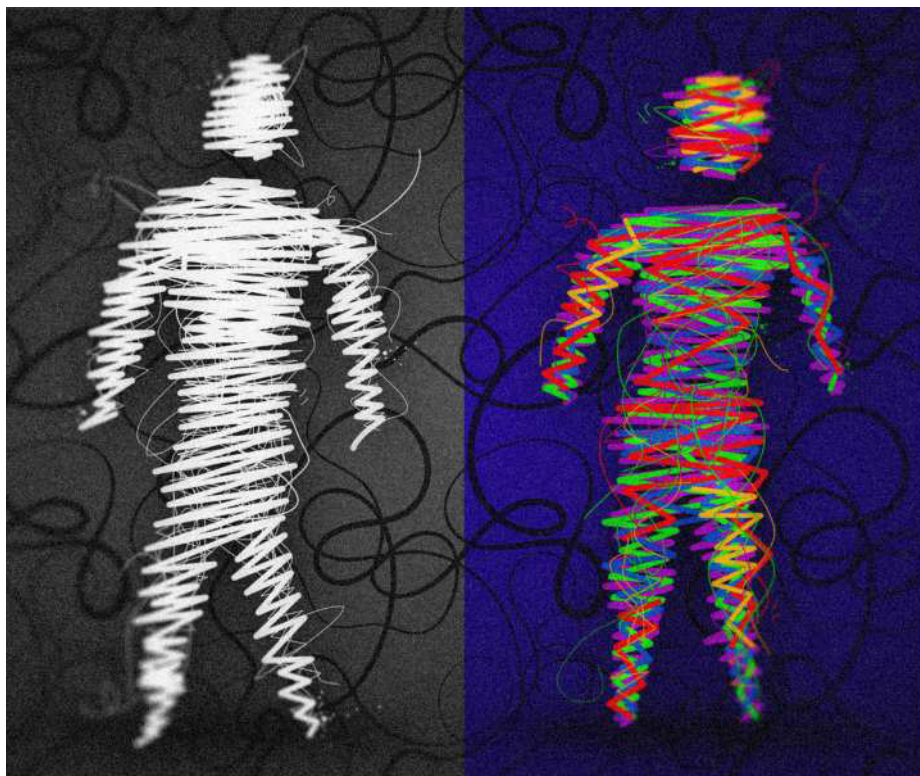
Image Credit: Emily Brown

SCIENCE FACT OR FICTION:

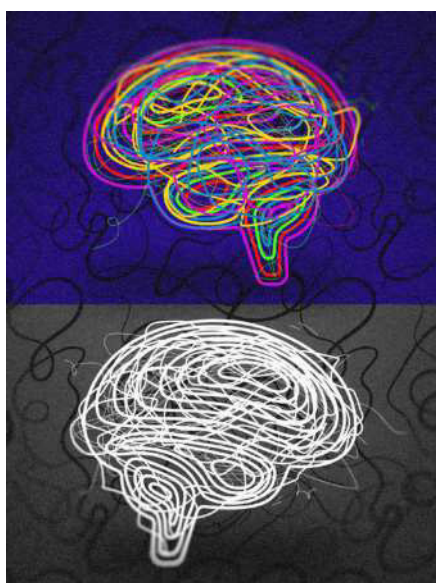
IS THERE A DIFFERENCE BETWEEN THE MALE AND FEMALE BRAIN?

Can you really tell someone's sex by looking at their brain? Laura Simmons investigates.





The question of whether there's a tangible difference between male and female brains is one of the most compelling – and controversial – in the history of **neuroscience**. On reading the title of this article, you might have immediately rolled your eyes: "What's she going on about? Surely, we left these kinds of conversations behind with the suffragettes!" Or, you might have nodded sagely: "Of course there are differences, and I can't wait to read an informed treatise on



the subject whilst my wife fixes dinner." As it turns out, we're going to have to disappoint both hypothetical readers to some degree.

There are some differences, just as there is a difference in average height between biological males and females. The question of just how profound these differences are is a trickier one to answer, as is the arguably more important one: does it even matter?

The historical perspective

The idea that something fundamental sets male and female brains apart really gained momentum in the 19th century. As explained by cognitive neuroscientist Gina Rippon in her book **The Gendered Brain**, this era saw an increasing push from women for greater rights and inclusion in society. For some reason, this disturbed the men who had enjoyed a monopoly on all the power and influence, and galvanized the scientific community into producing evidence that women were far too incapable and fragile to be taken seriously.

Enter the "science" of craniology. The idea was simple: a bigger brain meant greater intelligence. Through much fudging of data and a somewhat laissez-faire approach

to experimental consistency, many "measurements" that seemed to prove that men had the better brains were produced.

However, the theory did not stand up to closer scrutiny. Rippon explains how a team of mathematicians – including statistician **Alice Lee**, one of the first women to graduate from the University of London – produced data that led to the swift abandonment of craniology after demonstrating that some of the smallest heads in their sample belonged to a group of celebrated, and male, anatomists. As they say, size matters.

This wasn't the only – or the last – attempt to use scientific thinking to demonstrate the alleged immutable differences between the sexes. For example, there was the argument made by Edward H. Clarke in

Sex in Education; or a Fair Chance for Girls, that exposing women to the same teaching methods used to educate men was to risk "neuralgia, uterine disease, hysteria, and other derangements of the nervous system," including such choice insights as, "Boys must study and work in a boy's way, and girls in a girl's way."

You might be surprised (or horrified) to hear similar ideas persisted in education well into the 21st century. As neuroscientist Lise Eliot explained for **The Conversation in 2021**, "About a decade ago, teachers were urged to separate boys and girls for math and English classes based on the sexes' alleged learning differences," adding that "Fortunately, many refused."

Archaic ideas about how males and females think and learn proved hard to shake off, and the advent of more sophisticated scientific techniques did not see the end of this debate.

New questions, but still no answers

In the age of EEGs, PET scans, and MRIs, a huge amount of energy has been devoted to finding an anatomical or functional difference between male and female brains. There's no shortage of papers claiming **evidence** for this, but there's also a lot of work that falls on the opposite side, including

a **2021 review** led by Eliot that roundly rejected the notion of sexual dimorphism in the human brain.

New ways of studying the brain only meant new ways of trying to find the difference that many remain sure is there, lest it reveal the reason behind supposedly sex-specific behaviors. As Rippon explains, "In looking for sex differences, neurologists cheerily matched their assumptions about which bits of the brain were the most important to their findings about which bits of the brain were largest in males, even if it meant reversing earlier conclusions."

Let's get one fact out of the way: males really do have larger brains, on average. The simple reason for this is that males, on average, have larger bodies. Similar differences, some even more pronounced, can be observed in other organs.

One problem, though, is that no one can seem to agree on the best way of correcting for this very real average difference in brain sizes. It's also much more difficult than your biology textbooks would have you believe to go around linking certain parts of the brain to specific functions. To illustrate this, Rippon details the example of what she calls the "corpus callosum wars" (not the title of the next *Star Wars* spinoff).

The **corpus callosum** is a bundle of nerve fibers, part of the brain's **white matter**, which connects the two hemispheres together. A **paper** back in 1982 found that in females, part of the corpus callosum was larger. The fact that this difference was so minor as to be statistically insignificant did not seem to matter, and the idea took root.

It seemed to offer a neat explanation for some of the "known" differences in how men and women think. A smaller corpus callosum

equals fewer connections between the left and right hemispheres. This should allow the two hemispheres to perform their supposed separate functions more effectively, giving men an advantage in the fields of mathematics and science, while women were hindered by the constant interplay between the emotional and rational halves of their minds. We'll pause there while you stop laughing.

The fact that this finding, and others like it, gained so much traction speaks to another facet of this conversation: publication bias. Given how ingrained ideas about the "**proper**" places for males and females are in many societies, it's perhaps unsurprising that research supporting these ideas is so attention-grabbing.

The role of environment

Modern neuroscience is learning more every day about just how **adaptable** the human

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brain is. Our brains physically change when we acquire new skills.

The classic example is that of London taxi drivers, who undergo a training program called the Knowledge to memorize the meandering layout of the city streets. Learning the Knowledge has been **demonstrated** to change the brain structures of those drivers who pass, most notably by increasing the gray matter in the posterior hippocampus, which is linked with spatial memory.

Other skills, like **learning a musical instrument**, also leave their mark on the brain. What this suggests is that differences between two individual brains may have more to do with their different experiences, rather than their biological sex.

The way young male and female children are treated in society could also be affecting their brain development. Much attention has been paid to the important question of gender biases in **toys**, and whether societal pressures are restricting girls' **future career choices**.

Although some research has found that preferences for stereotypically "male" or "female" toys exist even in **monkeys** – who presumably have not had to endure a barrage of pink or blue advertising from birth – it would be difficult to say for certain that differences between male and female brains are innate when most people still grow up in an environment where a child's gender expression affects something as basic as how adults **speak to them**.

When things go wrong

One sticking point in this debate has been the fact that certain **psychological, neurological**, and developmental disorders affect one sex more than the other. How else can that be explained other than some fundamental difference in their brains?

A 2020 study in **PNAS** found some differences in the sizes of brain areas

between males and females, as well as different patterns of gene expression that were linked to sex chromosomes – something that had previously only been shown in mice. The authors suggested that learning more about sex-specific gene expression patterns could reveal more about sex differences in brain disease.

However, we also can't ignore the fact that some of what we thought we knew about the different sexes' susceptibilities to various conditions is turning out not to be true.

One example of this is autism, once thought to be something that **almost exclusively** affected males. In fact, under something called the **brain organization theory**, it was thought that sex hormones present during fetal development permanently "masculinized" boys' brains in ways that made them, among other things, more likely to have autism. Recently, there's been a rethink and a huge increase in our understanding of how autism **presents differently** in women and girls, leading to many more diagnoses.

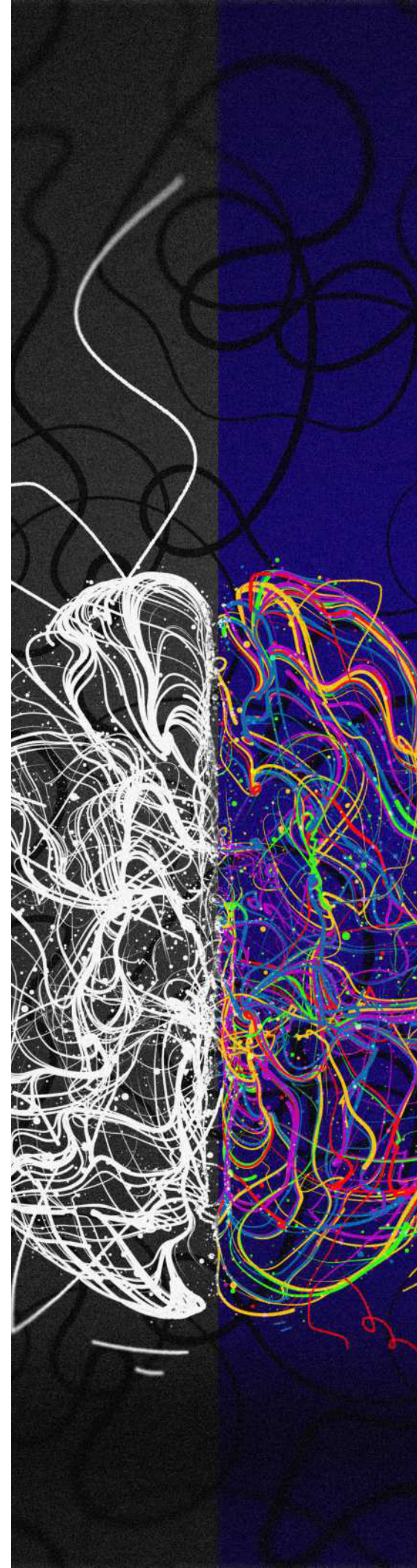
Where does that leave us?

We can say with certainty that there are some differences between male and female brains, and that there's more to be discovered about where these arise from. Redressing the balance by including females – be they **human** or **otherwise** – in research, where this has not always been a priority, would be a good start.

As to whether these differences tell some secret about the capabilities or aptitudes of men and women, that is becoming less clear with each new addition to the literature.

More interesting and instructive answers might come from looking at our brains as a function of the lives we've lived and experiences we've had, not only the sex chromosomes we were born with.

And thankfully, in much of the world at least, fewer and fewer of these potentially brain-altering life experiences are now solely the preserve of the menfolk. ●



FACE VALUE

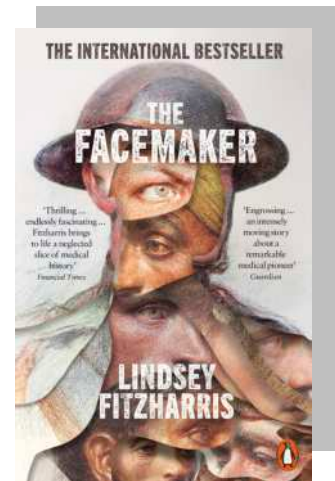
In this excerpt from *The Facemaker*, Dr Lindsey Fitzharris reveals the impact facial disfigurement had on First World War soldiers, their lives, and their identities, and muses on the importance we place on the face's ability to communicate as an indicator of value as reflected in our language.

The conflict's human wreckage was inescapable. It was strewn across battlefields and crammed into makeshift hospitals all over Europe and beyond. Between eight and 10 million soldiers died during the war, and over twice as many were wounded, often seriously. Many survived, only to be sent back into battle. Others were sent home with lasting disabilities. Those who sustained facial injuries – like Percy Clare – presented some of the greatest challenges to frontline medicine.

Unlike amputees, men whose facial features were disfigured were not necessarily celebrated as heroes. Whereas a missing leg might elicit sympathy and respect, a damaged face often caused feelings of

revulsion and disgust. In newspapers of the time, maxillofacial wounds – injuries to the face and jaw – were portrayed as the worst of the worst, reflecting long-held prejudices against those with facial differences. The Manchester Evening Chronicle wrote that the disfigured soldier “knows that he can turn on to grieving relatives or to wondering, inquisitive strangers only a more or less repulsive mask where there was once a handsome or welcome face.” Indeed, the historian Joanna Bourke has shown that “very severe facial disfigurement” was among the few injuries that the British War Office believed warranted a full pension, along with loss of multiple limbs, total paralysis, and “lunacy” – or shell shock, the mental disorder suffered by war-traumatized soldiers.

It's not surprising that disfigured soldiers were viewed differently from their comrades who sustained other types of injuries. For centuries, a marked face was interpreted as an outward sign of moral or intellectual degeneracy. People often associated facial irregularities with the devastating effects of disease, such as leprosy or syphilis, or with corporal punishment, wickedness, and sin. In fact, disfigurement carried with it such a stigma that French combatants who sustained such wounds during the Napoleonic Wars were sometimes killed by their comrades, who justified their actions with the rationalization that they were sparing these injured men from further misery. The misguided belief that disfigurement was “a fate worse than death” was still alive and well on the eve of the First World War.



A face is usually the first thing we notice about a person. It can signify gender, age, and ethnicity – all important components of an identity. It can also convey personality and help us communicate with one another. The infinite subtleties and variety of human expression comprise an emotional language of their own. So, when a face is obliterated, these key signifiers can disappear with it.

The importance of the face as a register of feelings or intent is even reflected in our language. We may attempt to “save face” or not to “lose face.” If a person is trustworthy, their word can be taken at “face value.” A liar might be considered “barefaced,” “bald-faced,” or even “two-faced.” Someone might “cut off his nose to spite his face” – which brings to mind both metaphorical and literal disfigurement. The list goes on.

Disfigured soldiers often suffered self-imposed isolation from society following their return from war. The abrupt transformation from “typical” to “disfigured” was not only a shock to the patient, but also to his friends and family. Fiancées broke off engagements. Children fled at the sight of their fathers. One man recalled the time a doctor refused to look at him due to the severity of his wounds. He later remarked, “I supposed he [the doctor] thought it was only a matter of a few hours then I would pass out of existence.” These reactions by outsiders could be painful. Robert Tait McKenzie, an inspector of convalescent hospitals for the Royal Army Medical Corps during the war, wrote that disfigured soldiers often became “victims of despondency, of melancholia, leading, in some cases, even to suicide.” ●

Q&A

AUTHOR



WITH LINDSEY FITZHARRIS

AUTHOR OF *THE FACEMAKER*

In her internationally best-selling book, *The Facemaker*, award-winning historian Dr Lindsey Fitzharris recounts the true story of Harold Gillies, the visionary surgeon who rebuilt the faces of the First World War's injured soldiers and, in doing so, paved the way for a modern era of plastic surgery. We spoke to Fitzharris to learn more about Gillies' work and find out what inspired her to tell his story.

Tell us about *The Facemaker*.

The Facemaker is about the pioneering surgeon, Harold Gillies, who rebuilt soldiers' faces during the First World War. This was a time when losing a limb made you a hero, but losing a face made you a monster. Gillies not only restored these men's faces, but also their broken spirits.

What drew you to Gillies' story?

When I began writing this book many years ago, I knew virtually nothing about the First World War, and very little about the history of plastic surgery. But I knew enough about Harold Gillies to know that there was a harrowing medical tale there. I only hope

that I've done his story, and the stories of the men whose lives he transformed, justice through the retelling of it in *The Facemaker*.

How did Gillies shape modern plastic surgery?

Plastic surgery pre-dated the First World War. In fact, the term "plastic surgery" was coined in 1798 by the French surgeon Pierre-Joseph Desault. Before the manufacture of the synthetic material known today as plastic, the word often referred to an object that could be shaped or sculpted. In this case, a person's skin or soft tissue. But efforts in earlier periods to rebuild, repair, or alter the appearance of the face were typically confined to small areas, such as the nose – rhinoplasty being one of the oldest documented surgeries in medical history.

It wasn't until the First World War that the surgical inadequacies of past centuries would finally be addressed, paving the way for plastic surgery to enter a new

era. The nature of warfare in this period led to high rates of facial injuries. Men were maimed, burned, and gassed. Some were even kicked in the face by horses. Before the war was over, 280,000 men from France, Germany, and Britain alone would suffer some form of facial trauma. Ultimately, this allowed Gillies and his team to try and test new surgical methods on a scale hitherto unimaginable.

Any favorite anecdotes from the book?

I loved writing about the French-American dentist, Charles Valadier, who retrofitted his Rolls Royce with a dental chair and drove it to the Front under a hail of bullets. Valadier was an absolute legend, and worked entirely free of charge throughout the war. It was Valadier who showed a young Harold Gillies the desperate need for facial reconstruction during the war.

What do you hope readers will take away from *The Facemaker*?

Plastic surgery is now associated with the pursuit of physical perfection, but it arose from abject horror – in the bruised, bloodied, and battle-weary faces of those who fought in the First World War. At its core, *The Facemaker* is about the terrible consequences of warfare, and the private battles that soldiers fight long after they put down their rifles. If Harold Gillies is the backbone of this story, then the disfigured men are its beating heart. We must remember them, too. •

The Facemaker by Lindsey Fitzharris is published by Penguin and is out now in paperback.



Fitzharris will be speaking at
CURIOUS Live on **October 21, 2023**

Sign up today for more details on IFLScience's first virtual festival of science!



Twelve thousand years ago, changing sea levels left a pocket of water isolated from the rest of the ocean, trapping in its confines a group of jellyfish. The unique subspecies can't be found anywhere else on Earth, but exist in their millions in Palau's Jellyfish Lake.

PALAU'S JELLYFISH LAKE

Jellyfish reign supreme inside one of 70 saltwater lakes on an island off the coast of Koror, Palau, in the western Pacific, that's uninhabited by humans. The water bodies were once connected to the ocean but got cut off thousands of years ago, creating unique pockets of ecosystems and unusual food chains including a haven for cnidarians.

It's estimated that **Jellyfish Lake** may have become isolated from the ocean as far back as 12,000 years ago, trapping its inhabitants. This was due to rising sea levels depositing them in the lake before receding again, leaving them behind.

Its residents are *Mastigias papua etpisoni*, also known as the golden jellyfish. The unique subspecies is named after former President Ngiratkel Etpison and this marine lake is the species' exclusive home.

They survive in partnership with symbiotic algae that live in their tissues. Collectively, these dinoflagellates are known as zooxanthellae, a term used to describe single-celled microorganisms that live inside a range of marine invertebrates including demosponges, corals, jellyfish, and nudibranchs.

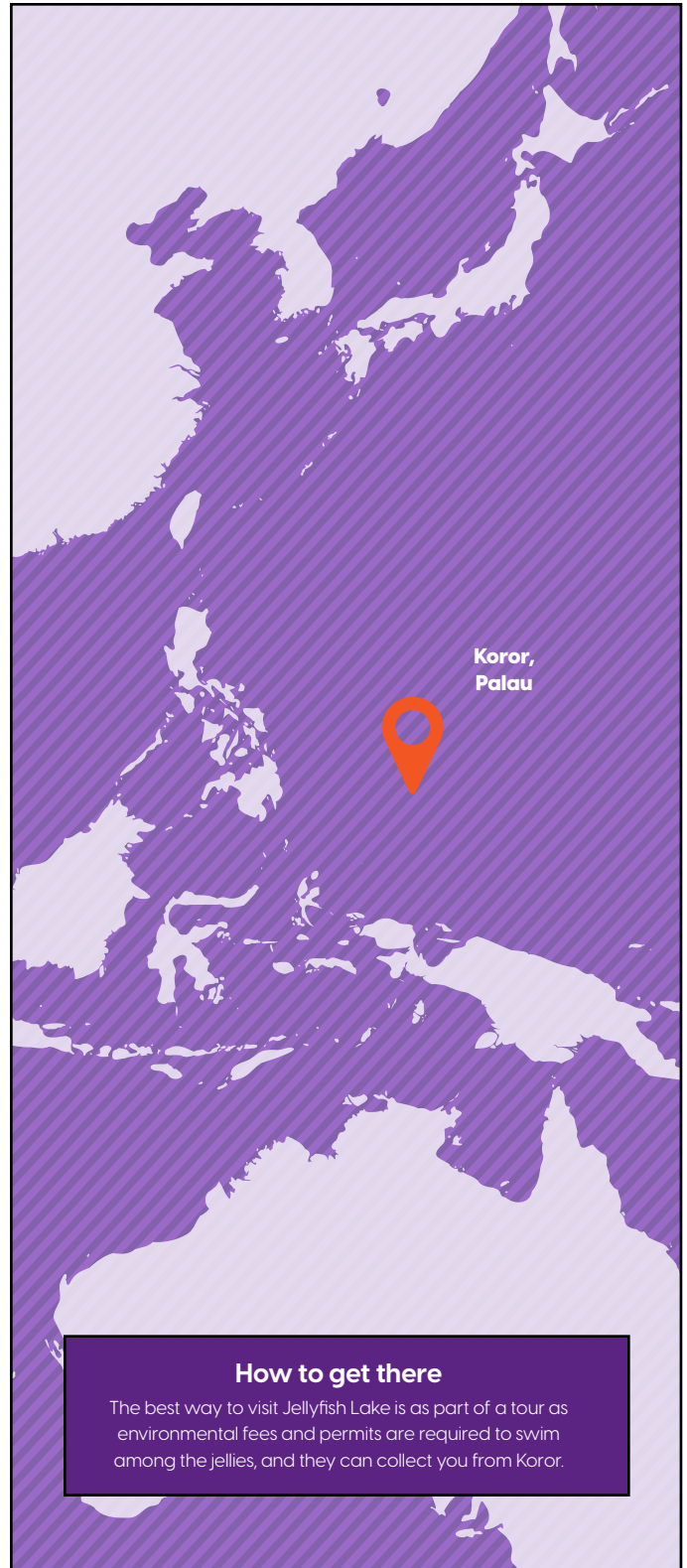
Jellyfish aren't the only wildlife found in the lake, which is lined at its edge by mangrove trees whose tangled roots are bustling with marine invertebrates. It's also home to moon jellyfish, but the golden jellyfish are by far the most numerous. During a peak for the lake's residents back in 2005, it's estimated there were around 30 million *M. papua etpisoni* in Jellyfish Lake, but most of the time there are thought to be nearer to 5 million swimming around.

While they can rest easy without the fear of predators, the jellyfish have a job to do. To ensure their tenant zooxanthellae get the sunlight they need for photosynthesis, they must rotate and swim around the lake's surface waters if they're to receive any energy and nutrients in return.

The lake's collaborating inhabitants aren't its only peculiar feature, as the water column is split up with all the complexity of a B52 shot. In total, it's around 400 meters (1,312 feet) long and 30 meters (98 feet) deep, but not all of the lake is safe to swim in.

At a depth of 13 to 15 meters (43 to 49 feet) sits a pink layer of bacteria that light cannot get through, creating a barrier beyond which no sunlight or oxygen can reach. This means the bottom water layer is made up of poisonous dissolved hydrogen sulfide gas, explains the **Coral Reef Research Foundation**.

So, are you going in? ●



INVESTIGATE



Who Shat On The Floor At My Wedding?

Podcast

A true crime podcast with a difference. Join "Detective" Lauren Kilby as she dives into a locked-room mystery involving two brides, one assailant, and a turd on a boat. With the aid of a polygraph "lie detector" (**here's how to cheat one**), clinical forensic psychologists, cognitive ecologists, and guest interviews, will they uncover Who Shat On The Floor At My Wedding? It's a real poo-dunnit.

Episodes available **now**.

EXPLORE

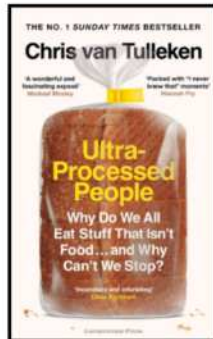
Endurance: Race To The Pole Series from Channel 5

Join adventurer Ben Fogle for this three-part series as he travels to Antarctica to retrace the steps of Edwardian explorers Scott, Shackleton, and Amundsen in their quest to explore the unknown and be the first to reach the South Pole. Fogle goes in search of answers to the questions of how they traversed the extreme conditions using early 20th-century equipment, food supplies, and shelter.

Episodes on Channel 5 in the UK and Paramount+ in the US, Autumn 2023.



READ



Ultra-Processed People

Book by Chris van Tulleken

In this book, infectious diseases doctor Chris van Tulleken asks the question, "Why do we all eat stuff

that isn't food... and why can't we stop?" The witty and explorative publication puts forward the argument that humans have entered a new "age of eating" in which we are encountering an entirely novel food group: Ultra-Processed Food. What does it do to us, and why does it matter?

Available **now**.

SCIENCE IN MEDIA



LISTEN



The Big Questions

Podcast by IFLScience

What is ancient ice telling us about the future? How are glaciers changing in a warming world? Are e-fuels the future of aviation? These are the topics that presenters Dr Alfredo Carpineti and Eleanor Higgs and guests will be tackling in September's episodes of *The Big Questions*. Don't forget to tune in! Catch it where you get all your podcasts, including **Spotify, Apple Podcasts and Podbean**.

Episodes released **every other Friday**.

WATCH



Animals Up Close

Series from Bertie Gregory

Following on from his *Epic Adventures*, Bertie Gregory is venturing from Antarctica to Africa, South America, and Asia to uncover the daily lives of some of Earth's most curious species. Follow along on his adventures and find out what it's like plunging into animal habitats as a wildlife filmmaker, with comical behind-the-scenes extras that demonstrate how filming wildlife rarely goes to plan.

Available **September 13 on Disney+**.





DATES TO REMEMBER

As the new school year approaches, so do these dates that you don't want to miss. This September, the equinox ushers in a new season, and you'll get the opportunity to celebrate scientific culture and microbes, all while cutting down your pollution and possibly getting your nose into a good book.

SEPTEMBER

6



Read a Book Day

Calling all book lovers: Read a Book Day is back. September 6 brings the perfect excuse to indulge in your hobby and get page-turning. Time to dig out an old favorite, or maybe try something new – if you're after something sciencey to get stuck into this Read a Book Day, check out our suggestions [here](#).



28 International Day of Scientific Culture

September 28 is International Day of Scientific Culture (IDSC),

which aims to celebrate STEM education and outreach and make us all aware of the importance of scientific culture in today's world. It is vital, for the future of humanity and the health of our planet, that people are engaged with science and, therefore, that we continue to strengthen scientific culture and communication. Find out what you can do to help this IDSC [here](#).

17

International Microorganism Day

Microbes often get a bad rap – they can have some nasty effects on our bodies, so it's easy to see why – but they're also an essential part of life. International Microorganism Day serves to highlight the good they do, for everything from our

health to our environment, and restore their sullied reputation. It's celebrated on September 17: the date on which, in 1683, Antonie van Leeuwenhoek wrote to the Royal Society about his discovery of "animalcules", changing our understanding of microbes forever.



23

Fall Equinox

If you're in the Northern Hemisphere, get ready to say goodbye to summer and hello to fall as the equinox returns on

September 23. Alternatively, for those in the Southern Hemisphere, spring is about to commence. For the second, and last, time this year, the Sun will be directly above the equator, illuminating the Northern and Southern Hemispheres equally and giving everyone roughly the **same amount of daylight and nighttime**.



18
TO
24

Pollution Prevention Week

Last year, around **66 million tons** of pollution were emitted into the atmosphere in the United States. As well as impacting our health, these pollutants have potentially devastating consequences for the climate, meaning action is urgently required. In light of this, the US Environmental Protection Agency (EPA) designates the third week of September

"Pollution Prevention Week" – a national campaign to raise awareness for the harmful effects of pollution and highlight ways that it can be reduced. To find out how you can help by minimizing pollution in your home, car, or garden, check out the EPA's [pollution prevention tips](#).



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

Choose how you end each issue. For those who prefer the darker side, Maddy Chapman investigates the usefulness of prehistoric poop. If you like your science lighter, Laura Simmons reveals what an ancient whale and Tutankhamun have in common.

PREHISTORIC POOP

There is much to learn about the curious creatures of the ancient world from their fossils, hence palaeontologists are often found rooting around in (and **occasionally licking**) rocks in search of remains. An unlucky few must sift through something a little less innocuous: fossilized feces. In a **recent analysis**, researchers poking around in the 200-million-year-old poop of a fearsome aquatic predator demonstrated that it was riddled with primitive parasites.

Fossilized feces – also called **coprolite** – might sound gross, but it's an invaluable weapon in a palaeontologist's arsenal. It's particularly useful for identifying parasites, which are otherwise difficult to find in the fossil record.

"Coprolite is a significant paleontological treasure trove, containing several undiscovered fossils and expanding our understanding of ancient ecosystems and food chains," the authors of the new study said in a **statement**.

In this instance, it's helped to unveil a host of freeloaders lingering in the excrement of an extinct aquatic predator.

The prehistoric, parasite-plagued poop was discovered at the Huai Hin Lat Formation in Thailand, dating back to the Late Triassic. Nestled within the fossilized cylinder were five microscopic organic structures, one of which may have been the egg of a parasitic **nematode worm**.

BASED ON THE MORPHOLOGY OF THE TIME-WORN TURD, IT WAS LIKELY PRODUCED BY A CROCODILE-LIKE PREDATOR.

"This is the first record of parasites in terrestrial vertebrate hosts from the Late Triassic in Asia," write the team in their study.

It also offers us a window into the life of an animal blighted by multiple parasitic species. Based on the morphology and contents of the time-worn turd, it was likely produced by a species of crocodile-like predator called a phytosaur.

Spare a thought for this unfortunate individual: It must have had a hard enough time swimming around in the Late Triassic beset by parasitic beasts, and now, to add insult to injury, modern humans are snooping on its bowel movements over 200 million years later.

KING TUT'S MINI LEVIATHAN

What do a legendary Egyptian pharaoh and an extinct marine mammal have in common? A surprisingly diminutive body size, apparently.

In a new **study**, palaeontologists describe the discovery of a delightfully small member of the basilosaurid family. These extinct, fully aquatic whales date back to the **Eocene Epoch**, when the Earth's oceans were their playground. Most fossilized remains, though, have been uncovered in Egypt, where the latest find was made.

Skull, jaw, teeth, and vertebrae fragments dating back 41 million years were unearthed in the Fayum Depression – according to the study authors, it's "one of the world's most productive whale fossil sites." Analysis showed the ancient whale was approximately just 2.5 meters (8.2 feet) long.

That's about the size of a **Komodo dragon**, an impressive specimen to be sure. But when you compare it to a **blue whale** – some of which have reached

the colossal length of 30 meters (100 feet) – it's a bit of a tiddler.

In fact, the authors confirmed that it's the smallest known basilosaurid to date, weighing around 187 kilograms (412 pounds).

THEY SETTLED ON TUTCETUS RAYANENSIS, IN HONOR OF VERTICALLY CHALLENGED PHAROAH TUTANKHAMUN.

"Great story, but what's that got to do with an Egyptian pharaoh?" we hear you cry. Well, the newly discovered little guy needed a name, and its location in Egypt provided plenty of inspiration.

They settled on *Tutcetus rayanensis*, in honor of vertically challenged pharaoh Tutankhamun. Most modern **estimates** place King Tut's height around 1.67 meters (5 feet 6 inches), so it seemed a fitting moniker to bestow on a dinky whale.

As to why *T. rayanensis* was so weeny, the authors think it could have been an adaptation to a warming event called the Lutetian thermal maximum, around 42 million years ago. For such a small guy, *T. rayanensis* sure could tell us a whole lot about the evolution of these long-lost whales.



The Darker Side of Science



THE LIGHTER SIDE OF SCIENCE