

CURIOS



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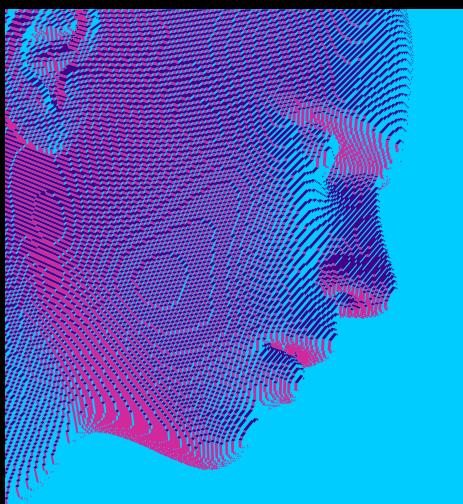
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NEWS BITES

How To Sort AIs From Humans

The easiest trick for sorting artificial intelligence (AI) from humans in conversation is to throw a capital letter at them, scientists have discovered.

Capitals seem to flummox AI chatbots like ChatGPT. The original Turing test was based on Alan Turing's proposal that AI would only be considered truly intelligent once we couldn't distinguish it from humans in a conversation. Now, over 70 years on, AI is more convincing than it has ever been thanks to large language models (LLMs) like ChatGPT, but a **new test** has come up with what the team is calling a "foolproof" way to weed out the machines. By including random words in capital letters to sentences – for example "isCURIOSITY waterARCANE wetTURBULENT orILLUSION drySAUNA?" – all five of the AI chatbots tested failed while 100 percent of humans answered "wet" as they knew what was being asked. Humans are excellent at spotting patterns where the AI assumed, despite the use of upper and lower case letters, they were one word. However, it's unlikely this test will be foolproof for long at the rate AI is learning.

Earth's Aphelion

On July 6, Earth will be at its farthest point from the Sun – its aphelion – at a distance of around 1.0167 astronomical units, or AU. AU is the average distance between Earth and the Sun, about 150 million kilometers (93 million miles). This distance differs by about 3 percent during Earth's orbit because it is slightly elliptical rather than perfectly circular. Technically, this marks the moment that the Sun is the smallest in the sky – but at a 3 percent difference, it's barely noticeable, it's just fun to know it!



Greetings From Mars

The European Space Agency (ESA) recently made history with the first-ever live stream from Mars. To celebrate the 20th anniversary of its Mars Express orbiter, ESA streamed the closest thing the speed of light allows to seeing the Red Planet in real-time. After the initial 17 minutes it takes to send an image from Mars to Earth, the images were then updated every 50 seconds, so viewers could almost watch what the orbiter was seeing as it flew past. An exciting leap towards one day watching live streams from the Martian surface.



Unknown

Unknown is a new Netflix documentary series exploring some of the most exciting uncharted territories – both physical places and gaps in our knowledge – in science right now. Rolling out weekly on Netflix from July 3, the four films explore what may be the **oldest graveyard** ever found in South Africa, the search for an unlooted tomb in the famous Ancient Egyptian necropolis of **Saqqara**, the mission to launch the iconic **JWST**, and a behind-the-scenes look at the use of (and concern surrounding) **AI in the military**. Despite the silly names – one film is called *The Lost Pyramid*, after all – these are fascinating tales of real-life expeditions that don't need the *Ancient Aliens* treatment, they are thrilling enough.



Oppenheimer

The tagline of Christopher Nolan's latest summer blockbuster is "The world forever changes" – and for once, this isn't hyperbole. When American theoretical physicist J. Robert Oppenheimer designed the atomic bomb, it set in motion events that would include a nuclear arms race and the deaths of over 200,000 civilians in Japan in 1945. Based on the Pulitzer Prize-winning book *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer*, the ethical debate over whether it was ever OK to "destroy the world in order to save it" still rages. The incredibly starry cast includes Cillian Murphy as Oppenheimer, Robert Downey Jr, Florence Pugh, and Matt Damon as General Leslie Groves Jr, director of the Manhattan Project, which produced the world's first nuclear weapons during World War 2, the only time they have ever been used in armed conflict. The movie opens worldwide on July 21.



The doctor will see you now *smiley face*. Emoji are used so ubiquitously to describe our emotions, scientists are now arguing they should be used in medical communication. You may laugh, but they make good points, including universal appeal; breaking language, age, and education barriers; and accessibility to diverse populations. "A universal emoji-based language system with a common agreement of meanings can be developed," the scientists **said**, noting simply pointing to an emoji on a scale could be a more helpful way of ascertaining how a patient is feeling.

WHAT'S UP?



What's In A Name?

How Mars Features Get Their Names

Name: Mars

Appearance: Rusty, dusty, and rocky

Location: Average distance from Earth: 225 million kilometers (140 million miles)

Why do Mars features have names?

Mainly, to keep track of where and what NASA has studied, though how scientists name them has changed in the 25 years they have been doing so.

How does NASA name these features?

Early Mars missions were more whimsical, with informal names used by the Sojourner rover team in the 1990s including Scooby-Doo and Casper. Attitudes changed slightly with the Spirit and Opportunity rovers in the early 2000s; naming became more intentional and commemorative, for example, historic vessels like the *Eagle* and *Endeavor*, or people, like the seven Columbia and three Apollo 1 astronauts that lost their lives. The **Curiosity** and **Perseverance** teams now draw grids on maps and choose a theme for each 1 km (0.6 mile) quadrant explored.

Are the names official?

Some are and have to be approved by the International Astronomical Union, which logs the names in the **Gazetteer of Planetary Nomenclature**. There are around 2,000 official names and hundreds of thousands of unofficial ones.

Are there guidelines for naming features?

Yes, and they include gems such as craters over 60 km (37 miles) having to be named after science fiction writers. For example, *Curiosity* and *Perseverance* landed in Ray Bradbury and Octavia E Butler craters, respectively.

What's the most famous feature?

Take your pick: there's **Valles Marineris**, the largest known canyon in the Solar System, or Olympus Mons, the mountain about two and a half times the height of Everest.

What's the best name?

It's hard to beat Indiana Jones, which is indeed a real Martian rock, though the one simply named Nigel gives it a good go.

OUR COVER STORY

THE SCIENCE OF “LUCK”

Are some people just lucky, or do they make their own good or bad fortune? Or is luck more psychology and sociology than superstition?

By Dr Russell Moul

Image Credit: James Rodrigues, Modified from iStock

Luck, a phenomenon that has fascinated and perplexed humans since time immemorial, has often been attributed to chance, fate, or supernatural forces. But is there more to this supposed phenomenon than mere chance and happenstance? Could there in fact be a rational and empirical explanation hiding behind the veil of mystery – in short, is there a science to “luck”?

Supernatural luck

Throughout history, humans have experimented with various ways to promote good fortune and, more importantly, to avoid disasters. Some common examples of fostering luck include carrying lucky charms, making wishes on stray eyelashes, or blowing out candles on a birthday cake, while actions taken to avoid bad luck include knocking on wood and throwing salt over a shoulder. In addition, some people will avoid circumstances that bring bad luck, such as walking under ladders or having anything to do with the number 13. Perhaps you have a special ritual of your own that you feel offers some protection from bad luck or encourages success in your life. If you do, you are not alone, and research suggests that such superstitions may serve a psychological purpose.

Investigations into the role superstitions play in our lives have found that they often stem from the assumption that unrelated events and actions are somehow connected – but they are most likely performed to facilitate **goal achievement**. For example, a person wears a particular pair of underwear the day they performed well in a game, so now they wear them to every game and maybe don't even wash them (apparently this is a thing). In this regard, the act of wearing the same underwear is an attempt to control fate and prolong a winning streak (though there is likely only one type of “streak” visible in these garments).

But does this type of superstitious thinking help? Well, it's unclear. In 2010, **researchers** observed students putting a golf ball. Half of the participants were told the ball was “lucky”. Those who thought they had the auspicious ball were better at putting than those who were told they had a regular, non-lucky one. This study has been celebrated in the media, but unfortunately, attempts to replicate its results have failed. Nevertheless, research has found that activating a superstitious belief can boost confidence and thus enhance performance.

Similarly, some scientists believe superstitious behaviors may serve an **evolutionary** role as well, as humans are not the only superstitious creatures out there. In fact, animals that exhibit superstitious behaviors also fail to reject them in the face of contradictory evidence. Explanations for how these behaviors work, especially as many are maladaptive, have led scientists to suggest that perhaps the behavior serves as a kind of placebo or may foster social bonding. Alternatively, the behavior could have had adaptive purposes in the past but has since lost its relevance.

Serendipity

Luck has many different meanings, and for some, there is a difference between “luck” and “serendipity”. The former could be regarded as something that is out of an individual's control and just occurs whether you like it or not, whereas the latter can be influenced, at least to a certain extent.

Over the last decade, an increasing number of researchers from different disciplines have examined serendipity – the phenomenon of stumbling upon or accidentally encountering something beneficial without explicitly seeking it – and how to promote it. In **one study**, creative professionals were asked how they increased their chances of serendipitous encounters. The results showed that these participants varied their routines, worked in different locations, were observant, and made changes in their workplaces that allowed them to avoid getting stuck in the same patterns.

But for a chance encounter to be truly serendipitous, there also has to be an “aha!” moment, a moment of insight, that helps make it meaningful. Indeed, the history of science is very much made up of moments of realization accompanied by chance discoveries: a phenomenon that is equally as important for fostering creativity as well. Now, **information scientists** have started to design digital tools that capitalize on these strategies to not only facilitate potential serendipity but to help individuals adopt the strategies to encounter them more often.

***LUCKY PEOPLE DEMONSTRATE
FOUR PRINCIPLES THAT SEEM TO
ENHANCE THEIR FORTUNES.***

The lucky mindset – lucky people

Some people are just luckier than others, right? Well, this may be an outcome of their thinking and attitude, rather than a particular aspect of their being. According to **Richard Wiseman**, Professor of Psychology at the University of Hertfordshire, England, who has explored factors that make a person lucky or unlucky for the last few decades, lucky people demonstrate **four principles** that seem to enhance their fortunes. The first is openness to opportunities. Lucky people, Wiseman writes, are “skilled at creating, noticing and acting upon chance opportunities”, which they achieve by “networking, adopting a relaxed attitude to life, and by being open to new experiences”. Lucky people also show an aptitude for listening to and trusting their gut and intuition. They enhance this intuition, he claims, by “**meditating** and clearing their mind of other thoughts”.

Another factor that lucky people tend to exhibit is an optimistic belief in the future. “These expectations become self-fulfilling prophecies,” Wiseman argues, “by helping lucky people persist in the face of failure,

and shape their interactions with others in a positive way.” Finally, lucky people turn bad luck into good by spontaneously imagining how things could have been worse and then taking control of the situation.

LUCK, HOW WE PERCEIVE IT, WHO IS THOUGHT TO HAVE IT, AND THE EXTENT TO WHICH WE BELIEVE RANDOM EVENTS IMPACT OUR LIVES, HAVE REAL-WORLD CONSEQUENCES.

More than a game of chance?

The studies on luck that have been discussed so far have generally focused on “luck” as a thing that can be enhanced or influenced, but the word itself is not neutral and should not be seen as just relating to chance or quirky psychology. Luck, how we perceive it, who is thought to have it, and the extent to which we believe random events impact our lives, have real-world consequences. In fact, **several popular books** on the subject published in the last decade have stressed how “luck” is an important factor that serves as a foil against rigid meritocratic arguments that are often raised to dismiss growing inequality in the United States, the UK, and many other Western countries.

Rather than relying on ideas about how “luck” is self-generating – “you make your own luck” or “luck is what happens when preparation meets opportunity” – we can ask more piercing questions about how some of **society’s most successful** people may owe more to chance – the circumstances of their birth, parental income, demographic and so on – than

to their self-reported explanation for their achievements. In this regard, luck is very “**real**” and has significant impact on people’s lives.

YOUR CHANCE OF BECOMING A CEO MAY BE INFLUENCED BY YOUR NAME AND THE MONTH YOU WERE BORN.

For example, recent research has shown that differences in income for people across the world can, at least in part, be explained by the **fluke of where they live** and the income distribution in that country. Your chance of becoming a CEO may be influenced by your **name and the month** you were born. Those with surnames that appear earlier in the alphabet are more likely to get tenured positions in academic **departments**, and women who have more **masculine-sounding** names are more likely to achieve well in legal roles.

Meritocratic strategies are based on the idea that rewards and honors go to the most deserving, but these few examples, and there are many more out there, undermine this view. Rather than being truly based on a strategy that favors the worthy, meritocracies miss the substantial role luck plays and ultimately adds to unfairness and tend to reward those who are already well rewarded.

So while it may not be worth worrying too much about breaking a mirror or seeing a black cat, luck does play a role in our lives and the more we understand it, the better equipped we are to not only maximize our own, but to think about how to create a fairer society as well. ●



Image Credit: Julia Kumpinovic/iStock

DEVIL'S TOOTH fungus

The devil's tooth fungus (*Hydnellum peckii*) appears to "bleed" as it grows, releasing a type of sap. It gives the beige, pink, and sometimes blue mushroom its other nickname "bleeding tooth fungus," but it isn't blood. It's the result of a process known as guttation, which causes plants and fungi to secrete droplets from their pores. In the case of the devil's tooth fungus, it's the result of water absorption increasing pressure within the mushroom, eventually squeezing out the pigment-tinted sap for a gooey, spooky aesthetic. The fungus also contains atromentin, giving it antibiotic and anticoagulant potential in medicines.



Image Credit: RapidEye/iStock

WHAT CAN WE LEARN FROM SKELETAL REMAINS?

IS IT TOO LATE TO LEARN WHEN THE BODY'S TURNED TO BONES?

Q&A

By Rachael Funnell

The rate of decomposition of the human body varies enormously depending on where it lies after its last breath. Kept in the cool conditions of a morgue, you can buy yourself time to plan a funeral and even embalm the body to keep it suitable for an open casket. By comparison, corpses left exposed to the elements can disintegrate rapidly, making it harder to identify the dead from sight alone.

It got us wondering if there's a point beyond which little can be learned about a body, forensically speaking. However, as forensic anthropologist, taphonomist, and entomologist Dr Devin Finaughty of the University of Kent explained, even skeletonized remains can still tell a compelling story.

Does finding bodies that have been dead for a long time make them harder to study?

DF: The more time that elapses after death, you lose context, and you lose evidence because the body is physically decaying. And the circumstances in which the body is in are changing. That introduces a lot of uncertainties. So, you're more constrained in terms of what you can figure out as you get further along in the post-mortem period. That doesn't preclude your ability to still generate a lot of information, but it really depends on what experts are involved.

For example, are you familiar with taphonomy as a discipline?

Err, loosely.

DF: It's inherently a study of preservation more than anything else. Now, obviously in forensic cases, our timescales are much shorter. We're still looking at preservation, but it's in the context of how quickly the body decomposes, and the role that different taphonomic agents play within that. That can include bacteria, plants, animals, or people.

So that's sort of like my bread and butter, but I'm also a trained forensic anthropologist, which specializes in looking at bones. And I do forensic entomology as well, which involves looking at the insects that are associated with death and decomposition.

From a forensic anthropological perspective, one of the main contributions they bring to forensic death investigations where skeletal remains are concerned is helping to reconstruct the person's identity.

How does that work?

DF: It involves creating what we call the osteobiographical profile, and typically comprises an estimation of biological sex, age at death, stature, potential trauma that might have occurred either before or around the time of, or after, death.

There's also a lot of information you can pull up about a person's lifestyle from their skeleton. I like to say that our life stories are written into our bones; the types of activities that we do, the level of physical activity that we do, history of disease processes.

If you get really, really sick with something, that is often reflected in the bones. Ongoing disease processes – if they're quite systemic, or maybe sometimes very localized – can affect bone as well. Histories of surgeries, the insertion of prostheses, repairs.

We can reconstruct a person's diet at different stages of their lives depending on where

we source the tissue from. Even when we've stopped growing, it doesn't mean that your bones just stop doing what they do. Your body continues to turn over that, and it's pulling in material from your diet as it does that. This means we can use stable isotope analysis to generate information based on your diet. Everything from the type of water you were drinking to the type of food that you were eating, all of that is written in bones.

Are some bones more revealing than others?

DF: Your teeth are particularly good in this regard. They recall what happened when your teeth were forming in early childhood, all the way up until your wisdom teeth form, which is going to be in your teenage years. That's fixed, your teeth don't continue to change. And then we can go right down to hair and fingernails, which will tell us what about the last few weeks and months before death.

All that is just around identity. There's also some really cool work that gets done by forensic facial artists who will look at the structure of your skull, and using an intimate knowledge of anatomy, combined with scientifically derived soft tissue depth standards, they can help to reconstruct what your face might have looked like. That method has a lot of potential, it's infrequently used as a conclusive means of identification, but it can generate new leads for investigation.

It means you can create a recognizable likeness of an individual, and send that out to the public. Then someone's like, "Oh, I remember that person," and suddenly you've got a whole new set of potential leads for the case to help identify the body.

Dr Devin Finaughty will be back to discuss the trials and tribulations of forensic science in IFLScience's first live virtual event, CURIOUS Live. Keep an eye out for further details, this is one you don't want to miss. •

Image Credit: RapidEye/iStock

SCIENCE FACT OR FICTION:

ARE WE REALLY MADE OF STARDUST?

The wildly popular concept that “we are all made of stardust” is not exactly wrong, but the devil is in the details. Dr Alfredo Carpineti explains exactly how the building blocks of us came to be.



Carl Sagan said: “The cosmos is within us. We are made of star-stuff. We are a way for the universe to know itself.” It’s a quote so unbelievably good it makes you stay up at night to take it all in. But of those words, let’s focus on two in particular: star-stuff. Sagan



did not actually say stardust. Star-stuff might be a more vague description, but, in a way, it is more precise. We are about to find out why.

On one hand, you can easily argue that we are made of stardust. Roughly 99 percent of the human body is made of just six elements. In order of fraction of mass, they are: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Around 65 percent of your mass is from oxygen, 18.5 percent from carbon. Hydrogen makes up 90 percent of all atoms and is the only element in the human body that does not come from stellar processes or events.

To make a human from scratch

To find the origin of hydrogen, we need to start at the very **beginning of the universe**. Within a few minutes following the Big Bang, the cosmos was experiencing nucleosynthesis. The whole visible universe a few minutes after the Big Bang was relatively small. If we centered it from the Sun, it would not stretch much further than a **few dozen** of the closest star systems. And it was hot, a state called quark-gluon plasma. Quarks are the bits that make

protons and neutrons, the particles at the center of atomic nuclei, and gluons make them stick together.

The universe was undergoing massive expansion, and as it became larger, it also became cooler – at least cold enough for protons and neutrons to pop into existence. Hydrogen in its simplest form is just a single proton, so as the protons emerged from the quark-gluon plasma, voila, you got hydrogen. The less common form of hydrogen is called deuterium, which has one proton and one neutron, and this ended up fusing into helium (two protons and two neutrons) and a tiny amount of other elements but nothing as heavy as carbon (in its most common form, six protons and six neutrons). At that point, the universe was 75 percent hydrogen and 25 percent helium (plus traces of other elements).

To make carbon and anything heavier, you’d need another source of nucleosynthesis: stars. Stars create heavier elements than hydrogen and helium by nuclear fusion. First, hydrogen is turned into helium, then helium into carbon and oxygen, and then heavier elements if the star is massive enough. When they get to iron, the system breaks down. It takes more energy to fuse iron than you get out. Without the energy production, the star collapses on itself, making more elements in the process and spreading those elements around the universe as it explodes in a supernova.

***SOME OF THE CALCIUM IN YOUR BONES
AND IRON IN YOUR BLOOD WOULD COME
FROM THE DEATH OF THESE STARS.***

These violent ends have violent delights

Some elements are produced in the explosion of white dwarfs. White dwarfs are stars that were not massive enough to go supernova by themselves, so their collapsed core ends up exposed. But if they have a companion, they might steal enough material to cross a critical threshold and go boom – in the process creating

new elements. Some of the calcium in your bones and iron in your blood would come from the death of these stars.

TO MAKE US, YOU NEED ALL THAT – NOT JUST THE BIG BANG OR STARS FUSING ELEMENTS; YOU ALSO NEED THEIR EVOLUTION AND EVENTUAL DEATH, ESPECIALLY IN THE MOST DRAMATIC AND EXPLOSIVE FASHION.

The final process that forms the heavier natural elements in the periodic table is neutron star collisions. It's the only way you can have the rapid neutron capture, also known as the r-process. This is a set of nuclear reactions that create half of the elements that are heavier than iron. It is responsible for stuff such as gold and platinum, but also for elements fundamental to human physiology. The crucial

contribution of neutron star collisions to our composition is iodine. There is not much, but it's a key element for our metabolism.

So, to make us, you need all of that. Not just the Big Bang, not just stars fusing elements; you also need their evolution and eventual death, especially in the most dramatic and explosive fashion. You need big stars and small stars. Maybe even the biggest stars that ever existed, objects **up to 10,000 times** the mass of our Sun that lived for just 2 million years at the very dawn of star formation in the universe.

With all of this in mind, it is quite obvious we are made of star-stuff. We are here because stars have died. But the question we're addressing is slightly different: are we made of star dust? The answer is partly – and now this is where we can properly nerd out.

Dust to dust, ashes to ashes

Stardust, cosmic dust, extraterrestrial

dust – whatever you want to call it, the universe is peppered with it. But it's not like Earth dust. First of all, it's usually much finer, mostly between the consistency of smoke and structures made of just a handful of molecules. The biggest structures are micrometeoroids about 100 microns across (around 0.1 millimeters). And here we get to the issue: stardust has a very specific meaning in astrophysics.

It is dust created by stars, but not all dust is created there. So, it is a nitpicking argument but it is an important one. Firstly, it's interesting to know that some stars created molecules, even some complex carbon-based ones. Stars make these molecules and they are then ejected into space. Some carbon molecules might eventually find their way to planets, where they might be used as the building blocks of living things.

So you see, we are stardust, but only in part. A **common estimate** of how much stars directly contribute to all the dust in



the universe is around 6 percent. This might seem like a disappointing number, but we're going to argue that it's not. Being nitpicky about the question "are we made of stardust?" allows us to better appreciate **all the sources** that eventually made our planet and, in time, us.

Cosmic dust is created near stars, as they lose the outer layers of their atmospheres. It is created in the ejected material of novae, the ephemeral state where astronomers observe the sudden brightening of a white dwarf stealing material from a companion star. And of course, as supernovae explode, dust also forms in the ejecta of these cataclysmic events.

"STAR-STUFF" IS MORE MATTER-OF-FACT AND LESS DEFINED, BUT IT ENCOMPASSES ALL THE SHADES OF THE STELLAR PROCESSES THAT DIRECTLY OR INDIRECTLY ENDED UP MAKING US.

From the stars to our bodies

Dust is then processed in the interstellar medium, the matter that exists in the space between stars. Here, dust can be destroyed and reconstituted, it can be turned into something new. The interstellar medium is filled with complex molecules such as polycyclic aromatic hydrocarbons, precursor molecules to important organics like amino acids, the building blocks of proteins. The evolution of these dust grains occurs not only when stars are dying or have died, but also at their birth.

Intense energy from the protostellar phase can create a reaction in the cloud of gas and dust that surrounds a fledgling star. Those processes will eventually lead the grains of dust to interact with others, to accumulate into pebbles, and from pebbles

to planets – well, it's just a short step in cosmic terms. Everything around you comes from stars. We are the product of those cosmic interactions.

But there is a molecule that we have not considered yet, not exactly stardust but stardust adjacent (sometimes literally attached to it): water. Water ice is a byproduct of star formation and it is the most common solid material in the universe.

The water in our rivers, oceans, drinks, and bodies formed long before the Solar System in the cooler parts of interstellar space where it can condense. But water vapor can also form in cool stars, those that have a temperature less than the value that causes water molecules to split. So, among that dust released by stars, there's also water. Water that eventually found its way to Earth and to us.

Stuff is better than dust

We are a hopelessly romantic species. "Stardust" to us has connotations of something sparkly and magical, like fairy dust; a sprinkling of cosmic magic that makes it a bit more special. "Star-stuff" is more matter-of-fact and less defined, but it encompasses all the shades of the stellar processes that directly or indirectly ended up making us.

Maybe "stuff" has less magical connotations but the grit of it has more power. Stars burned to make us, became giants, and went supernova. The densest stars in the universe merged to make bits of us, and the molecules that make us formed in burning atmospheres and freezing interstellar clouds. We are star-stuff, a patchwork of elements and molecules formed in a huge variety of cosmic environments. But we are more than just dust or stuff, we are the sum of universal processes that came together in what we call a human being. ●



LONDON IS CHOKING

In this eye-opening snippet from London Mayor Sadiq Khan's new book, *Breathe: Tackling The Climate Emergency*, he retells how his first mayoral visit forced the media to recognize that the climate crisis had arrived in the UK's capital.

Sir John Cass's Foundation Primary was the kind of school that could only exist in London.

Located just inside the ancient east gate of the City of London, it was nestled snugly between some of the country's most remarkable buildings – a fragment of Roman city wall here, a medieval church there, and the Gherkin towering over everything from a few metres to the north-west. It was the sort of school that parents boast of sending their kids to: a brilliant state primary, open to everyone, in the vibrant heart of the world's greatest city.

In fact, everything about Sir John Cass was exemplary except the air quality.

Just a few metres from the school was the A11, one of the busiest thoroughfares running from the City into East London. Inside the school was the constant roar of traffic;

outside, the air felt suffocating. You could almost taste the pollution.

On Friday, 13 May 2016, less than a week after my election as Mayor of London, I paid a visit to Sir John Cass. In defiance of its polluted surroundings, the school breathe 50 had begun several environmental initiatives – including creating a green roof garden to help teach pupils about the natural world. That's why we were there. Where better place to announce that we'd be launching the biggest public consultation and education programme on air quality in London's history?

These were early days in my mayoralty, and we were still finding our feet. Upon arriving at the school, I met with the teachers and students to discuss my plans while helping out with some weeding. About an hour into the day, I heard some alarmed mutterings coming from my team behind me. They had spotted that I had forgotten to wear my wedding ring. Normally this wouldn't have worried anyone – but given who I'd just succeeded as mayor, and his reputation for infidelity, they didn't want to take any chances. In the end, the journalists present didn't notice my jewellery mishap, but they were bemused by the trip. Reporters kept asking my team why I'd chosen the school as my first proper mayoral visit.

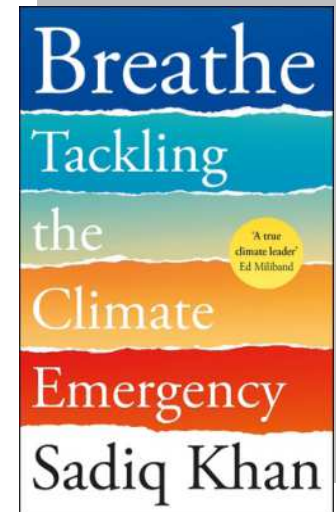
Our reasoning was simple. During the election campaign, we had often found

it difficult to get coverage of our climate policies. Hustings events, where candidates come together to debate policies and address potential voters, had taken place across the city on topics from transport to housing – and were usually religiously attended by the London and national media. But there were far fewer climate-focused events, and those there were attracted little media attention.

The assumption seemed to be that climate change was something that happened "over there". The term conjured up images of rising sea levels in Bangladesh, or desertification in East Africa. A problem, certainly. But not one that anyone in London needed to pay much heed to.

Sir John Cass's Foundation Primary School proved otherwise. The climate crisis was an issue right here in London.

Making Sir John Cass the first proper mayoral visit was our attempt to force the media to notice. As I argued in my remarks at the school, we had been here before. In previous air crises, London had only responded after the emergency. The vast Victorian sewers were only constructed after the Great Stink in 1858; the Clean Air Act followed the Great Smog of London of the 1950s. Now, it was happening again. Since 2010, the government had been hopelessly inactive on air quality and it was the most vulnerable Londoners who would suffer as a result. This time, I wanted to act before the emergency. •



Q&A
AUTHORWITH
SADIQ KHANAUTHOR OF *BREATHE: TACKLING THE CLIMATE EMERGENCY*

The Mayor of London Sadiq Khan's debut book reveals the toll pollution is taking on the city, as well as his own health.

You have personal experiences with the effects of the climate emergency.

I was diagnosed with adult-onset asthma after running the London marathon. The marathon wasn't just the beginning of my journey as a runner, it was also, unexpectedly, the beginning of my journey as a climate activist. After a run, I would find myself wheezing and struggling to breathe. When the wheezing turned into coughing, I gave in and went to see my GP.

When I received the diagnosis of "adult-onset asthma" I was incredulous. I was 43. I'd never had any breathing or respiratory issues. My GP explained that it wasn't uncommon for

people to develop the condition in adulthood, largely due to environmental factors like poor air quality. I had almost certainly developed it from the air I was breathing while training on London's roads.

I was asked recently whether I'd feel as passionately about tackling the climate emergency – or even whether this book would exist – had I not run the marathon and got asthma. Truthfully, the answer is probably not.

What has your time spent fighting for green issues taught you?

I have been surprised by the loudness of the opposition to my attempts to tackle the climate crisis. It doesn't help that we are seeing populist parties around the world using it as a "wedge" issue to divide the public.

An effective response to climate change requires global cooperation. But having been in the room where it happens, getting rich and poor nations, and left- and right-wing

governments, to work together often feels near impossible. Despite its good intentions, the COP26 climate pact will probably not meet the scale of the challenge. That's where the role of cities comes in. When you compare national governments to cities over recent years, the difference in taking bold climate action is striking. It's night versus day. It's the difference between delayers versus doers. We are doing great things and that brings me real hope.

What is *Breathe* about?

My book's core message is one of hope for the future because there are two key things I have learnt. First, the climate crisis is not some "tomorrow", far away issue that we can afford to be apathetic about. It's right here on our doorstep and its impact is being felt today. Last summer, the UK hit record temperatures of over 40°C (104°F) and wildfires raged, destroying homes and livelihoods in minutes. In London, the Fire Brigade had its busiest days since The Blitz in WW2. Wherever you live, the issues in the book are either affecting you now or will be coming to you very soon.

Yet the climate crisis isn't intractable either, and the pessimism so many people feel about it is misplaced. For those who think there's nothing we can do – you're wrong. Just look at what we have done in London since 2016: toxic air has been reduced by almost half. London is now expected to meet legal pollution limits by 2025 as opposed to the 193-year wait expected when I was elected in 2016.

What's your hope for the environmental future of London and beyond?

Now I'm better informed about climate change, I feel more part of the world and understand the challenges we face. I'm no longer a passive consumer, but an active citizen. And that's what I want everyone else to be too. So, whether it's reading a book (preferably mine!), listening to podcasts, or asking questions of your local councilors and MPs, get involved. ●

***Breathe: Tackling the Climate Emergency* by Sadiq Khan is out now (Hutchinson Heinemann, Hardback, Ebook, Audio £16.99)**



A window into Earth's steamy thermal activity can be found in Nevada, USA, where the Fly Ranch Geyser sports cascades of color. Each hue is the result of mineral deposits that course up the geyser's hydrothermal system from deep within Earth's crust, eventually cooling as colorful precipitation.

STEAMY STUFF AT FLY RANCH GEYSER

Geology and biology collide at Fly Ranch Geyser in Nevada, USA, where a human-made well provides a window into Earth's hottest watery environments and the curious life they support. Few animals would be lining up to take up residence in a place that reaches temperatures of 93°C (199°F), but a group of extremophile tenants is in part to thank for the magnificent view at Fly Ranch Geyser.

The other-worldly environment sits on the edge of Black Rock Desert. Settlers trying to establish a ranch in the region were likely unaware of the searing power of Nevada's Hualapai Geothermal Flats when they began digging here over 100 years ago. To make the land suitable for ranching they carved out a well but ended up with an explosive source of boiling water that was useless for what they needed. This geyser would be the first of three brought on by human interference with the land, and it was known as The Wizard.

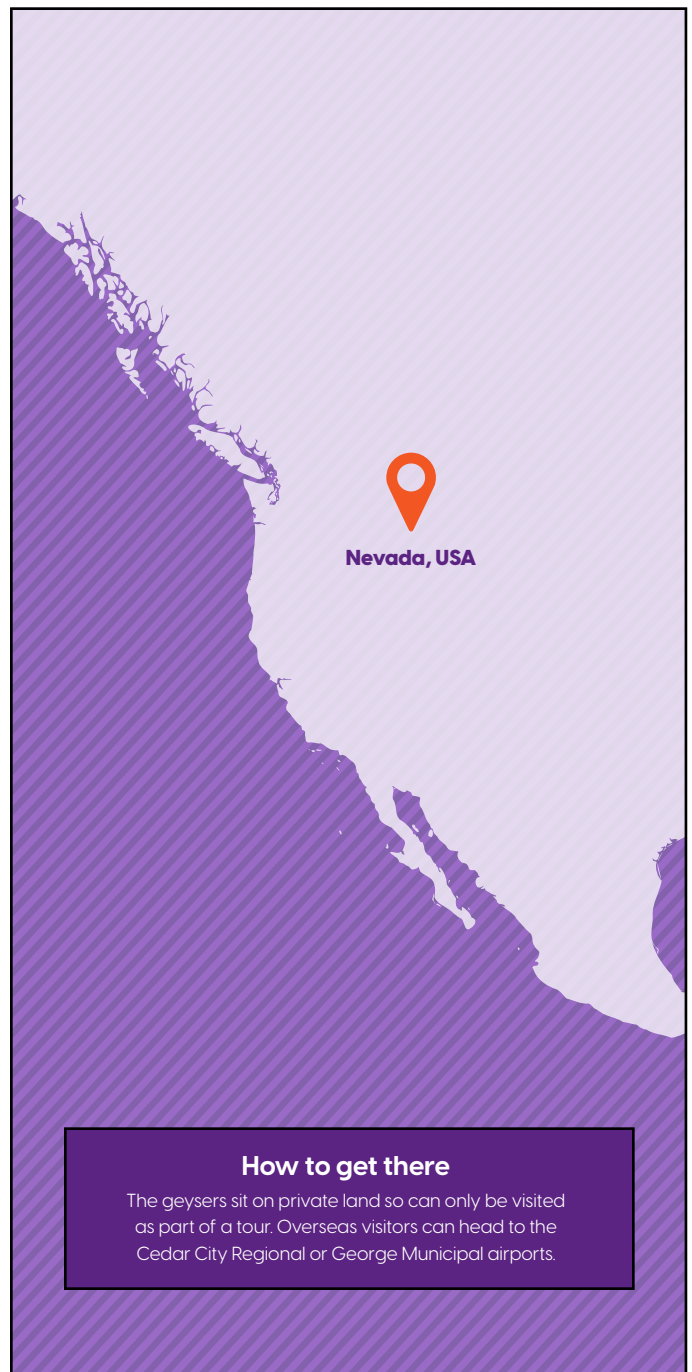
The region was drilled in the 1960s as a means of generating geothermal energy, but the additional human-made geyser turned out not to be hot enough to be of use. This well was sealed, but it didn't hold, and the disturbance led to the development of a third, massive geyser a few hundred feet away. The second is known as Fly Geyser, and the third is called Will's Geyser.

Geothermal waters are a force to be reckoned with, and the pressure meant the geysers kept growing year-on-year as boiling water burst out the top, replenishing layers of accumulating minerals and supporting a rich biome of colorful algae growing on the terraces.

The ever-growing cones now sport shades of red, green, and orange, as the result of thermophilic algae and mineral deposits. The minerals are picked up as the hot water surges through cracks in the rock, dissolving it as it moves. They then precipitate when they meet cooler temperatures on their escape from the geyser, building up in layers.

It might not sound homey but there are a variety of thermophilic bacteria, archaea, and algae that have set up a home in this extreme environment. They're known as extremophiles for their tolerance and are popular subjects in scientific studies looking to understand how life might respond to a warming world.

As well as being a site of scientific significance, Fly Ranch Geyser is a popular tourist destination having been purchased by the non-profit Burning Man Project. •



How to get there

The geysers sit on private land so can only be visited as part of a tour. Overseas visitors can head to the Cedar City Regional or George Municipal airports.

SEE



Elemental Film from Disney Pixar

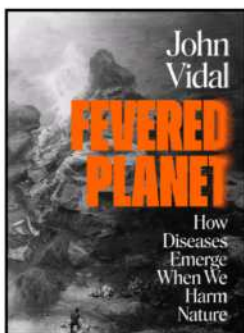
Let's go to Element City where fire, water, air, and earth elements live, but do not mix. Each element experiences its own trials and tribulations (it's not easy getting by as water when something as innocuous as a sponge can suck you up) at a safe distance from their worlds-apart neighbors. That is, until someone splashes unexpectedly into the life of our fiery protagonist, Ember.

In cinemas from **July 7**.

READ

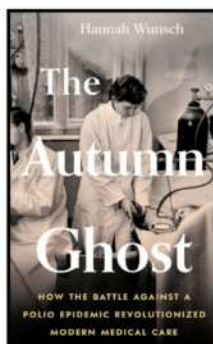
Fevered Planet Book by John Vidal

As one of the leading environmental journalists, Vidal brings 40 years of experience on the frontline of the climate crisis to his latest book, *Fevered Planet: How Diseases Emerge When We Harm Nature*. It's his view that we are now living in the age of pandemics, as the way we farm, eat, travel, and experiment has created the perfect environment for deadly diseases to emerge and spread. With COVID-19, monkeypox, bird flu, SARS, HIV and AIDS, and Ebola all fresh in our memories, has modern life become a haven for pathogens



Available **now**.

READ



The Autumn Ghost Book by Dr Hannah Wunsch

The battle against the mid-20th century polio epidemic was known as "the autumn ghost" after it slipped into

the homes of healthy children at summer's end. In her new book, Wunsch explores how the polio epidemic of 1952 sparked a worldwide revolution in medicine. As testimony from doctors, nurses, medical students, and patients reveals, the COVID-19 death toll could've been much worse without the mechanical ventilators the polio epidemic inspired.

Available **now**.

LISTEN



The Big Questions Season 3 Podcast by IFLScience

Could we bring back dinosaurs? Why is space junk such a big deal? Can we save a species on the brink of extinction? These are some of the topics IFLScience podcast hosts Dr Alfredo Carpineti, Eleanor Higgs, and Rachael Funnell will be tackling in season three of The Big Questions. Catch it where you get all your podcasts, including **Spotify**, **Apple Podcasts** and **Podbean**.

Available **now**.

PLAY

Oxenfree II: Lost Signals Game from Night School

Following five years on from the original, *Oxenfree II: Lost Signals* follows Riley as she returns to her hometown where strange electromagnetic waves send her on an investigation to find out what's going on. The search for the town's unsettling signals will expose a shadowy cult made up of supernatural beings as you manipulate the world around you to get to the bottom of the mystery.



Available **July 12**.

SCIENCE IN MEDIA





DATES TO REMEMBER

As we head full steam into summer, there's plenty to enjoy besides the weather. So, don your shorts and your sunhat and find out how you can help tackle plastic pollution, protect coral reefs, and celebrate space exploration this July. There's also the opportunity for some advocacy with World Brain Day, and the first meteor shower of the season to feast your eyes upon.

JULY

Plastic Free July

Plastic pollution is a problem: there are now over **171 trillion pieces** of plastic in the world's oceans, seabirds are suffering "**plasticosis**", even **rocks** haven't been spared. **Plastic Free July** is a global movement that encourages people to be part of the solution by reducing their plastic consumption for the month. By providing resources and ideas to help us limit single-use plastic waste in our homes, schools, workplaces, and communities, the initiative hopes to inspire small but meaningful change as part of a global effort to combat plastic pollution.



17-23 Coral Reef Awareness Week

Every third week of July is Coral Reef Awareness Week, which aims to raise awareness of these diverse ecosystems and how they should be protected and maintained. Coral reefs are home to a large number of organisms and provide an important source of food and new medicines, as well as protection against coastal erosion. They are, however, one of the ocean's most threatened ecosystems, vulnerable to the effects of climate change, pollution, and tourism, meaning their conservation is vital.



22 World Brain Day

July 22 is World Brain Day, which aims to increase public awareness and promote advocacy related to brain health. For 2023, the theme is Brain Health and Disability. "Brain health is a human right which applies to everyone, everywhere," says the World Federation of Neurology. "Join us on World Brain Day as we make sure that no one is left behind." Find out more [here](#).

20 Space Exploration Day

The anniversary of the Apollo 11 **Moon landing** is the perfect time to observe Space Exploration Day, dedicated to celebrating humanity's incredible feats in space exploration thus far and inspiring future generations of space explorers.



30 Delta Aquariids

From late July to early August, the Delta Aquariids will be putting on a show for us, kicking off the summer meteor season in the Northern Hemisphere. The predicted peak is on July 30, although you can expect to see a steady stream of meteors over several days. They will be best viewed from the Southern Hemisphere or by those at mid-latitudes.





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 reveals the world's deadliest spider has a venom-changing trick up its eight sleeves. If you like your science lighter, let Jack Dunhill introduce you to the California town run by puppy politicians.

VARIABLE VENOM

A leopard may never change its spots, but not all in the animal kingdom are so inflexible. Take, for example, the funnel web spider – the deadliest arachnid in the world. Its venom might be the most potent on the planet, but that doesn't mean it's consistent. The angry arachnids have been found to shake things up, varying the composition of their poison depending on their situation.

Per a **recent study**, Border Ranges funnel-webs (*Hadronyche valida*) tinker with their toxins when their heart rate and defensiveness are up, such as when under duress of predation.

"FUNNEL-WEBS HAVE THE MOST COMPLEX VENOMS IN THE NATURAL WORLD."

Brave scientists collected specimens of four species of Australian funnel-webs and subjected them to different tests designed to irk them (but not hurt them). These included being prodded with tweezers and puffed with air to mimic a predator. They then measured the spiders' heart rates and

mapped their behaviors, before collecting and analyzing their venom.

"With the Border Ranges funnel-web, the expression of some venom components was associated with heart rate and defensiveness," **explained** Dr Linda Hernández Duran. "The other species didn't demonstrate this, suggesting that particular associations may be species-specific."

This, the researchers say, is the first time that specific constituents of venom have been linked to particular behavioral and physiological variables, a discovery that could help further our understanding of venom itself, and may have applications in seemingly unrelated fields such as medicine.

"Funnel-webs have the most complex venoms in the natural world, and they are valued for the therapeutics and natural bioinsecticides that are potentially hidden in their venom molecules," explained Hernández Duran. "Knowing more about how they are produced is a step towards unlocking this potential"

In the grand scheme of arachnid poisons, funnel-webs may have the more malleable cocktail of toxins at their disposal, but scorpions' natural exudates are the most expensive liquid in the world. Or are they? Have a peep at **issue 4** of CURIOS to find out.

THE GOODEST BOY IN GOVERNMENT

If you're unhappy with the way things are run, why not replace your politicians with golden retrievers? That's exactly what Idyllwild (don't ask us to pronounce that) in California did, after electing **Mayor Max** the golden retriever to the highest power in their town. From there, Max went on to create a doggy dynasty that has seen his golden relatives in the most important seats for years, and frankly, we're here for every bit of it.

MAYOR MAX II RAN WITH THE INCREDIBLE SLOGAN "I'M MAX AND I'M VERY FRIENDLY."

Believe it or not, Mayor Max I and his relatives have been running the show now for over 10 years, after the first of his name was elected in 2012. His popularity was so widespread that his term quickly became extended, but Max I tragically passed away in 2013. Luckily for Idyllwild, his successor,

Maximus Mighty-Dog Mueller, II, arrived shortly after and was swiftly voted in, where he served the people with his deputies Mikey and Mitzi (also golden retrievers) until 2022.

Mayor Max II was 9 years old when he passed in 2022 and had recently been re-elected, where he ran with the incredible slogan "I'm Max and I'm very friendly". It's no surprise then that the campaign captured the hearts and minds of locals, and the town overwhelmingly supported his succession to the mayor's office. Mitzi and Mikey then ran as interim Co-Mayors until December 2022, when Mayor Max III was sworn in as the new mayor as just a young pup.

The idea to have a dog run as mayor originated when locals wished to raise money for a local dog shelter, where each vote cast in the 2012 election cost a \$1 donation to Idyllwild Animal Rescue Friends (ARF). Astonishingly, they raised \$31,000 and the era of Max I began.

Max III is continuing the legacy and smashing all his roles, which include being "present at community events" and speaking out "on behalf of the animals of this mountain, domesticated and non-domesticated". As expected of such a good boy, he's doing an outstanding job.



The Darker Side of Science



THE LIGHTER SIDE OF SCIENCE