

CURIOUS

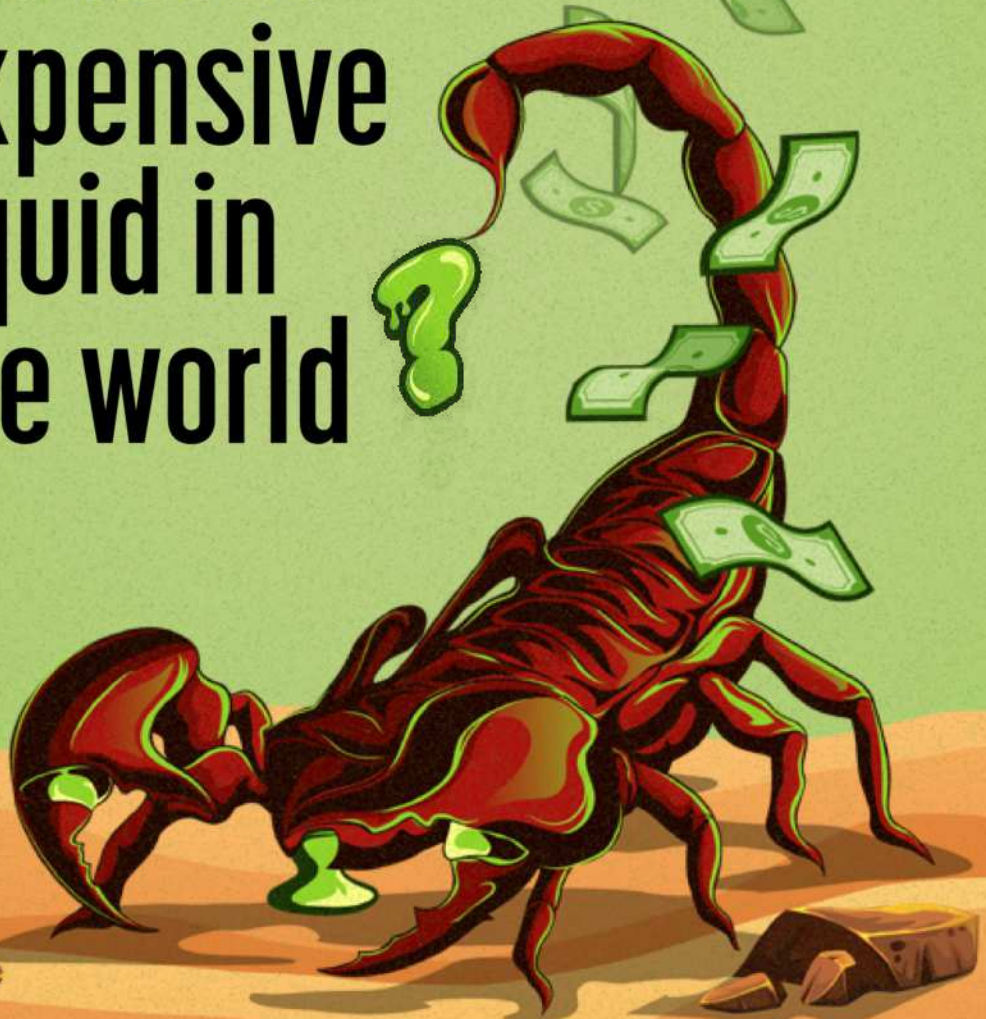


DOES OUR SPORTING FUTURE LIE
BEYOND EARTH'S ATMOSPHERE?

CAN YOU REALLY BE
ALLERGIC TO THE SUN?

IFLSCIENCE.COM | NOVEMBER 2022

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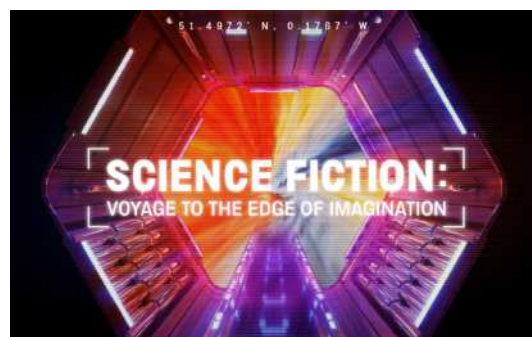
In Space, No One Can Hear... Pop!

As space tourism ramps up for those who can afford an out-of-this-world trip, it was only a matter of time before we got space champagne. Maison Mumm, one of the world's largest champagne producers, has teamed up with Axiom Space to produce what they call the "first champagne bottle and tasting experience designed for space travel". Named Mumm Cordon Rouge Stellar, the bubbly is set to fly on Axiom's space missions from 2023 and will be available on its future commercial space station. After four years of development, including sending Mumm's "cellar master" on a parabolic flight to understand the impact of microgravity on fizzy wine, the high-tech champagne has been signed off by both space flight officials and Mumm's champagne connoisseurs. To ensure no bubbly explosions in space, a shell of aeronautical-grade aluminum protects the bottle while a stainless steel ring attaches the cork so it doesn't hit anything (or anyone) crucial. Cheers!



Nights-In November

The nights are drawing in and you want to be transported to a magical world; enter Disney's new animation *Strange World*. Obviously inspired by the epic adventure tales of Jules Verne and HG Wells, the movie follows a family of legendary explorers in an uncharted and treacherous land filled with fantastical creatures. They are rumored to be inspired by everything from tardigrades and dinosaurs to sea stars. It's also reportedly the first Disney animated film to have an openly gay main character, but we've heard that before so we'll see. The movie is released in cinemas on November 23, which also sees the global release of *Good Night Oppy* on Amazon Prime Video. Charting the incredible true story of NASA's Opportunity rover, sent to Mars for a 90-day mission that ultimately lasted 15 years (until contact was **officially lost June 10, 2018**), it's sure to be both inspiring and emotional – especially if you know what Oppy's **last message was**.



100 Years Of Tutankhamun

On November 4, 1922, Howard Carter was met with an unfamiliar silence when he arrived at an excavation site in Egypt's Valley of the Kings. That morning, Hussein Abdel Rassoul had been trying to place jars of water on the sand when he discovered what would later be recognized as the first step leading to the tomb of Tutankhamun. Here, the young pharaoh had remained in a nest of coffins undisturbed for more than 3,000 years. In the century that's passed since the discovery, we've learned a lot about the young pharaoh who was almost lost from memory after his name was near-completely erased. Thankfully, Edward Ayrton's discovery of a faience cup bearing King Tut's name led to one of the greatest archaeological discoveries in human history.

Go On A Sci-Fi Adventure

If you find yourself in London between now and May 2023, don't miss the huge new *Science Fiction: Voyage to the Edge of Imagination* exhibition at the Science Museum. Described as an "immersive, genre-defying" experience, you'll be placed at the heart of a sci-fi adventure – guided by an alien AI, of course – to explore visions of the future through the science of today. Plus props, artwork, and photos from the most beloved sci-fi books, movies, and TV shows, including Darth Vader's helmet and *Doctor Who's* Daleks. Not one to miss, nerds. Find out more **here**.



Blood Moon Total Lunar Eclipse

The second total lunar eclipse of the year takes place on November 8, and then that's our lot for 2022 eclipses. A total lunar eclipse is when the Earth comes between the Sun and a full Moon and Earth's shadow covers our satellite. Instead of going dark, however, the Moon turns red. The Moon does not have its own light and only reflects the Sun's, so when Earth is in the way, its atmosphere bends the sunlight and indirectly lights up the Moon's surface. Luckily, a lunar eclipse doesn't require any special eye protection and you should be able to see it from pretty much anywhere in the world.

Will AI Save The Planet?

The latest United Nations Climate Conference, COP27, is set to take place in Egypt this month. From November 6-18, countries, governments, scientists, and activists will come together to try and hash out what is preventing us all from working together to save the planet. Not since COP21 in 2015, when the Paris Climate Agreement to limit global warming to well below 2°C (3.6°F) was agreed, have we seen meaningful global climate cooperation. Even that hasn't been achieved yet, so what the 2022 version has in store is unclear. Perhaps, as a **new study** has demonstrated, it would be better left up to artificial intelligence? With time running short for the world to agree on how to reach net zero by 2050, scientists have turned to AI to find which policies have the best chance of seeing international agreement. Using machine learning AIs representing 27 nations, they debated 100 years of climate negotiations in just a few seconds, learning from the results of each simulation. You can even try your hand at it **here**.

WHAT'S UP?



Space (Resort) Oddity

Visit the Moon without leaving Earth

Name: Moon World Resorts Inc.

Appearance: Big, round, Moon-like

Location: Dubai.

Tagline: "12 people have been there, 7 billion want to visit!"

What is this? A massive Moon-shaped resort with space-themed attractions so Earthlings can visit the "lunar surface" without stepping off-world.

How massive? Pretty massive. A perfectly spherical, 224-meter-wide (735-foot) replica of the Moon that can accommodate 2.5 million annual guests, sorry, "astronauts" a year. It's set to be the world's largest spherical building.

Will it actually look like the Moon? The entire thing will be lit up to mimic the different phases of the Moon as well as featuring the well-known regions and craters of our natural satellite.

How much will it cost? Space tourism isn't cheap. It will be free

to enter the Moon but the proper experience will cost \$500.

Proper experience? A 90-minute tour includes the opportunity to walk on the "lunar surface", exploring a working lunar colony, spacewalks, and rover taxis. You can also ride in a Moon shuttle.

A real Shuttle? Well, the real Space Shuttle never actually reached the Moon, it was a low-Earth orbit space launch system. Here, after suiting up, you get to experience a ride in a shuttle for an "out of this world" audio-visual liftoff before landing on the "surface". Rumors are the space suits give you a certain degree of reduced gravity. Cue slow hops across the ground and the sound of "That's one small step for man" in multiple languages around you.

Can I go now? Technically, it doesn't exist yet. The \$5 billion project could open around 2027-28. We are starting the "work trip" campaign now.

IS SCORPION VENOM REALLY THE MOST EXPENSIVE LIQUID IN THE WORLD?

While a minute amount of venom can fetch a pretty penny, getting into the scorpion business is unlikely to make you a millionaire.

By Rachael Funnell



Few among us can resist the allure of a get-rich-quick scheme, and upon hearing that a modestly sized arachnid has “liquid gold” dripping from its tail you might find your eyes turning to dollar signs. Could it be that simply milking a few small animals for their natural exudates could see one’s bank account shuffle into Bloomberg Billionaires Index territory? As is often the case in science, when it comes to scorpion venom, it’s a little more complicated than that.

Google “scorpion venom value” and you’ll be met with estimates that stretch into the multimillions, and in some ways they’re right. Valued in scientific research for compounds that could have far-reaching applications in medicine, as well as teaching us more about ecology and evolution, there are indeed labs across the globe forking out for tiny amounts of the danger milk. In other parts of the globe, scorpion products are purchased in larger volumes to be smoked, but as it turns out not all venoms are created equal. There are many avenues for the scorpion farmer prospecting for venomous gold, but it pays to remember that something’s market value is dependent on the existence of a flourishing market. In the case of top-shelf scorpion venom, that market is as small as it is choosey.

Why do scorpions make venom?

On the ouchy end of a scorpion sits a venomous sting that’s fed by a gland, and while all scorpions are venomous, there are only a few worth worrying about. “When it comes to scorpions, the bigger the better,” said Indiana Jones in *The Kingdom Of The Crystal Skull*. As it turns out, he was onto something.

Research conducted earlier this year found that yes, smaller scorpions with more modest pincers are indeed the most likely to pack a serious punch. For instance, the

large-clawed scorpion (*Scorpio maurus*) has sizable pincers but only boasts a weak venom. As such, they represent less of a danger to humans who can handle pincers. It seems, as a scorpion, you either invest your energy in gaining pincer might or venom potency, though this is a topic scientists are still researching.

As for making the venom itself, this too weighs heavy on a scorpion’s energy reserves.

“Scorpions have to raise their metabolism enormously to produce venom. For them, it’s like running a marathon,” evolutionary biologist **Dr Arie van der Meijden** of the CIBIO-InBIO Institute in Portugal told IFLScience. “It takes a lot of effort to make it, but then they never use quite so much.”

Van der Meijden’s research looks at the function of different body parts in their ecological contexts, including scorpion’s venom, and it has clearly demonstrated that these arachnids do not part with it lightly.

“We did a study a few years ago where we just poked the scorpion and made it angry so it would inject venom into a vial. They tend to use maybe 3 to 5 percent of their venom per sting which means they can sting many times. But that was in a scenario where you’re just annoying it from above. So, for instance, I’ve been stung by a scorpion several times and I’m never worried about it being dangerous because if the scorpion is free to move it’s just telling me to go away by using a very small amount of venom.”

Seems fair enough. So where does the real danger arise?

“I’ve seen a lot of people in North Africa sleeping on the ground between their palm trees at night to protect them because they’re

their only source of income. Those are the people who get killed because they can accidentally roll over on top of a scorpion. Then, they don’t inject just 3 to 5 percent of their venom, they inject 100 [percent] because they are being crushed.”

Northern Africa joins the Middle East, India, Mexico, and parts of South America in being home to some of the 50 or so scorpion species that represent a potential threat to human life. While it’s widely understood that different species’ venoms are built differently in terms of potency, what’s perhaps less well known is that the venom’s quality also changes with the number of stings.

I HAVE SEEN PEOPLE EXTRACTING SCORPION VENOM USING REALLY HIGH CURRENTS... AND YOU SEE THE SMOKE COMING OUT OF THE SCORPION. OBVIOUSLY, THAT POOR THING IS VERY BADLY HARMED.

Scorpions produce pre-venom in their first sting, which comes out as a clear fluid. A few stings in, that venom turns



increasingly opaque as it gets thicker and stickier. By the final few pumps, the venom is a very different texture, something Van der Meijden saw first-hand when his team established a new methodology for extracting its RNA in a scorpion-friendly way.

How do you “milk” a scorpion?

Historically, the industry standard for isolating scorpion venom involved killing it, removing the venom gland, and grinding it up. As nature has demonstrated, scorpions can also be goaded into envenomating objects, but that’s not necessarily the easiest way to collect it in significant quantities.

In 2021, Van der Meijden and colleagues succeeded in establishing a **non-lethal method for studying scorpion venom**, in their case to look specifically at the transcriptomes, which could tell them the genes involved in creating it. Their new-and-improved method uses an electro-stimulator that delivers a low current to activate the nerves that empty a venom gland.

Beyond animal welfare, keeping the scorpion alive and healthy has many potential benefits for research as it enables scientists to look at a scorpion’s venom qualities over several days. This could one day reveal the influence of diet, season, and other factors on venom composition, which

as well as teaching us new things about these animals, could have implications for its other uses.

Why do humans want scorpion venom?

Nature has long been an inspiration for human innovation in everything from technology and design to pharmaceuticals and therapies. With scorpion venoms being rich in proteins, peptides, and molecular compounds that boast the capacity to block, or rearrange, ion channels in the body, they’re considered promising candidates for venom-derived drugs.

THE AMATEUR VENOM-EXTRACTION BUSINESS IS HAVING A SIGNIFICANT NEGATIVE IMPACT ON WILD SCORPION POPULATIONS.

Scorpion venom’s applications in pharmaceuticals can vary depending on the specific ion channels they influence. Some that act on sodium channels have shown promise in the management of **epilepsy in mouse models**. Others that influence potassium channels are being investigated in the **treatment of autoimmune diseases** such as multiple sclerosis.

These venoms have evolved as a weapon to disable certain species by acting on these channels. The general money-making idea behind turning these weapons in our favor is that they may have beneficial effects on other animals, such as us. Scorpion venom, alongside that of sea anemones, snakes, and all manner of bitey, stingy animals, is therefore of great interest in certain areas of potentially profitable research. And with

great interest comes great marketability, no? Well, that depends on the volumes you’re talking about.

Is scorpion venom the most valuable liquid in the world?

“I am always puzzled by this big story about scorpion venom being so expensive,” said Van der Meijden. “I have lots of it. I should be a millionaire, but I am not. And that’s because yes, it’s very expensive to buy... but scorpion venom itself has to be really high quality, and you have to be able to refine it to get the particular components out in quite a pure way, which is even more expensive. And then there is a tiny market.”

While a miniature sample of a few hundred micrograms of scorpion venom might fetch you around \$200, that sample could be enough for a year’s worth of research. The potential for profit begins to look even less promising when you consider that the people doing those studies are unlikely to buy their product from unfamiliar sources.

Associate professor at the University of the Sunshine Coast, Volker Herzig, whose research has included the effect of scorpion venom on epilepsy, has been approached by venom farmers. As he told **ABC News**, few in research are likely to take people up on these offers.

“I’ve been contacted by a number of places... They’ve contacted me saying they’ve got this number of scorpions at their farm and they’ve been trying to sell me venom. I believe a number of other toxinologists have been contacted as well.”

For his supply, Herzig prefers to travel to Europe where he milks the scorpions of pet enthusiasts. Elsewhere, labs produce stocks by sequencing the DNA of naturally derived samples and figuring out how to artificially synthesize their own. As for Van der Meijden and his generous supply? “I share it with researchers for free.”

Why do humans want scorpion venom?

A trustworthy source of scorpion venom is not just important for ensuring its quality



(remember what Van der Meijden was saying about those expensive refinement processes?), but it also has implications for conservation and species extinction. An **article** published by researchers of the Biodiversity Unit at the University of Turku, Finland, outlined how the amateur venom-extraction business is having a significant negative impact on wild scorpion populations.

Having scuttled across this planet for **more than 430 million years**, in which time they've succeeded in spreading to almost all of Earth's major landmasses, scorpions are now threatened by the pet trade and amateur farming, both of which are extracting them from the environment. It's the authors' outlook that this industry may hasten the extinction of scorpions, and what's driving that threat is the same misunderstanding that has led to so many believing that their venom represents a lucrative business opportunity.

"Interest towards scorpion venom has unfortunately led to the situation where enormous amounts of scorpions are collected from nature," said co-author and doctoral candidate Alireza Zamani in a **statement**. "For example, a claim was spread in social media in Iran that scorpion venom costs 10 million dollars per litre.

"As the situation escalated, illegal scorpion farms were established in the country and tens of thousands of scorpions were collected into these farms. Simultaneously,

businesses devoted to training people in captive husbandry and rearing, marketing, and bulk distribution of live scorpions began to flourish. As a result, many species are quickly becoming endangered."

So, as for the million-dollar question: Is scorpion venom the most expensive liquid in the world? The answer, it seems, depends on your approach. If you're a researcher looking to do investigations into the talented peptides and proteins contained in scorpion venom then yes, it's up there as one of the most costly items by weight that money can buy (which, given the going rate for **lab-grade peanut butter** perhaps isn't all that surprising).

If, however, you're approaching the scorpion venom market intending to become a millionaire with the installation of a few terrariums, it looks like bad news. While you could probably fashion a makeshift hotel in which to store a few miniature cash cows, chances are the only thing you're going to find yourself rich in is memories of the time you ended up sitting on a load of scorpion venom with nobody to sell it to. •





Image Credit: Embryology by Jaime Culebras, Terrestrial Life Finalist, BigPicture Natural World Photography Competition

TALENTED EGGS IN ECUADOR

The Wiley's glass frog (*Nymphargus wileyi*) is quite the innovator when it comes to daycare. This photograph, taken by Jaime Culebras, shows the egg clutch of one mating pair artfully attached to the tip of a fern. The gelatinous blob encasing the eggs protects the developing embryos from predation, dehydration, and fungal infections until they're ready to plop into the water below. This image was originally published in **bioGraphic**, an independent magazine about nature and conservation powered by the California Academy of Sciences, and media partner of the **BigPicture Natural World Photography Competition**.

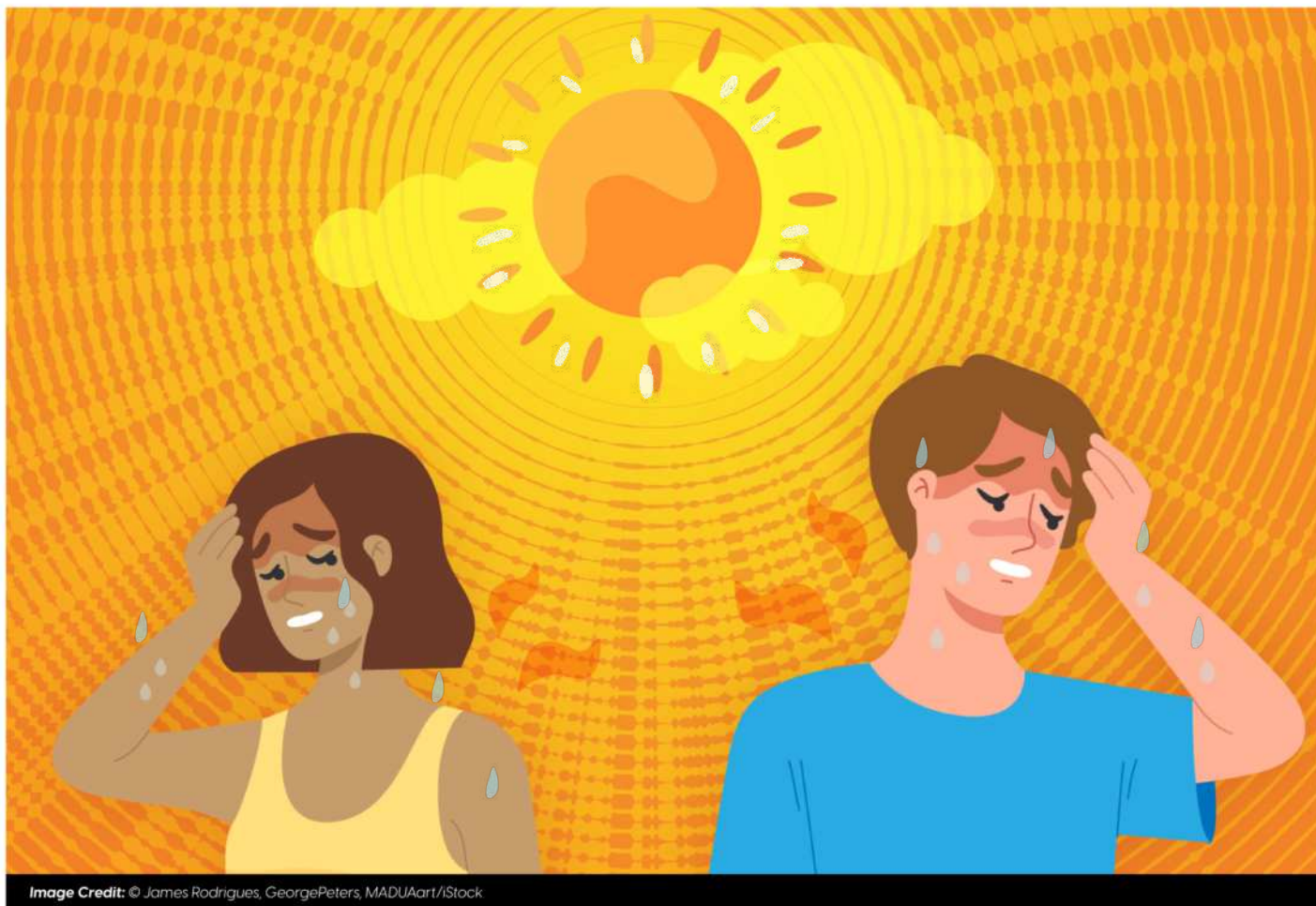


Image Credit: © James Rodrigues, GeorgePeters, MADUAart/iStock

CAN YOU REALLY BE ALLERGIC TO THE SUN?

DR ROBERT SARKANY, LEADING SUN ALLERGY EXPERT AT ST JOHN'S INSTITUTE OF DERMATOLOGY AT GUY'S AND ST THOMAS' HOSPITAL, LONDON, BREAKS IT DOWN.

By Katy Evans

Without the Sun, life on Earth would've had no hope of getting off the ground. A star to warm our little rocky planet helped create conditions that meant life could unfold in this tiny corner of the cosmos. Yet somehow, some humans appear to have developed allergies to sunlight.

Sunlight is made up of an electromagnetic radiation spectrum that includes visible light, infrared (heat), and ultraviolet (UV), the last of which we can't see or feel but is the culprit of a range of Sun

damage that spans from irritating to painful and deadly. You won't leave the house without sunscreen after reading this.

So, can you really be allergic to the Sun?

The short answer is yes. In lots of different ways.

How does the Sun affect the body?

If you break up sunlight with a prism, do the Isaac Newton thing, you'll find you get a fan of rainbow colors, but just all the visible ones from the shortest to longest wavelengths. However, if you put your hand in it, you won't see anything, but it'll feel hot; that's the infrared. You can't see and you can't feel anything, but if you keep your hand there for long enough, you will sunburn. That's called ultraviolet (UV) and that's 5 percent of what the Sun sends out to us.

UV can penetrate the skin because it just so happens that the energy in a UV photon matches the energy gap between electron orbitals in the sort of carbon-containing molecules that make us up and by that, I mean proteins, DNA, and, lipids etc. So, that's a very physicsy way of saying that UV chemically changes the biochemicals that make our pathways, and so any bits of the body that are exposed to daylight will change anywhere it gets through. It'll get through the first millimeter or two of skin, it will get onto the eyes, and what you will have is the very worrying situation that

all the time the cells are being exposed, their DNA is being changed, and you get mutations and changes in the DNA.

Any sort of long-term cells, like the stem cells that are millimeters down in the skin, you suddenly find that you've changed the genetic code. You're going to get all sorts of things suddenly appearing after exposure, which are sort of modified, chemically altered versions of proteins that take different shapes. And your immune system is going to turn around and say, "Oh, don't like the look of that, that's clearly something that shouldn't be there." So you end up with a load of stuff that looks foreign and your skin starts mounting all these auto-immune reactions against bits of you that have been a bit damaged.

What are the body's defenses against sunlight and UV light?

Essentially, daylight is a uniquely ubiquitous, potentially very dangerous, environmental thing, which is clearly damaging anything it encounters in the body. As a result of this, we've had to develop a very, very sophisticated immune defense system to deal with this major threat that can cause cancer, autoimmune disease, induce mutations in DNA etc.

So, how the hell do you deal with that? You have three major responses: you produce pigment [in the skin] so that less damage happens tomorrow. You tan up quite quickly to protect against UV exposure so if the same thing happens tomorrow it will be absorbed and not get to the DNA.

You also have an intracellular, complex pathway of DNA repair to look for all those bits of DNA damage, and nip them out before they turn into proper mutations like cancer. The cells whose DNA is irreparably damaged are thrown into cell suicide, also known as apoptosis. They die, and that causes the reaction that we see as sunburn.

How do we avoid an autoimmune disease being triggered by exposure to daylight?

The immune system in skin is profoundly immune suppressed for about three days

after exposure to UV and three days is long enough for all the UV damage and altered components like proteins in the skin to be cleared out and got rid of. However, during that three-day period, what you don't want is to mistake collagen or something normal that has been slightly altered by UV for something which needs to be attacked, inducing an immune response against it. Then, unfortunately, that immune response might start attacking your collagen that has not been UV altered, and you've produced an autoimmune disease.

If anything slips past the defenses of those three responses, you will end up with things that you don't want to happen, pathological things happening when that person's skin is exposed to UV.

What are the different types of allergies, and how can we treat them?

Polymorphic light eruption (prickly heat) - The most common sun allergy in temperate zones, polymorphic light eruption, sometimes called prickly heat, affects one in six people. A few hours after exposure, certain parts of the body (the chest and neck, upper back, shoulders, and thighs) will have an extremely uncomfortable, red bumpy rash, which stays for up to seven to 10 days and then disappears. These people have a slightly more active immune response in that three-day period after exposure.

For really severe attacks, we use immunosuppressing medications, so steroid creams and tablets. For a really bad attack, we can use UVB in a controlled setting to expose the skin to very precise doses and it can actually do what's called hardening of the skin or desensitization of the skin for a few months afterwards, which works very well in many people.

Chronic actinic dermatitis (UV-related eczema) - Less common but can be extremely severe is chronic actinic dermatitis, in which absolutely tiny amounts of UV can induce a really severe dermatitis – an extreme version of eczema – in the areas where daylight has been. It can cause

dry, inflamed, very itchy skin that can be swollen or weeping on the hands, forearms, face, and neck for up to six months or a year. Most of the normal treatments for eczema are insufficient, so many patients are only treatable with very strong immune-suppressing tablets or injections. These people should avoid the Sun because the triggering dose for another flare is often as low as 120 seconds in daylight. Over a five-year period, for about 50 percent of people, it will disappear.

Erythropoietic protoporphyria (EPP) -

Then there are the rarer but very severe genetic diseases that cause photosensitivity. There is a family of inherited diseases called porphyria that all occur due to the accumulation of chemicals internally called porphyrins (essential for the function of hemoglobin).

The one that causes the most severe hypersensitivity is called erythropoietic protoporphyria (EPP) – an inherited lack of an enzyme in the pathway of heme. In people with EPP, in the thinner areas of skin – the face, tops of the feet, and backs of the hands – the porphyrin becomes toxic, it damages whatever it's around as a result of being exposed to daylight. It is caused by visible blue light, not UV, and damages blood vessels in the skin, causing terrible severe pain that can go on for three or four days. These patients have an extremely painful lifelong photosensitivity problem. It was first recognized in 1961, but in the last few years, for the first time, effective treatments appear to be coming through. One drug that has gone past trial stage increases pigmentation in the skin, which should not necessarily be very helpful in EPP, but it appears to have other effects on the skin, which do seem to be rather effective.

Xeroderma pigmentosum (XP) - Rare, but devastating, is xeroderma pigmentosum (XP). I mentioned how, fortunately, we have an effective and sophisticated DNA repair system. But if you happen to have a mutation in one of the genes which encodes the proteins that are part of this DNA repair pathway, then you have an inherited genetic lack of DNA repair in these cells. You can't repair the

DNA damage, which means every time these people go outside if it is not dark or nighttime, there will be damage that is not being repaired in all their skin cells, which will turn into mutations. So these patients, if they're not very, very well UV protected by the age of five or six, may develop multiple skin cancers, eye damage, and eye cancers as well. In areas where health service access is poor, the average lifespan is 13 or 14 years old.

In more developed countries where there are better health services, less sunshine, and sunscreens and methods of UV protection are more accessible, lifespan can be longer. With specialist services, what we're finding is that many people can live a nearly normal lifespan if they have very extreme and absolute protection.

Hydroa vacciniforme (HV) - Hydroa vacciniforme (HV) tends to come on in children five to 10 years old as a result of severe photosensitivity due to the immune system – it's a proper allergic reaction. Just 10 to 20 minutes of long wavelength UV radiation (UVA) exposure and you get blisters, big, red, itchy spots that come up on the face and hands, sometimes filled with puss. When they heal after a few weeks, they can leave very deep pock-mark scars. Only in recent years, and we've been very involved in this, has the cause of this disease been understood. HV has turned out unexpectedly to be due to chronic active Epstein-Barr Virus (EBV) infection. In other words, once those people are exposed to EBV, which generally causes glandular fever, it appears the immune system is not capable of eliminating it.

The EBV is infecting certain types of T lymphocytes – preventative immune cells – and when UVA goes into the skin of somebody with HV, the infected T lymphocytes seem to be allergic to UVA and dramatically react whenever the skin is exposed. So, HV is a rare and previously not very well recognized way in which chronic active EBV infection in the whole body can cause problems. It can be very life-restricting but in many people, it just goes away. Presumably, the immune

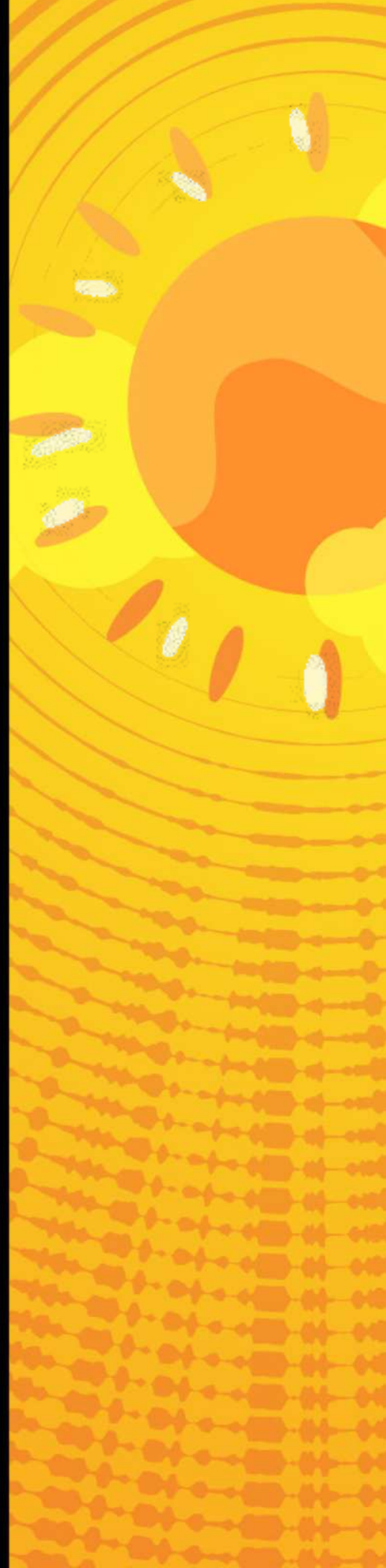
system is managing to eliminate EBV and the photosensitivity goes.

Solar Urticaria - There's a horrible condition called solar urticaria, which is the posh word for hives. Hives is very common, where people get a release of histamine and they get these nettle-like rashes that come up for an hour or three and then go down again. What is rare is the solar version. It comes in a very severe form and is a result of an allergy to UV or visible light in sunshine. You don't just get nettle-looking rashes, you get half an hour of intensely itchy, swollen red rashes on every single square inch of skin that's not covered by clothes when you go out and it can be from minimal amounts of daylight.

The problem with it is that yes, it goes away within half an hour, it's not EPP or chronic actinic dermatitis, with bouts going on for days or weeks, but what you've got is this intensely unpleasant thing every time you walk outside the door. People are effectively imprisoned in their houses during daylight hours. And even then they often have to have UV protective window films and things like that. So it can be very unpleasant even though it's not a dangerous disease. It can occur at any age, but young adults are the most commonly affected, and it can go on for decades. We do have improved treatments, injections or tablets, and it can go away on its own.

Photocontact dermatitis - Finally, there's a thing called photocontact dermatitis, which is not really a sun allergy, but an allergy to certain chemicals in sunscreens. With a few of these chemicals, particularly in sunscreens and in nonsteroidal anti-inflammatory gels and creams like Nurofen or ibuprofen that are put on the skin, the allergy doesn't happen unless you also have UV from sunshine that can trigger that particular chemical allergy in that person.

So, there's a dramatic range of Sun allergies, from the common and irritating "it's going to mess up my holiday" to the life-restricting and devastatingly life-threatening, which, thankfully, is a bit rarer. ●



SCIENCE FACT OR FICTION:

DOES OUR SPORTING FUTURE LIE BEYOND EARTH'S ATMOSPHERE?

Companies are trademarking logos for sports in space, but is microgravity sport really the future? Stephen Luntz investigates.





For all of human history, and probably before, people have tried to put any new environment or technology to use for the purposes of food, alcohol, sex, or sport. It's unlikely space will be any different. Growing food in space has turned out to be a difficult, but possible, task. Sex and home-brewed superstrength alcohol are likely

to be big marketing tools for future space hotels, so it's no surprise companies are planning for an era of sport in space, too.

Just because some people have big dreams, however, doesn't mean they'll come to fruition. There are a lot of obstacles to making space sports more than a novelty.

FINDING OUT IF YOU'RE BETTER AT LAYING A FOOT ON A BALL IN THREE DIMENSIONS THAN YOUR COMPANIONS COULD BECOME THE EQUIVALENT OF A GAME OF TENNIS AT A HOLIDAY RESORT.

Space sports: a history

Probably the first performance of sport in space came when astronaut Alan Shepard hit some golf balls on the Moon during the Apollo 14 mission in 1971. It wasn't exactly a professional effort – he didn't even challenge his crewmate Edgar Mitchell to a round. Instead, Shepard's efforts served as a demonstration of how even a one-handed swing with a makeshift six-iron could send the ball "miles and miles" in the low lunar

gravity and absence of wind resistance, or at least so it seemed.

Reanalysis of the mission's footage reveals the true flight path was about **36 meters** (118 feet), presumably reflecting how hard the suit made hitting the ball squarely. Shepard and Mitchell also tried javelin throws with a solar wind collector, which Mitchell claimed to have narrowly won.

The following year, Charlie Duke and John Young conducted a "**Second Moon Olympics**" to celebrate the fact that the Earthly event was coming up. The pair claimed to set records for the javelin and high jump, but after Young could have died falling on his back, further leaps were abandoned.

Brief missions in cramped spacecraft don't really lend themselves to sporting contests, but as missions have extended and craft got a little roomier, sport beyond Earth's atmosphere has revived. Astronauts have tossed frisbees and footballs around and hit balls with miniature hockey sticks, although no actual contests have been reported.

Cosmonaut Pavel Vinogradov was scheduled to hit a golf ball off an attachment to the International Space Station so that it would circle the Earth many times before burning up in the atmosphere. Had it happened, it would have broken countless records, but the idea was postponed, and then canceled, despite the no doubt considerable funding on offer from a golfing equipment firm for the publicity.

As the balance of space travel shifts from hard-working scientists to tourists with time on their hands, however, sports may have their day.

The new space sports

It's more than 40 years since Carl Sagan suggested space yachting using solar wind. Lunar dune buggy racing and skiing on Mars are also popular suggestions, but maybe the space sports shouldn't look quite so much like existing ones.

The existence of an organization called the **Space Games Federation** might seem



deeply premature, but it's an indication some people are very serious about a sporting space race. "Our focal points are entertainment, engagement, and education," founder Linda Rheinstein told **Space.com** in January. "We see new playing fields, new rules and taking new and traditional competitive organized sports to parabolic aircraft, spaceships, space stations ... the Moon, Mars and beyond."

The federation ran a contest inviting people to propose microgravity sports, be they adaptations of existing ones or entirely new concepts.

These were narrowed to 16 entries, all of which could theoretically be played inside space stadiums, but the practicality of many remained up for debate.

From these, five semifinalists were chosen based on principles such as throwing a magnetized ball through a hoop with the

same polarity, a version of dodgeball with more ease of movement in all directions, and astronauts racing to tie knots while tethered together.

NOVELTY VALUE ALONE WILL PROBABLY MEAN PLENTY OF EARTH-BASED EYEBALLS FOR THE FIRST PROFESSIONAL SPACE SPORTS, PARTICULARLY IF THEY INVOLVE ATHLETES THAT OFFER BIG-NAME RECOGNITION.

Social space sports

The ethics of space tourism are hotly debated, but it's certain to grow. Proponents are spending the GDPs of small nations to grab a share of what they expect to be an immense industry, which raises the question of what people will do once they are in space if they're not there to perform scientific research.

Just staring out the window as the satellite passes over Earth may be enough for some, but most space tourists are probably looking for a more complete microgravity experience. Finding out if you're better at laying a foot on a ball in three dimensions than your companions could become the equivalent of a social game of tennis at a holiday resort.

Professional space sports leagues

A pastime for space tourists is one thing, but some have much more lucrative ambitions. "Sports are going to be a big part of space evolution. When you look at the sponsorship money that goes into the NFL or NBA, this is a no-brainer," John Spencer of the Space Tourism Society told the **Wall Street Journal**.

FOR THE MOMENT, SPACE SPORTS REMAIN A LITTLE PIE IN THE SKY (AND ANY "SPORT" THAT INVOLVES PIE FIGHTS IN SPACE IS DEFINITELY NOT RECOMMENDED).

The Sports Games Federation's Equal Space Council advisory body is made up of retired professional athletes, sports broadcasters, and film producers who could certainly make a big contribution to promoting a space league. To secure a share of the revenue, companies have started trademarking names and logos, such as Sports In Space, whose goal is "organizing and sanctioning games and sports competitions played in zero and microgravity." However, more detail is hard to find, and it's not clear if efforts like this are serious or speculative. Moreover, the trademark for another company, ZERO GRAVITY SPORTS, turns out to be for tabletop games rather than anything played in orbit. Perhaps they're hedging their bets.

The obstacles to overcome

For all the enthusiasm, making a profitable business out of space sports may be harder than the boosters acknowledge.



Novelty value alone will probably mean plenty of Earth-based eyeballs for the first professional space sports, particularly if they involve athletes that offer big-name recognition. Getting people to tune in regularly enough to cover the inevitable immense costs could be a different matter, and the costs really will be... astronomical.

Even if the anticipated reductions in costs for space launches are met, it's not going to be cheap getting people into low Earth orbit for a contest. Team sports, particularly those that require many players, will be more expensive still. Building a stadium could be the biggest cost of all – there's a reason conditions on the International

MICROGRAVITY MIGHT NOT BE A SUITABLE LOCATION FOR EXISTING SPORTS, BUT LOW GRAVITY ENVIRONMENTS LIKE THE MOON AND MARS ARE A VERY DIFFERENT MATTER.

Space Station are so cramped. To take advantage of microgravity's effects and ensure plenty of spectacle, sports in space will probably need large playing fields.

Then there is the problem that muscles and bones **waste away** during prolonged periods in space, to the point where even very fit astronauts often faint on returning to Earth and can take a long time to recover. Spending the offseason in space is a sure way to kill the career of any ground-based athlete.

Indeed, for all Spencer and Rheinstein's enthusiasm, for the moment, space sports remain a little pie in the sky (and any "sport" that involves pie fights in space is definitely not recommended).

Any space sports league will have to overcome the fact that people mostly prefer to watch sports they grew up with, whether watching or playing. Sports with immense appeal in their home market struggle to attract viewers in places where they weren't a part of childhood. New sports that do take

off are usually those, like car racing, where people have experience of something comparable, albeit more low-key.

Unfortunately, familiar sports just don't translate all that well to microgravity, and unfamiliar ones might have little more than novelty value.

One space sport with saturation coverage and using some familiar faces might make an impact, but there's no agreement on what that would be. Years after the semifinalists in the Equal Space Challenge were announced, the website declared them all winners. The contest looks much more successful as an educational tool to get students thinking about the physics of microgravity rather than a path to inventing a sport many people would watch.

Generations of science fiction writers don't seem to have solved the problem either.

The Moon and Mars

Microgravity might not be a suitable location for existing sports, but low gravity environments like the Moon and Mars are a very different matter.

More flexible space suits should finally make Shepard's claim true, and future visitors to the Moon may be keen to reenact his efforts while wearing more flexible protection. Nevertheless, when it comes to sports in space, golf isn't likely to be a particularly popular example. After the thrill of hitting the ball out of sight wears off, who wants to have to trudge all that way to get it, let alone try to putt on the dusty lunar surface? And if the ball goes down a lava tube, it's toast.

On the other hand, basketball or volleyball games where players can leap tall (OK, small) buildings in a single bound would appeal to social players and watching fans alike. All we need is for Moon missions to become so routine that sponsors can afford to send multiple teams of athletes, support staff, and food. Oh, and a lunar stadium big enough there's no danger of players hitting their heads on the roof when they jump. Simple really. •



TIPPING POINTS AND FEEDBACK LOOPS

In this excerpt from Greta Thunberg's latest release, *The Climate Book*, Director of Potsdam Institute for Climate Impact Research, Professor Johan Rockström, explores the warning signs of the Anthropocene.

Scientifically, it is now well established that Earth has entered a new geological epoch, the Anthropocene, where our globalized world constitutes the largest driver of change on Earth. The amount of CO₂ emitted so far from our fossil fuel burning (some 500 billion tonnes of carbon) and the environmental destruction caused by us is sufficient to affect our planet's future during the next half a million years. We are in the driver's seat, determining the future state of our home, planet Earth. We triggered the Anthropocene some 70 years ago when our fossil-fuel-driven industrialized world economy went truly global, causing multiple "hockey sticks" of rising human pressures; the "Great Acceleration" is a fact, manifested in an accelerated rise in greenhouse gas emissions, fertilizer consumption, water use, marine fish catching, and terrestrial biosphere degradation, to name just a few.

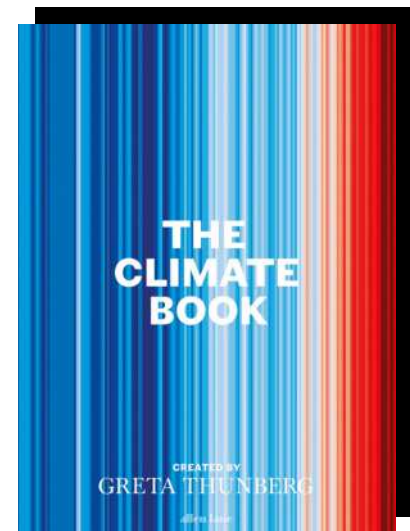
The drama, though, is much larger than this almost mind-boggling insight. We haven't just triggered an entirely new geological epoch. We are deep into the Anthropocene, and our planet is showing the first signs of an inability to absorb more human abuse. Merely 70 years after its onset, we are forced to conclude that the Earth system seems to be running out of resilience, losing its biophysical

capacity to buffer and dampen the pressure, stress, and pollution we are exposing it to.

The scientific community now must explore whether we are at risk of destabilizing the entire Earth system, which means pushing biophysical systems and processes – like the ice sheets, forests, and the ocean's circulation of heat – past their tipping point, where feedbacks shift from cooling and dampening to warming and self-reinforcing, which could culminate in an irreversible drift of the entire planet away from the stable interglacial state of the planet, the Holocene, that we have benefitted from since the emergence of human civilizations some 10,000 years ago, and still completely depend on.

This means that we have reached an existential fork in the road. We are in the Anthropocene and are seeing rising signs of the approach of irreversible tipping points. Still, the Earth system, while showing worrying signs of destabilization, remains in an interglacial Holocene-like state. This may seem odd, but it is the reason we can still talk of hope. While the Holocene is a state of the planet (an interglacial with two permanent ice caps in the Arctic and Antarctica), the Anthropocene, so far, is "only" a trajectory – a movement away from a Holocene state and not, yet, a new state.

But the risk is that there is only limited hope. At 1.1°C [1.98°F] of global warming (as of 2021), we have exceeded the warmest global mean surface temperature (GMST) on Earth since we left the last Ice Age. We have reached the ceiling of the comfortable interglacial state where temperatures never left a "corridor of life" of plus or minus 1°C [1.8°F]. Our grand challenge is to stop our current trajectory and to prevent the Anthropocene from becoming a new, self-reinforcing hot state. The only way to



succeed in this human quest is to avoid crossing tipping points in the Earth system that regulate the state of the climate and the living biosphere. This, in turn, requires that we govern and manage the global commons – all biophysical systems that are critical in regulating the state of the planet – within planetary boundaries that provide a scientifically defined safe operating space on Earth.

We have built our economies, our societies, and our civilizations on two assumptions about the natural world: first, that change happens in an incremental, linear way (allowing for regret and simple repair); second, that the biosphere has essentially infinite space and capacity to absorb human impacts (our waste) and cope with our extraction of resources (our consumption).

The science of resilience and complex systems debunks both of these assumptions. Earth's biophysical systems – from ice sheets to forests – ultimately determine how inhabitable the planet is. They do this not only by delivering immediate services to us humans (like food and clean water) but also by having a built-in resilience – the capacity to absorb shocks and stress (like warming due to greenhouse gas emissions and deforestation) and thereby cool and hold the planet within a narrow temperature range. But only up to a certain point. Pass this threshold and the system – be it a coral reef, a frozen tundra, or a temperate forest – will irreversibly tip over from one state to a qualitatively different state. ●

Q&A

AUTHOR

WITH

JOHAN .. ROCKSTRÖM

**DIRECTOR OF THE POTSDAM INSTITUTE FOR CLIMATE IMPACT
RESEARCH AND CONTRIBUTOR TO *THE CLIMATE BOOK***



In *The Climate Book*, activist Greta Thunberg has curated over 100 experts to share their wisdom on securing a better future for our planet. The message is clear: There is hope, but we must listen to the science before it's too late. We spoke to contributor Johan Rockström to find out more about the project.

How did you come to be involved with this project?

On invitation from Greta [Thunberg]. It was not difficult for her to persuade me.

Have you worked with Greta Thunberg before?

I have been offering our scientific support to Greta and the Fridays For Future (FFF) movement since it started. In fact, when the first global FFF demonstration was held in Berlin in 2018, I invited Greta and German FFF leader Luisa Neubauer to come and visit the Potsdam Institute for Climate Impact

Research (PIK) after the demonstrations. They gladly came, and we held a closed-door scientific seminar, where these young activists could learn and pose questions to our top scientists at PIK.

Greta kindly wrote the foreword to my latest book, *Breaking Boundaries*, which is a scientific update of the planetary boundaries science, and a science companion to Sir David Attenborough's *Breaking Boundaries: The Science Of Our Planet* series on Netflix. So, in a way, I "owed her" a chapter in her book...

What do you hope people will take away from *The Climate Book*?

That we are deep into the climate crisis already today, and that this is scientifically well established. But most importantly, we are not facing an environmental crisis, it is a crisis of our modern civilisation, and solving it will take us to a new level of modernity, prosperity, and equity.

Solving the climate crisis is not backing off from good modern lives. It is taking us towards a new level of higher quality life, which, most importantly, is proving to be the

only way of enabling dignified lives for all people in the world.

How can the public support climate scientists?

By following the science! Not the academic papers, but the latest findings on extreme events, attribution of these events (are they caused by us humans?), risks of crossing tipping points, technologies for a zero-carbon future, climate justice, and – most importantly – how we collectively take care of the entire planet.

Showing genuine interest in these existential issues, and talking to friends, colleagues, and family about them, helps knit together a knowledge and awareness bridge between science, citizens, and decision-making in societies.

What changes do you hope to see in humanity's approach to the climate crisis?

In the short term, that the climate crisis is given the position and attention it requires, namely as a guide or boundary condition for everything we do, across all political areas or economic sectors, from defence, to health, finance, and agriculture. All activities and sectors in society need to align with a path towards a climate-safe future that holds the 1.5°C [2.7°F] global temperature limit.

In the longer term, to really solve the global climate crisis, we need to come to a point where we do the right thing without necessarily thinking about the climate crisis. Fossil fuel-free, sustainable consumption and production simply become the cheapest, smartest way of acting. When sustainable food, electric mobility, and biomass-based construction of houses (replacing concrete and steel), for example, become not only cheaper but also of higher quality, then we will start seeing a world saving the planet without even recognising it. This is the ultimate hope. ●

**The Climate Book is published
by Allen Lane and is available
to buy, RRP £25.**

WHERE ON EARTH



A hidden network of cenotes sits beneath the Yucatán Peninsula in Mexico, having formed as water combined with gases to form corrosive acids. As the region dipped above and below sea level over millions of years, these tunnels and sinkholes have developed peculiar geological formations.

THE SACRED CENOTES OF THE YUCATÁN PENINSULA

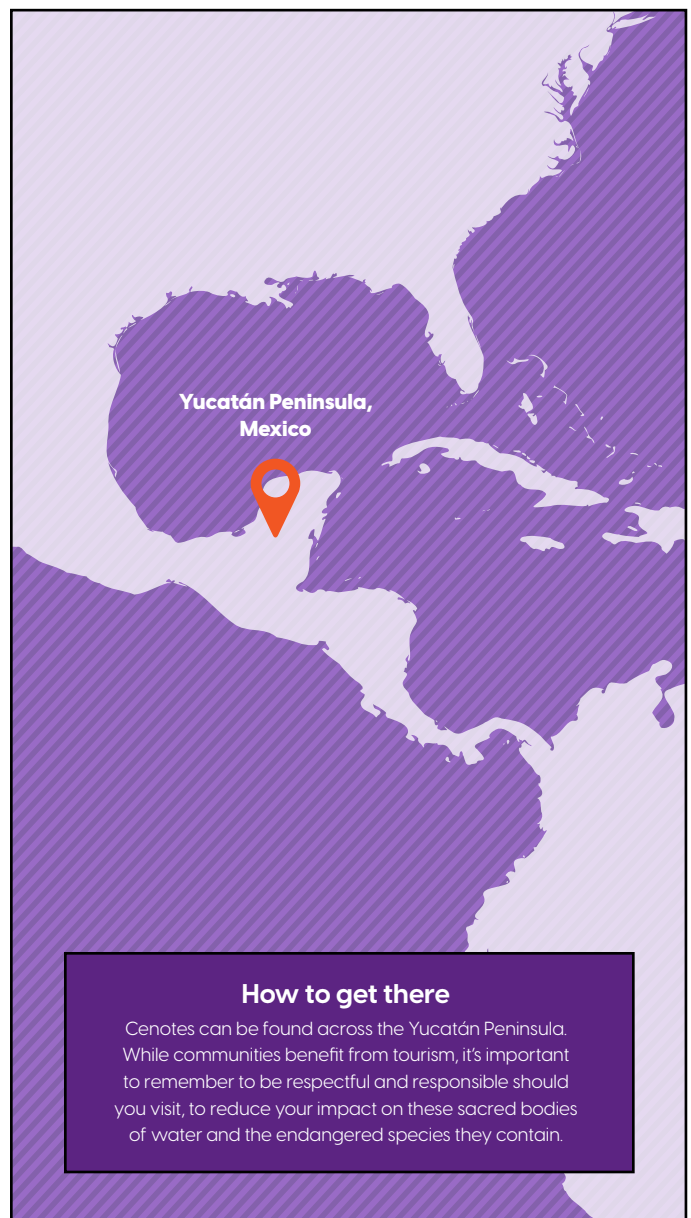
The Yucatán Peninsula in Mexico is unusually flat topside, but beneath its surface sit vast networks of underwater tunnels and sinkholes known as cenotes. They formed through speleogenesis (doesn't science have fun words?) as rainwater mixed with carbon dioxide in the air and seeped into cracks in the limestone where the resulting weak acid slowly ate away at deposits of calcium carbonate, also known as calcite.

When this same acid mixed with salt water deep in the limestone, its corrosive power increased and this is where the greatest dissolution is seen, creating cavernous spaces with small openings to the outside world. Bacteria also play a part in carving out these cave systems as they decompose organic matter to create hydrogen sulfide, which, when mixed with small amounts of dissolved oxygen, can create sulfuric acid.

Despite these seemingly harsh conditions, cenotes contain a surprising diversity of fish and zooplankton, several of which can only be found in the Yucatán and are endangered by development, pollution, and agricultural runoff.

Beyond the spectacular caves and curious wildlife, the cenotes are also home to icicle-shaped deposits called stalactites and stalagmites, which form as water dissolves over limestone. Stalactites hang from the ceiling and drip as they actively form, and it's these drops that eventually lead to the development of a mound-shaped stalagmite on the floor. Over time, stalactites and stalagmites can meet in the middle, forming colonnades like the one on the previous page.

While the cenotes of the Yucatán Peninsula are a popular tourist spot, they are considered sacred in Maya tradition. Researchers diving in cenotes have discovered many ancient archaeological artifacts indicating their significance, and recently uncovered a 12,000-year-old human skeleton. The Guardians Of The Cenotes are currently working to get these sacred sites protected to reduce their pollution, but visitors can help by leaving no trace and not entering a cenote without permission.



EXPLORE

Goat Simulator 3

Game from Coffee Stain

Coffee Stain is delivering more chaotic Bovidae adventures in Goat Simulator 3. As the sequel to the original Goat Simulator (there was no second game), this third-person adventure game can be played online or offline with options to roam alone or form a herd in multiplayer mode. Dust your hooves off for some farmyard havoc, or don a jetpack for adventures into space. Get ready to explore pastures new with your fully customizable goat alter ego complete with ability-infused gear.



Available on Playstation, Xbox, and PC from November 17.

SEE

Black Panther: Wakanda Forever

Film from Marvel studios



In the wake of King T'Challa's death, Queen Ramonda (Angela Bassett) must lead

Wakanda through a new threat – a war with the aquatic kingdom of Atlantis (which real archaeologists **are not looking for**). Wakanda, whose fierce Dora Milaje were inspired by the real-life all-female **Agojie warriors**, faces a new chapter in this latest release from Marvel Studios, but the sequel pays clear tribute to the late Chadwick Boseman with references to the actor's legacy woven throughout. Tenoch Huerta joins the roster as Namor; set to be the villain of the piece, his name means "Avenging Son" in mythical Atlantean, apparently.

Available in cinemas from November 11.

READ

Hurricane Lizards and Plastic Squid

Book by Thor Hanson



Biologist Thor Hanson explores the biology of climate change through the stories and discoveries of scientists who have uncovered how plants and animals are responding to the climate crisis. While anole lizards are adapting to be hurricane-proof with larger toe pads for clinging onto surfaces, Humboldt squid in increasingly warm waters have reportedly undergone a transformation so dramatic that fishers are failing to identify them. "Though rooted in the climate change crisis, it is not a crisis book," says Hanson. "I hope that the many insights I've gained in researching and writing this book will be mirrored in the reading of it, and that it sparks a desire to take action as well as interest."

Available to purchase from November 1.

PLAY

God of War Ragnarök – Father and Son

Game on PlayStation 4 and 5

Set in ancient Norway, this new release from PlayStation's Santa Monica Studios follows father and son Kratos and Atreus as they go in search of a means to prevent Ragnarök: Norse mythology's answer to the apocalypse. In their pursuits, they'll face down old enemies, like Freya, and new ones such as Thor, alongside giants and enormous wolves. The hotly awaited release is the ninth in the God of War series and sequel to 2018's critically acclaimed God of War game.



Available to purchase from November 9.

EXPERIENCE

Beyond King Tut: The Immersive Experience

Exhibition from National Geographic

To celebrate the centenary anniversary of the discovery of Tutankhamun's tomb, the National Geographic Museum has put on an exhibition with a difference. Beyond displaying traditional artifacts, the exhibition plays with photography and technology to create an immersive experience as you learn all about the young boy who ruled Egypt as pharaoh more than 3,000 years ago. Currently open in Washington, D.C. and Boston, the exhibition invites you to descend into a replica of his burial chamber and follow his quest for immortality as you meet the gods of the underworld.



On now until February 2023.

SCIENCE IN MEDIA





DATES TO REMEMBER

November provides an opportunity to spot the remnants of a comet, win prizes for your photography, and support Pride in STEM to make careers in science a better place for all. From the return of polar bears to celebrating a World Science Day For Peace And Development, it's a real all-rounder.



OCT 30 - NOV 5

Polar Bear Week

Each fall, Hudson Bay in Canada sees the return of polar bears who gather on its shores to await the return of sea ice. Since the 1980s, the bears have been waiting longer for it to return as a result of the climate crisis, putting pressure on the population, which needs ice to hunt for seals. This year, you can help these animals by organizing a fundraising event for **Polar Bears International's** "Detect and Protect" project, which aims to use "bear-dar" systems to spot polar bears before they come into contact with people and prevent negative encounters.

NOVEMBER 10



World Science Day For Peace And Development

Celebrated on November 10 each year, the UN's **World Science Day for Peace and Development** is about highlighting the relevance of science in society and daily life and the need to engage the public in scientific issues. This year's theme is "Basic Sciences for Sustainable Development", explaining the role science plays in peaceful sustainable societies and encouraging shared science between nations. Anyone can get involved, from scientists to the media, teachers, and students. Let people know what you're up to using the hashtag #ScienceDay on social media.

18

Pride In STEM Day

Pride In STEM Day highlights the work achieved by LGBTQIA+ people in science, technology, engineering, and math, as well as the



barriers they face. Research has found that between 20 and 30 percent of LGBT+ people have considered leaving their jobs as a result of discrimination. November 18 is symbolic of the anniversary of American astronomer and gay rights activist Frank Kameny's US Supreme Court fight against workplace discrimination, a fight that continues globally. For information and inspiration on events visit prideinstem.org.

IFLScience The Big Questions

The latest episode of IFLScience's The Big Questions podcast explores how diet affects disease, specifically cancer, so who better to quiz than Dr William Li, world-renowned physician, scientist, speaker, and author of *Eat To Beat Disease – The New Science of How Your Body Can Heal Itself?* Put it in your diary for **November 4**, available on all your favorite podcast platforms.

4

Taurid Meteor Shower

If you're in the Northern Hemisphere then keep your eyes peeled for the **Taurid meteor shower** this month as Earth plows through debris left behind by Comet Encke. The spread of debris is why we get two hits of this particular meteor shower annually. As meteor showers go, the Taurids aren't the most dramatic, but if you find yourself a nice spot with low light pollution, it can be an opportunity to familiarize yourself with the night sky as you try and spot some zoomy rocks. No need for binoculars or a telescope, just sit back and take it in.

12^{to} 13



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 viruses are watching you – yes, you. If you like your science lighter, let us tickle your fancy with the revelation of why humans can't tickle themselves.

YOU'RE BEING WATCHED

"Big Brother is watching you," but so too are viruses, apparently. While the menace of Orwell's dystopian 1984 was government surveillance, in real-world 2022, the threat to our privacy may be microbial.

Yes, it's viruses we need to keep an eye on, or rather, who could be keeping an eye on us. That flu virus rattling around your immune system **this winter** isn't about to spill your secrets, but it might be doing something even more sinister...

**SHHH! KEEP IT DOWN IN CASE THE
VIRUSES ARE LISTENING.
DON'T LET THEM KNOW
WE'RE ON TO THEM.**

Recent research suggests that some viruses may lie in wait inside their host, seeking the perfect opportunity to strike. At that moment, the virus will spring into action: multiplying itself and killing its host. To select the most opportune time to attack, the viruses get their Big Brother on, spying on the unsuspecting host cell and its environment.

The study looked at phages – viruses that infect bacteria. "If phages are listening in on their hosts, the viruses that affect humans are bound to be doing the same," senior author Ivan Erill **said**.

The team found that many different phages can monitor levels of a protein, called CtrA, in their host. This protein controls the production of bacterial appendages, which allow phages to infect cells. It also controls the cell cycle in some bacteria, which means phages could, theoretically, keep tabs on how their host will replicate and use this to their advantage.

It's in a phage's best interest to explode out of its host when there are many potential targets, so-called "swarmer" cells, around.

"We hypothesize the phages are monitoring CtrA levels... to figure out when the swarmer cell is... becoming a factory of swarmers," Erill added, "and at that point, they burst the cell, because there are going to be many swarmers nearby to infect."

It's a mechanism so menacing, it's practically Orwellian.

But shhh! Keep it down in case the viruses are listening. Don't let them know we're on to them.



**The Darker Side
of Science**

A TICKLISH TALE

Nothing sees us humans erupt into fits of giggles like a good tickle. It even tickles the fancy of rats, who can burst into raptures of **rodent giggles** when petted just so. But almost no one – human or rat – can tickle themselves. For rats, this ability might well be hindered by their teeny tiny arms, but what's humans' excuse?

A **new study** has attempted to answer this cardinal question, delving into human responses to self-tickling and asking what happens when we're tickled by others.

"A tickle is a complex sensation," the paper's authors write. One that they hoped to disentangle by analyzing, among other things, subjects' facial expressions and vocalizations in response to being tickled.

**PARTICIPANTS TICKLED
THEMSELVES WHILE
SIMULTANEOUSLY BEING
TICKLED BY ANOTHER PERSON.**

Participants were generally ticklish, emitting an audible chortle more than 70 percent of the time when tickled by someone else at the neck,

armpit, torso, or foot. And this snickering was speedy in its onset, bursting forth just half a second after tickling started. Even more swift were participants' facial expressions in response to tickling: in 300 milliseconds, on average, they were beaming from ear to ear.

The faster and more vociferous the laughter, the more extreme ticklishness the individuals reported.

But what of our inability to tickle ourselves? The authors investigated the so-called "tickle effect" by having participants tickle themselves while simultaneously being tickled by another person. Far from being an intense, laughter-inducing, two-pronged tickle attack, people reported feeling significantly less ticklish and were less likely to let out a chuckle, leading the authors to conclude that self-tickling does indeed suppress ticklishness.

Tickling by someone else, they suggest, is an excitatory sensory input, while self-tickling is inhibitory. When both are happening at the same time, the inhibition may outweigh the excitation, which effectively overrules the tickle sensation and puts a lid on laughter.

So, there you have it, best to leave tickling to the pros (read: literally anyone else). Can someone please inform the rats?



**THE LIGHTER SIDE
OF SCIENCE**