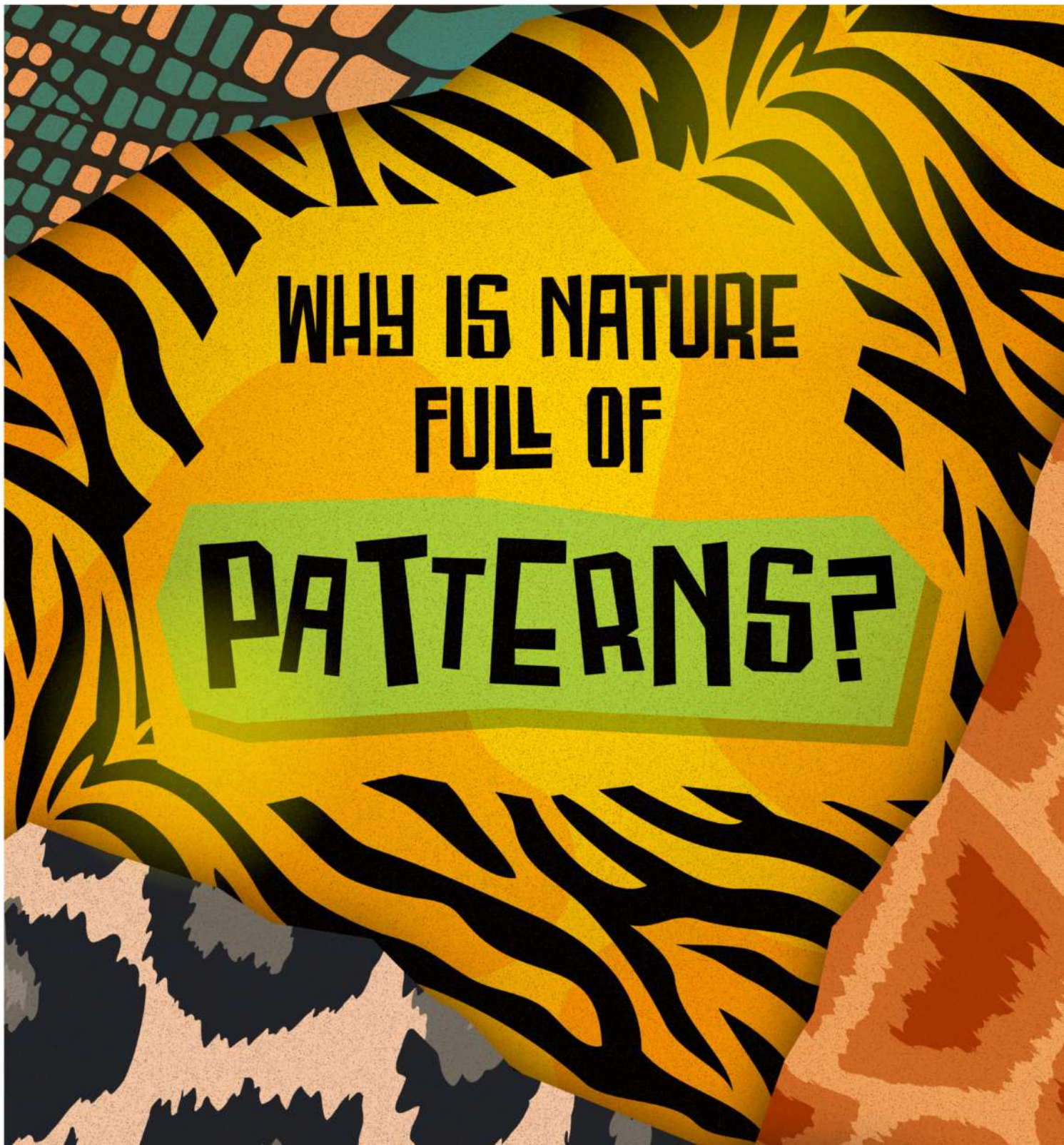
CURIOUS?

DOES YOUR DNA PREDICT YOUR DESTINY?

CAN YOU GO TO SPACE IN A BALLOON?

IFLSCIENCE.COM | FEBRUARY 2023



IFLSCIENCE

16



WHERE ON EARTH

A MINERAL FOREST FOR A NATURAL SPA
Petrified waterfalls form a dreamy cascade of infinity spas in Turkey.

10



DEEP DIVE

DOES YOUR DNA PREDICT YOUR DESTINY?
Are we a slave to our DNA? Let Maddy Chapman be your epigenetics guide.

4



OUR COVER STORY

WHY IS NATURE FULL OF PATTERNS?
Or are we just seeing what we want to see? Dr Alfredo Carpineti investigates.

February 2023

CONTENTS

News Bites | page 2
What's new, what's weird, what's happening?

What On Earth | page 7
Hermit crab's new plastic home

We Have Questions | page 8
Can you go to space in a balloon?

Book Bites | page 14
What connects kink, mindwandering, and creativity?

Meet The Author | page 15
Moshe Bar on *Mindwandering: How It Can Improve Your Mood and Boost Your Creativity*

Science In Media | page 18
What to watch, read, and listen to this month

Dates To Remember | page 19
What to look out for this month

Dark Vs. Light | page 20
How will you end the issue?

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NEWS BITES



Don't Miss: Cocaine Bear

We can't quite believe we're writing this, but the **wild true story** of how a black bear in Georgia came to eat over 30 kilograms (66 pounds) of cocaine in a drug heist gone wrong 38 years ago is now a wild not-so-true movie directed (also improbably) by Elizabeth Banks. Inspired by the chaotic 1985 events, this "dark comedy" (it does not turn out well for the bear or the many humans who cross its path) promises a rollercoaster ride when a 230-kilogram (500-pound) – which is nearly three times the real size – apex predator goes on a cocaine-fueled rampage, decimating a surprisingly starry cast. **Released worldwide** on February 24, frankly, unless *Paddington 3* sees Paddington's marmalade addiction take a dark turn, it's going to take a hell of a lot to beat as the strangest bear movie of the year (and 2023 includes *Winnie The Pooh: Blood And Honey*).



Behold The Sonic "Thump"

Almost two decades ago, the Concorde landed for the last time and ended supersonic commercial flight. The greatest barrier that kept the Concorde from spearheading the next generation of airliners was the sonic boom created when a plane breaks the sound barrier. Those under the flight path were not big fans. Now, NASA plans to break the sound barrier again with its experimental X-59 aircraft designed in such a way that it relegates the noisy sonic boom to a quieter sonic "thump" no louder than a car door closing. An upcoming test, rumored to be early this year, could see it make history, and if successful, the X-59 could reignite dreams of traversing the globe at the speed of sound in mere hours, just like Concorde.



Bessie Coleman Quarter

The US Mint is continuing its four-year American Women Quarters™ program with a brand new quarter fresh in circulation. Celebrating the often overlooked pioneering women that have made America what it is, the latest quarter honors Bessie Coleman, the first African American and first Native American woman pilot, and the first African American to earn an international pilot's license. "The woman known as 'Brave Bessie' defied the odds and became an aviator. Her tenacious drive and fearless personality helped pave the way for future generations," says Mint Director Ventris C. Gibson. Look out for Bessie in your pocket.

#SpaceJuice

The European Space Agency's mission to explore Jupiter and its three largest icy moons is getting even juicier. The JUpiter ICy moons Explorer – or Juice, as it's known – mission is launching in April and ESA is inviting people to design a #SpaceJuice to be in with a chance to attend ESA's launch party in Germany. You just have to design the most imaginative juice mocktail (no alcohol) inspired by the Juice mission. The winning drinks will also be served at the event. You'll have to be quick though, the contest closes on January 31. There are rules and regs, of course, so find out more **here**.

Image Credit Left: Universal Pictures, ***Right:*** Lockheed Martin, ***Bottom Right:*** US Mint

Stone Skimming's Curvy Secret

The secret to the perfect skimming stone has a curvy bottom according to **new research**. Until now, flat and round pebbles had been considered the ideal shape, but scientists have revealed that potato-shaped is the ideal beach body for that flawless bounce. "Skimming" stones is the art of throwing a stone at a low angle so it impacts the water's surface and bounces across it before sinking. The more skips the better. Using a mathematical model, scientists found that it all came down to the relationship between mass and how curvy the underside was for whether they'd sink or skip. Given the right curvature, even bigger rocks were better at skimming the light fantastic.



Astro Art

The Royal Observatory Greenwich's 15th **Astronomy Photographer of the Year** competition is back and entry is now open for all submissions. Searching for the most striking images of our cosmos, the categories are far-reaching in every sense, ranging from Stars and Nebulae to Aurorae and Galaxies. There's even an award for image innovation, bringing together the worlds of art, astronomy, and astrophotography. Entries to the competition (up to 10 per person) must be submitted by March 3, and the winning images will be showcased in the annual exhibition at the National Maritime Museum, London, UK, opening in September 2023.

WHAT'S UP?



First Moon Tourists

Holiday destinations are now out of this world

Name: dearMoon
Appearance: Nine (probably) smug-looking passengers in one giant rocket.
Location: 384,400 kilometers (238,855 miles) away.

What is dearMoon? The first private, all-civilian trip around the Moon, slated for this year.

Who is dearMoon?
In 2018, Elon Musk announced the first civilian "lunar loop" aboard a SpaceX rocket and Japanese multibillionaire Yusaku Maezawa bought up every ticket. Now, he's revealed his eight-strong crew, which includes a K-pop rapper, an American YouTube star, an Indian actor, a DJ, an artist, and two filmmakers.

How much does it cost?
For the crew, absolutely free. For Maezawa, potentially around $5 billion.

(Asks casually) How does one become a crew member?
Maezawa launched a **worldwide competition** to search for potential travel companions. A reported million applications from 249 countries and regions around the world poured in before going through a strict selection process. What that was is unknown, but there's a definite artistic bent.

How are they getting to the Moon?
Aboard SpaceX's massive Starship rocket, bigger and more powerful than NASA's mighty SLS. Although it hasn't flown since 2021, many missions are relying on Starship including NASA's Artemis mission to land humans on the Moon again, and Musk's own plans for future travel to Mars.

How long is the vacay?
It should take Starship three days to reach the Moon before completing a loop around it and flying home, so six days in total.

When will it launch?
The plan is this year, though an actual launch date hasn't been announced. Starship has to conduct its first orbital test flight first, and even then, we have to take Musk's optimistic timelines with a pinch of lunar dust.

Image Credit Left: zorazhuang/iStock, *Right:* SpaceX

WHY IS NATURE FULL OF PATTERNS?

Patterns constantly form in nature, from molecules to our consciousness. Or are we just seeing what we want to see?

By Dr Alfredo Carpineti

Image Credit: James Rodrigues

In science, we often stumble upon profound questions about what is real and what is perceived. Quantum mechanics and the **uncertainty principle** is a fan favorite, for example. A more subtle question we might encounter is about naturally occurring patterns. From snowflakes to Northern Ireland's Giant's Causeway, Romanesco broccoli to Saturn's polar clouds, why does nature keep arranging itself in patterns?

Humans are so good at spotting patterns that we sometimes trick ourselves into seeing things that are not there. This phenomenon, called pareidolia, lets us see meaningful images in random or ambiguous visual patterns, and may have been vital for our survival. There's a reason we see shapes in clouds, faces in sockets, and mice on Mars.

So is nature actually full of patterns or are we simply too good at seeing them, regardless of whether they're there or not? As is always the case for these juicy scientific dilemmas, the answer is far from simple and far from definitive.

From mighty hexagons to molecular crystals

A lot of natural structures, to us, have distinct patterns so we give them names. Take the six-sided hexagonal form, for example. Once it has a recognizable name and shape, it starts appearing everywhere, though there may be many different causes. Saturn's polar vortex famously takes a hexagonal shape. The six-sided storm covering the top of the planet's north pole is believed to be caused by **smaller storms interacting with bigger cyclones**, which find a sort of equilibrium in this hexagonal shape.

Closer to home are the hexagonal columns that make up the Giant's Causeway in Northern Ireland. Their natural shape is due to the **cooling of these structures** from when they were still molten lava. As they cooled, the first cracks happened at a 90-degree angle but evolved quickly to 120 degrees, which releases more energy, creating the patterns we see today.

The most recognizable hexagonal pattern is probably that of snowflakes, which, in their six-branch versions, is due to the angle in water molecules between the oxygen atom and the hydrogen atoms. It's not just hexagons, there are plenty of geometrical patterns that emerge from small chemical bonds that end up creating large complex crystals. Pyrite is a pretty and extremely cubic example of that.

"Molecular crystals form like that because that's the way they minimize their overall energy," Professor Andrew Croll from North Dakota State University told IFLScience. "They just fit in better, like eggs in an egg cart. And they kind of roll into these little holes and they sit there."

But Croll stresses that there are multiple ways to create structures in nature, even things that at first glance don't look like they'll be good for patterns at all. An example is a type of molecule called block copolymers. Polymers are long molecular chains made by repeating sub-units. They are used to make plastic and can often be in disordered layers.

But in block copolymers, two or more polymers that repel each other are tethered together, which creates some interesting patterns. Two of the same length might end up in an alternating layer structure, but by varying the length, it is possible to create structures with curvature with familiar or less familiar geometrical patterns. And they can have surprisingly common applications too.

"In terms of actual market applications, I know for block copolymers there are things like shoe rubber. So, the rubbers in your shoes tend to be a triblock copolymer, so you'd have maybe a polystyrene block and then a big elastic kind of chain, and then another polystyrene block," Croll explained. Another application includes the absorbent material in diapers.

It takes a computer genius to see the patterns in randomness

There are certain natural patterns that do not follow neat geometrical rules of repeating shapes but they are distinctive nonetheless. We can recognize the stripes on a tiger or a zebra or the spots on a leopard as specific natural patterns even though they are not the regular patterns of geometry.

These patterns are named Turing patterns after the English mathematical genius Alan Turing, father of computing, whose 1952 paper titled "**The Chemical Basis of Morphogenesis**" worked out how the spots and stripes structures can naturally form without input from a homogenous and uniform state.

"When you think about the spots on a leopard or the stripes on a tiger, those are patterns where there is this element, the stripe or the spot, that's repeated, but it's not repeated perfectly. There's not that perfect



Giant's Causeway, Northern Ireland

Image Credit: benedek/iStock

regularity you get from, say, a checkerboard. But there's still this shape, this feature that is repeated across space," Ben Balas, a professor of psychology at North Dakota State University, told IFLScience.

Balas's work focuses on understanding how humans look at these and other types of natural patterns and recognize them for what they are, something he says is a "huge question". It's trying to understand not only if you can tell the difference between a zebra pattern or a leopard pattern, but also if a texture is smooth or rough, shiny or dull, etc.

"We think a lot in my lab about this idea we call summary statistics," Balas explained. "When you think about recognizing something like a face or an object, we often think about descriptions that care a lot about exactly where things were in the picture. For a face, it matters that there's an eye here, an eye here, and a nose and a mouth.

"Textures are different because those things are spread out over the image. It sort of doesn't matter exactly where you saw the spot on a leopard. It matters that you saw spots, spread out across this image."

PATTERN RECOGNITION LIKELY SAVED OUR ANCESTORS ON MORE THAN ONE OCCASION AND WHAT THEY NEEDED FOR SURVIVAL, WE NOW USE DAILY FAR BEYOND WHAT THEY MIGHT HAVE DREAMT.

Summary statistics is about having the gist of the pattern rather than the specifics. Balas's team is looking at measuring what makes patterns distinctive and using the measured quantities to create new patterns to understand how our brains relate to them.

We see what we see and what we want to see

Our ability as humans to understand textures and patterns has an important function in terms of survival. For example, by looking at the things that we eat, from their glossiness to their prickliness, we can make a snap judgment on their safety for consumption.

"Our world is not made up of just random images. There are these regularities to what we see. And what we understand now is there's lots of ways that the human visual system is adapted to those regularities," Balas told IFLScience.

Pattern recognition likely saved our ancestors on more than one occasion and what they needed for survival, we now use daily far beyond what they might have dreamt.

"Our brain is constantly trying to make sense of the outside world. One way the brain accomplishes this goal is by detecting and learning patterns, which are essentially statistical regularities in the environment, because these patterns help the brain decide how to react or behave in order to survive," Dr Jess Taubert, from the University of Queensland, told IFLScience.

But such a powerful tool for finding patterns can also be fooled into seeing things that are not there. This is the visual phenomenon known as **pareidolia**. One type that we experience frequently is face pareidolia, where we see **faces in inanimate objects** such as houses, rocks, and vegetables.

"The reason we believe the experience of face pareidolia is so common is that our visual system is optimized for detecting faces. This is because knowing when people are around (and whether they are friends or enemies) has been so important for our survival as social primates. But a side effect of this hypersensitivity to faces is that we sometimes see faces where there are none," Dr Taubert explained.

Nature is rich in patterns, from the nanoscopic to vast celestial structures, and we are perfectly suited to appreciate those patterns. But this excellent skill of ours is also sometimes too good, making us see patterns when they are not really there.



Image Credit Background: James Rodrigues



***Image Credit**: British Ecological Society, Andreas Eich*

HERMIT CRAB'S NEW PLASTIC HOME

In Pulau Bangka, Indonesia, this *Coenobita* species of hermit crab has found a new and unlikely home. Having stuffed its booty into a faded bottle cap, it demonstrates the lived experience of many marine animals trying to carry out their natural behaviors in an environment littered with human trash. The photo – taken by **Andreas Eich** – was selected by the **British Ecological Society** as a category winner in its "Capturing Ecology" photography competition highlighting the threats wildlife faces in changing environments.



Image Credit: *HALO Space*

CAN YOU GO TO SPACE IN A BALLOON?

HALO SPACE HAS COMPLETED ITS FIRST TEST FLIGHT USING A BALLOON TO CARRY A PASSENGER CAPSULE INTO THE STRATOSPHERE, SO THE ANSWER APPEARS TO BE YES.

By Rachael Funnell

In **issue 5 of CURIOUS** we mentioned HALO Space, an ambitious company with big plans to send people into space in a balloon. Well, more of a capsule suspended by a balloon. The curious contraption gives passengers a 360-degree view of Earth as they drift down from the stratosphere, or at least it will if all goes well in the lead-up to HALO Space's estimated commercial launch of 2025.

Since they first came on our radar, **HALO Space** has been busy conducting their first test flight to send one of their balloons, complete with a full-size uncrewed capsule, 40 kilometers (25 miles) into the air, which in December 2022 they successfully did. To learn more about the highs and lows of going to space in a balloon, we caught up with the folks over at HALO Space to hear how the first test flight went and find out how soon we can expect to see humans floating through the stratosphere.

Forget flying kites, Poppins. We're going space ballooning.

What is the HALO Space balloon?

Tom Huddart: The balloon is made of a polycarbonate fabric and has a maximum dimension of between 110 and 120 meters [360 and 394 feet], the length of a football field, at full extension. The balloon reaches that size at an altitude of 35 kilometres [22 miles], when the gas filling it is fully expanded. The gasses used to inflate it will be helium or hydrogen. The balloon connects to the capsule with a flight train.

How did the test flight go?

TH: Our first test flight went exactly as planned, delivering successful results for all systems and components being tested. The balloon, carrying a full-size prototype of our capsule, flew to an altitude of 37 kilometres [23 miles] into the stratosphere and landed safely and successfully after a flight that lasted four hours. The most important thing is that the flight demonstrated the behaviour of the HALO capsule at launch, ascent, cruise, descent, and landing, as well as safety systems, ground and onboard equipment, which are the most critical parts of HALO's flight program.

Is the balloon piloted or self-driven?

TH: During the test phase, such as the recent test flight in India, the capsule is uncrewed. However, following completion of all required tests, the balloon and capsule will be piloted by a pilot who will be able to direct the flight and determine the landing location to be used, updating the route with real time data during the flight.

How many people will it eventually carry, and for how long?

TH: The capsule will be able to take eight passengers alongside a pilot. The commercial flight will fly between 25-40 kilometres [16-25 miles] high allowing passengers to observe the curvature of planet Earth and the vastness of space in a flight lasting up to six hours.

Is the balloon really going to space?

TH: The balloon will take passengers to "near space" [somewhere between the Armstrong limit at 19 kilometres (12 miles) and the Kármán line], to a maximum altitude of 40 kilometres.

What do you hope to achieve during the next test flight?

TH: The second test flight is scheduled for the first half of 2023 in southern Spain, where HALO Space will test the steerable parachute navigation system as well as advancements to its current systems based on what has been learned from its first flight.

What sights can future visitors expect to see while riding with HALO Space?

TH: We want to give customers a life-changing experience, The **Overview Effect** – a view of the curvature of the Earth that can only be experienced starting at an altitude of 30+ kilometres [19+ miles]. Astronauts have described it as a state of awe with self-transcendent qualities, precipitated by a particularly striking visual stimulus, from space.

> THE COMMERCIAL FLIGHT WILL ALLOW PASSENGERS TO OBSERVE THE CURVATURE OF PLANET EARTH AND THE VASTNESS OF SPACE IN A FLIGHT LASTING UP TO SIX HOURS.

What obstacles does HALO Space have to overcome before tickets go on sale?

TH: Safety is of course our highest priority, and we will be continuing our extensive testing program in the coming years, including achieving FAA certification. We plan to begin operating commercial flights in 2025 and aim to reach up to 400 commercial trips with 3,000 passengers carried per year by 2029.

Does the idea of drifting to the mid-stratosphere in a balloon float your boat? With just two years until HALO Space's estimated launch date, you'd best get thinking. •

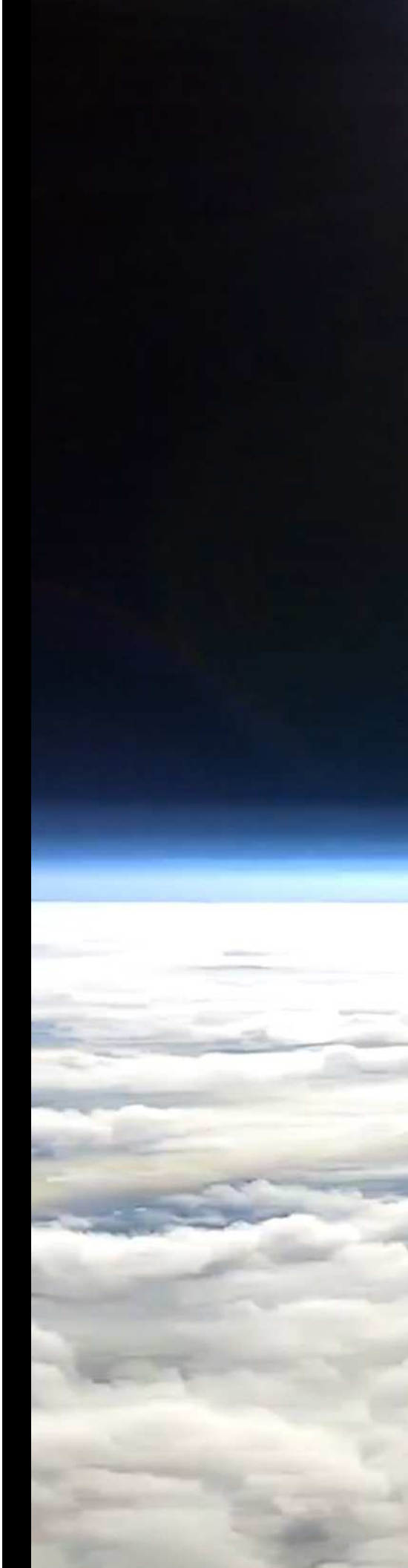


Image Credit Right: HALO Space

SCIENCE FACT OR FICTION:

DOES YOUR DNA PREDICT YOUR DESTINY?

Are we slaves to our DNA or does our environment have some sway? Enter epigenetics and your guide, Maddy Chapman.

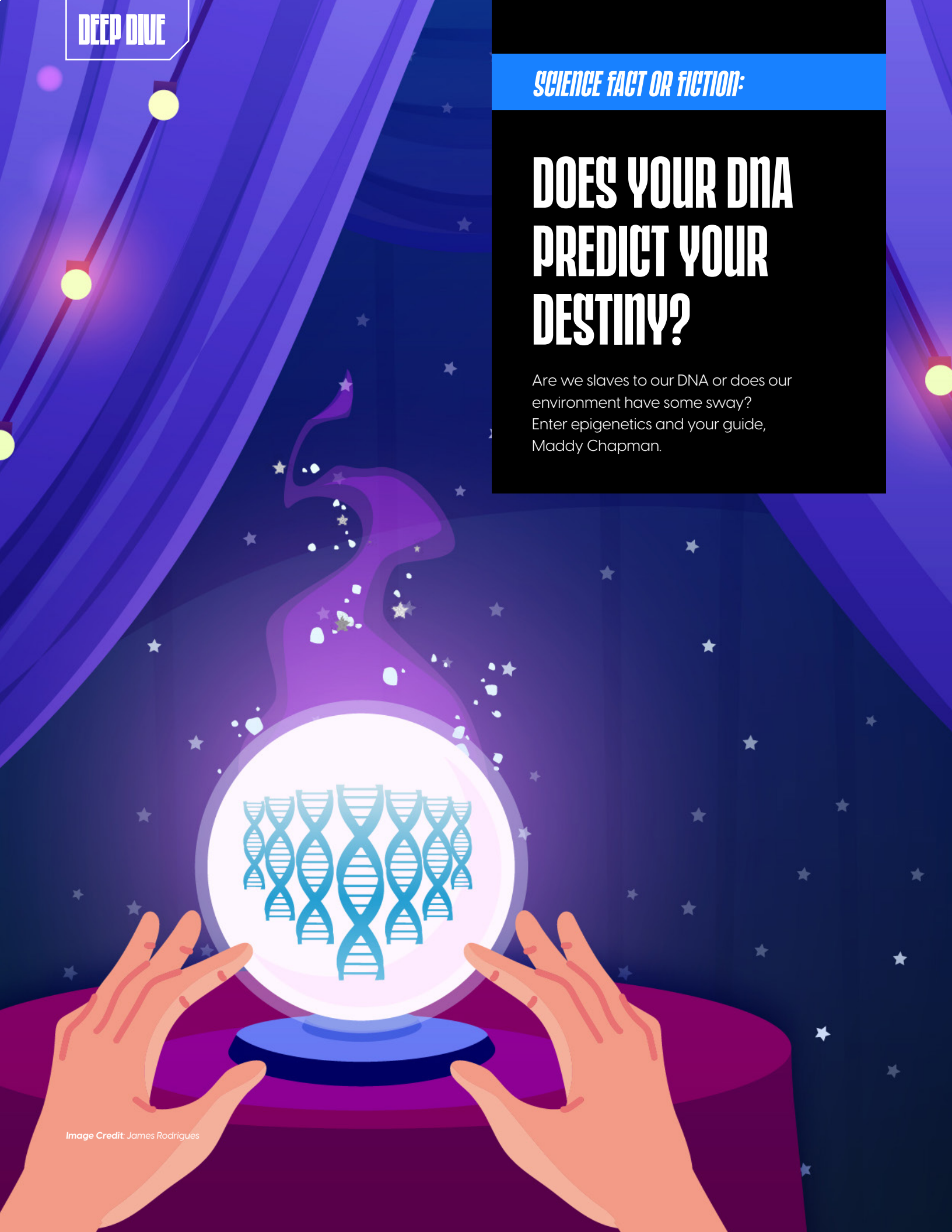
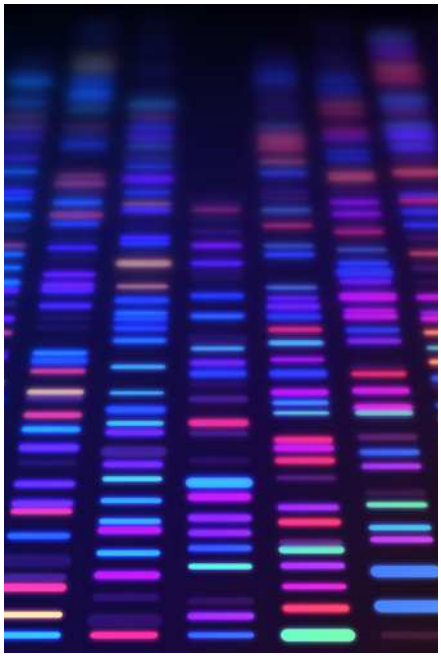


Image Credit: *James Rodrigues*



If you've ever taken a high school biology class, you might well fancy yourself an accomplished geneticist. Why are your eyes blue? Genes. Why is your hair curly? Genes, duh. We're taught early on that our traits are predetermined by our DNA, by the genes we inherit from our parents. Even our predisposition to certain health conditions, we're told, is written into our genetic code. This idea that our "genetic destiny" is sealed before we're even born permeates much of our education and understanding of genetics.



Two alleles for brown eyes and BAM, you've got yourself a pair of chocolate-colored peepers. Inherit a copy of a gene that puts you at risk of cancer and you'll likely go on to develop it. Simple. Except it isn't.

"Contrary to what you might think, your genetic destiny is not preordained," **writes** Aubrey Milunsky in his 2001 book *Your Genetic Destiny: Know Your Genes, Secure your Health, Save Your Life*. "Despite our genetic blueprints, there is much we can do to secure our health – and even to save our lives or those of our loved ones."

Of course, genes do have an important role to play, but, as it turns out, the tale we're spun in school is a super watered-down version of things. It's so much more than just DNA, which makes sense really – such a fundamental thing as determining our genetic destiny should, rightfully, be pretty complicated to explain.

But we're about to try. Allow us to introduce you to the world of epigenetics.

What is epigenetics?

Epigenetics is the study of changes that affect gene expression (the process by which instructions in DNA are converted into a functional product e.g. protein) without actually altering the DNA sequence.

The clue is in the name: "epi" is a Greek word meaning "in addition". In this case, it means in addition to the genome – factors beyond the genetic code that can affect an organism's observable characteristics, their phenotype.

So while genes are busy underpinning our physical traits, epigenetics is busy tinkering with our DNA. Epigenetic changes can affect how our bodies "read" a DNA sequence, effectively turning genes "on" and "off" as they please.

Epigenetic changes are **intrinsically linked** to our behaviors and environment: things such as diet and exercise can sometimes result in epigenetic changes that could alter gene expression. They are also reversible since the DNA sequence itself remains unchanged.

How does epigenetics modify DNA?

That's all well and good but what does it *actually* mean? The DNA sequence is exactly the same and yet these mysterious "changes" can completely overhaul how it's expressed: it's confusing, to say the least.

DNA is made up of four bases – adenine, cytosine, guanine, and thymine, (A, C, G, and T) – which are essentially its "code". Epigenetic changes don't mess with this code in the sense that they don't alter the sequence of bases, but they do affect the DNA molecule in several ways.

One of these ways is methylation, the process of adding a chemical group – a methyl group, hence the name – to DNA. When added at the right place on the DNA molecule, these groups can prevent proteins from binding to, and therefore "reading", the DNA.

Another type of epigenetic change is histone modification. Histones are proteins that interact with DNA and help to package it into

Image Credit Top: peterschreiber.media/iStock, Bottom: filo/iStock

chromosomes. When DNA is tightly packed around multiple histones it is less accessible to the "reading" proteins and so will not be expressed. By adding or removing chemical groups to histones, epigenetics can change how DNA interacts with them and turn genes "off" or "on".

"Known epigenetic changes [also] include changes to gene expression during embryogenesis [embryo development], which can lead from a single undifferentiated, fertilized egg to a whole range of different cell types and tissue types (brain, heart, muscle, other organs) in the developing embryo," David Scott Wishart, Distinguished University Professor in the University of Alberta's Departments of Computer Science and Biological Science, told IFLScience.

These, and numerous other epigenetic changes, all influence gene expression over the course of our lifetimes and contribute to our genetic destiny.

Causes of epigenetic changes

As for why these changes happen, there are myriad reasons, Wishart explained.

"Epigenetic changes arise through the action of chemical or protein gradients within cells (in the case of embryogenesis) or through the actions of chemicals, proteins or small RNA fragments (siRNA, miRNA) that lead to reversible changes in DNA structure or changes in how DNA is read or transcribed."

"Epigenetic changes can also arise from oxidation of DNA (via chemicals) or the expression of certain proteins or RNA fragments that interfere with gene expression," Wishart added.

And, as we hinted at earlier, the environment can occasionally play a part in this.

"Some of these effects can be due to stress, diet, exposure to certain chemicals, exposure to viruses or bacteria, or the presence of certain proteins. Overall, epigenetic changes reflect environmental effects on the genome."

However, Wishart was quick to add, this is pretty rare.

"Many environmental exposures do not lead to epigenetic or genetic changes. So it's important to note that environmental exposures are only occasionally converted to epigenetic events. The environment affects much more than DNA and some of these effects are much more profound and significant for health and disease than epigenetic or mutagenic events."

Effects of epigenetics

As we've established, epigenetic changes can have a profound effect on gene expression and, therefore, on our genetic destiny. But what exactly does this look like? How, specifically, do these changes impact our development, our phenotype, our health?



OUR EPIGENETIC CHANGES CAN INFLUENCE OUR OFFSPRING, AND MAYBE EVEN "GRANDOFFSPRING", TOO, MAKING THEM DICTATORS OF DESTINY ACROSS GENERATIONS.

According to Wishart, epigenetics is fundamental in human embryo development: it plays a key role in the formation of our limbs and organs, and in the differentiation of our cells and tissues.

In adults, it can play a part in the development of disease, including obesity, cancer, heart disease, and diabetes. "These diseases are all 'environmental'," Wishart explained. "They can be caused by poor diet, but the diet also modifies the expression of genes so that even if someone reverts to a healthy diet, the epigenetic changes may still persist and may even be passed on to other generations."

Our epigenetic changes can influence our offspring, and maybe even "**grandoffspring**", too, making them dictators of destiny across generations.

And they don't just impact the destiny of our species. In the animal kingdom, epigenetic changes can affect the sex determination of turtles, which is **dependent on temperature**. And in the plant world, they have a part to play in flowering time, for example.

Genetics vs. epigenetics vs. something else?

When it comes to destiny, we know genetics is important. And we know epigenetics shouldn't be overlooked either. But which is weighted heavier on the genetic fate scales?

"The genetic code is more important for determining your destiny than epigenetics," says Wishart. "However genetics and epigenetics only play a minor role in your overall destiny or overall phenotype."

So, what then, if not genetics or epigenetics, has the final say?

"The direct effects of your environment, your diet, your lifestyle, your microbiome, your exposure to bacteria or viruses and other non genetic and non-epigenetic factors play a much bigger role in determining your health, your quality of life, or how long you will live."

These things, Wishart told us, are part of the "exposome" – a measure of all the things an individual is exposed to in their lifetime and how they relate to health. They don't act on DNA, instead affecting our proteins, cells, tissues, or organs.

WHILE OUR GENES MAY BE, TO AN EXTENT, A BLUEPRINT FOR OUR TRAITS, THEY ARE NOT SOME KIND OF CONGENITAL CRYSTAL BALL THAT WILL REVEAL WHAT LIES IN OUR FUTURE.

According to Wishart, just 5 percent of deaths or diseases can be accounted for by our genes. "The other 95 percent of deaths are a result of what you've been exposed to. Bacteria and virus infections cause about 30 percent of all cancers, exposure to fire smoke or air pollution kills tens of millions of people due to direct damage to lung tissues, overeating (obesity) causes most cases of heart disease, stroke, and diabetes."

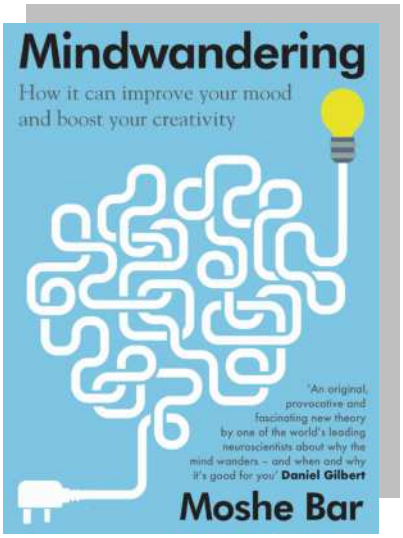
While our genes may be, to an extent, a blueprint for our traits, they are not some kind of congenital crystal ball that will reveal what lies in our future. DNA does not necessarily predict our destiny, and not just because of epigenetics. It turns out the exposome has a lot to answer for. But, thankfully, that is something it may be possible for us to control.

"It's hard to change your genome, it's easy to change your exposome," said Wishart. "That's why your destiny is in your hands, your destiny is not in your DNA."



Image Credit: James Rodrigues

WHAT CONNECTS KINK, MINDWANDERING AND CREATIVITY?



In this excerpt from *Mindwandering: How It Can Improve Your Mood and Boost Your Creativity*, neuroscientist Moshe Bar explains why the evolution of our drifting minds shows that mindwandering can be beneficial.

Talking about sex, kink, and ADHD, Catie Osborn, an actor and a Shakespeare aficionado, confesses that before discovering the less conventional sexual practices of "kinkiness," her mind would often drift during sexual activities. In an interview for Haaretz, she says that discovering "kink" and BDSM was a purifying moment for her, helping her connect her mind with her body. When you are blindfolded and your partner slides an ice cube over your body, or drips hot wax on your skin, you stop thinking about the noise from the air conditioner or the squeaking of the bed. You are all immersed in the real thing. Indeed, extreme experiences drag you in by calling for your undivided attention. But once you've learned to give in and let the experience take you, it no longer needs to be reserved for extreme situations anymore. Imagine how your life could feel if eating a blueberry would be just as immersive as kink sex with hot wax on your skin, sucking in your entire mind. Immersion is a gift waiting inside our brain.

We all know how insistently mindwandering can hijack our attention, and as our lives have become so much more frenetic, people are increasingly worried about the quality of their mental experience; not just their ability to focus and get their work done, but their ability to enjoy their lives, to be truly, deeply engaged in them. I learned just how concerned they are when an op-ed I wrote, titled "Think Less, Think Better," was published by the New York Times a few years ago. In it, I considered "how much we overlook, not just about the world, but also about the full potential of our inner life, when our mind is cluttered." As resonant as the piece was, it didn't touch on the important insights I have to share about why our minds wander and how their preoccupations are actually vital to our well-being even though some of our mindwandering is indeed harmful.

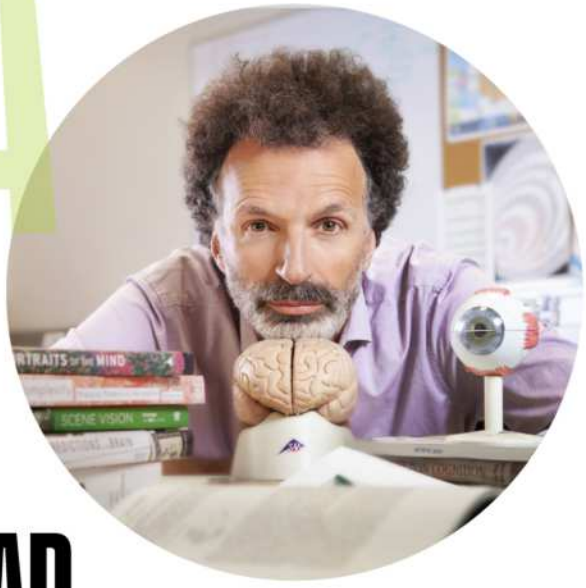
So much attention has been paid to ways to unplug from the bustle, and that's absolutely to be commended. I'll share my own positive experiences with doing so in silent meditation retreats. But as a series of discoveries in neuroscience over the past several decades have revealed, the greater challenge is freeing ourselves from the distractions within, which disrupt our attention and intrude on the quality of our experience even when we are in a perfectly quiet place. In fact, they may do so even more in times of quiet.

Research has revealed that our brains are inherently active. A number of brain regions connected in what's dubbed the default mode network (DMN) are always grinding away, engaged in a number of different involuntary activities that neuroscientists collectively call mindwandering: from daydreaming to the incessant self-chatter and from ruminating about the past to worrying about the future. The brain regions most often identified as being part of the DMN include the medial prefrontal cortex, the posterior cingulate cortex, and the angular gyrus, but there are several more that come and go as part of this massive, large-scale network. Not only does all of this inner commotion tug our attention away from the present moment, but it can dampen the quality of our experience, lowering our mood and potentially contributing to anxiety and depression.

Yet there's a method to this apparent madness. Evolution has clearly taught our minds to wander. According to various studies, they're caught up in mindwandering between 30 and 47 percent of our waking time, gobbling up a great deal of energy. The logic of evolution suggests there must be something beneficial about it, and over the course of the past couple of decades, I and my neuroscience compatriots have identified a core set of its important functions. •

Image Credit: Bloomsbury Tonic

Q&A AUTHOR



WITH MOSHE BAR

AUTHOR OF *MINDWANDERING: HOW IT CAN IMPROVE YOUR MOOD AND BOOST YOUR CREATIVITY*

The name of this e-magazine is a tribute to the way our creativity and curiosity can inspire great things, but what is actually happening when we allow our minds to explore ideas? In his book, *Mindwandering*, neuroscientist Moshe Bar explains how letting your mind wander could be the key to checking off a few goals for 2023.

What's happening in our brains when our minds wander?

One of the biggest discoveries in recent neuroscience research is what came to be known as the brain's default-mode network (DMN). A substantial network of connected regions that is vigorously active when we are not occupied with a specific task. The DMN is the seat of mindwandering. We plan, we generate simulations about possible futures, we think about our self and the self of others, and we generate creative ideas. But mindwandering is not always fun and constructive, especially when we focus on repeated worries, or ruminations, and when it takes us away from a precious present.

Why is mindwandering good for us?

There are several reasons to allow and even encourage mindwandering. First, every decision we make, and we make many of them every day, requires mental stimulation. Choosing between A and B implies thinking in advance about the two possible outcomes and going with the more favorable one, and such simulations are at the heart of mindwandering.

Second, mindwandering is also the basis of what we call creative incubation, which requires generating many ideas and evaluating them until we settle on the best one. Third, we have shown that broad and unconstrained mindwandering is highly conducive to a better mood.

Any particularly telling discoveries from your research for this book?

One thing I came to realize is how much guilt society has instilled in us for wandering. Sure, we want to be productive achievers, but mindwandering is there for a reason. Appreciating and making time for regular wandering is key for creative thinking, proper planning, and for a better mood. One more thing I've learned during my work on the book is the apparent conflict between mindfulness and mindwandering. This is not a real conflict, but rather, as I elaborate in the book, there are times we want to be mindfully here and now, and there are other circumstances where drifting is essential, productive, and fun.

Are there any practical tips you could share for people who'd like to make mindwandering work better for them?

Respect the role and importance of mindwandering, allow yourself to engage when appropriate, learn to distinguish between good and bad mindwandering. While mindwandering is notoriously hard to control, understanding how it works will help you summon the most beneficial wandering as you go.

What do you hope people will take away from the book?

The elements of brain research behind our wandering mind, the importance of a progressing and broadly roaming mind, that we can learn from our imagination, and that the quality of our everyday experience can vary anywhere between mindful, immersive, and drifting, each good in different contexts. Wander far but stay close. •

***Mindwandering: How It Can Improve Your Mood and Boost Your Creativity* is published by Bloomsbury Tonic and is available now, RRP £10.99.**

Image credit: Yael Keidar Yaelook Photography



Calcite has transformed the landscape of Pamukkale in Turkey where the "Cotton Palace" has sprouted a mineral forest. The petrified waterfalls and terraced basins look like a dreamy cascade of infinity spas, which is exactly what they once were for the kings of Pergamon.

Image credit: *Ryzhkov Oleksandr/Shutterstock.com*

A MINERAL FOREST FOR A NATURAL SPA

Since the second century BCE, the city of Pamukkale, which neighbors the ancient Roman site of Hierapolis, has been used as a natural spa. The ancient formation was once believed to have healing powers, decked out with hot thermal springs and white terraces that make for some pretty visually stunning R&R.

The natural site in Denizli Province in southwestern Turkey was made possible by thermal spring water that brought bucketloads of calcite into the region. It's classed as travertine, a type of limestone that forms when a mineral-rich lake or river system evaporates and leaves behind a crusty, but admittedly quite beautiful, calcium carbonate trail.

As a UNESCO World Heritage Site since 1988, it's recognized as a site of cultural and natural heritage to be protected and admired. A fitting status for a spot that once bathed the kings of Pergamon, a Greek state that ruled during the Hellenistic period.

Hierapolis is the name of the ancient Greek city that was built on top of the travertine formation, which has been nicknamed the Cotton Palace for its snow-white limestone. The crusty cotton formed over millennia as mineral-rich waters dripped down the mountainside.

As a type of sedimentary rock, the travertine was deposited by 17 hot springs in the region whose temperatures range from 35°C (95°F) to 100°C (212°F), aka balmy to boiling. The milder temperatures made for a warming spa for humans of the second century BCE, at a time when doctors considered it to be a healing center.

The site's historic significance is remembered in a museum that contains historical artifacts including Bronze Age trinkets. Its past is also spelled out in archaeology, as the site boasts the Theatre of Hierapolis and a necropolis (ancient cemetery) with sarcophagi that stretch for over a mile. •



How to get there

The Çardak Airport is the nearest airport to Pamukkale. From there, it's around an hour's drive.

SCIENCE IN MEDIA

SEE

Unwelcome
Film from Warner Bros

Big problems arise from little things in this folk horror film from director Jon Wright and writer Mark Stay. After moving to an idyllic home in rural Ireland, a young couple are puzzled to learn that they're expected to give a blood offering every day. Miss it, and they face the wrath of a mysterious cabal of murderous goblins lurking in the woods. Described by its makers as "*Gremlins* meets *Straw Dogs*", it'll have you eying your shrubbery with suspicion.

***Available in cinemas from* January 27.**



WATCH

Star Trek: Picard, Season 3
Series from Paramount+



The third and final season of *Star Trek: Picard* will grace our screens this February, as Jean-Luc reunites with the former command crew of the USS Enterprise. As old favorites return – Geordi, Worf, and Beverly are back in the action – so too do old enemies with the return of Lore Vadic. How will the reunited crew fare against old foes on their final journey into the great unknown?

***Available on Paramount+ from* February 16.**

LISTEN



Academic Writing Amplified
Podcast by Dr Cathy Mazak

Got a big project coming up? The Academic Writing Amplified podcast from Dr Cathy Mazak could be for you. It explores how to improve your work without overworking, celebrating inclusive opportunities and supporting achievements without promoting the burn out culture that often plagues life in academia.

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



READ

Otherlands by Dr Thomas Halliday
Book from Penguin

This debut from palaeobiologist Thomas Halliday went from the slush pile to an instant best seller as a deep dive into Earth's history. Tracking life through 16 epochs across 500 million years, it brings together a wealth of modern research to paint a picture of the planet's history like never before. "I suspect it will be a very important book for future generations," said Ray Mears, Chair, Wainwright Prize 2022.



***Available in paperback from* February 2.**

PLAY



Kerbal Space Program 2
Game from Intercept Games

Want to go to space but don't happen to be a wealthy entrepreneur who recently purchased Twitter? Well, we have good news. Kerbal Space Program 2 will enable you to construct powerful spacecraft and navigate expansive celestial bodies as you explore cosmic mysteries. As an early release it'll be available on PC and builds on its acclaimed space-flight simulation predecessor with revamped features and rich new environments.

***Available from* February 24.**

***Image Credit Top Row Left**: © Warner Bros. Entertainment Inc. All Rights Reserved, **Middle**: kinbostanci/iStock, **Right**: Penguin, **Bottom Row Left**: Paramount+, **Right**: © Intercept Games*

DATES TO REMEMBER

Eclectic doesn't quite cover it this month. As part of Black History Month, February will see the remembrance of prominent Black scientists, while elsewhere humans will be looking to hibernating rodents for advice on the weather. Plus, don't miss your chance to win prizes for your curious photographs and recordings.

FEBRUARY



Black History Month

In the US, Black History Month is recognized in February, the same month NASA scientist **Katherine Johnson** passed away. The esteemed mathematician was one of the first African American female "computers" at NASA in 1958 and was responsible for calculating the flight path for the first crewed mission to the Moon. She retired from NASA in 1986 and went on to receive the Presidential Medal of Freedom from Barack Obama. By the time of her death five years later, the STEM icon was 101 years old.



2 Groundhog Day

Why not ask a rodent for the weather this Groundhog Day? The idea of Groundhog Day comes from Pennsylvania Germans who settled in America in the 18th and 19th centuries. The superstition says that if a groundhog emerges from its burrow and sees its shadow in the clear weather, it will head back into its den to wait out the next six weeks of winter. If it doesn't see its shadow, due to cloud coverage, it will emerge, and spring will arrive early. Alternatively, you could just watch the movie.

11 International Day Of Women And Girls In Science

The United Nations General Assembly declared this day in 2015 to mark a concerted effort to end the exclusion of women and girls in science, which they recognize as a barrier between achieving internationally agreed goals, such as the 2030 Agenda For Sustainable Development. It aims to celebrate women and girls as agents of change and establish gender equality in science.



BigPicture Photo Competition

CURIOUS issue 4's **What On Earth** featured a Wiley's glass frog brood chilling rather alienlike in a jelly creche that the embryos develop in until they're ready to plop to the ground. It was recognized by the BigPicture Natural World Photography Competition and now you have the chance to enter. Entries are open now and close March 1, so **enter here** and be in with a chance to win the $5,000 grand prize.



28 Sound Of The Year Awards 2022

The deadline for the **Sound Of The Year Awards** is February 28, so if you recorded any weird or wonderful noises in 2022 now is your chance to get them recognized. Sounds can be real or imagined, pleasing or disgusting – good luck!

Image Credit Top Left: GPA Photo Archive via Flickr, CC BY-NC 2.0. Top Right: Aaron Silvers CC BY-SA 2.0, Bottom Left: NDAB Creativity/Shutterstock.com, Bottom Right: Embryology by Jaime Culebras, Terrestrial Life Finalist, BigPicture Natural World Photography Competition





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 looks at some unorthodox ways to express your feelings this Valentine's Day. If you like your science lighter, find out why Monty Python's Ministry of Silly Walks may be scientifically sound.

ROACHES ARE RED, VIOLETS ARE BLUE...

There's nothing like a cockroach to say "I love you". And, come to think of it, nothing says "I hate you" quite like a cockroach either. Whatever message you're trying to send this Valentine's Day, these versatile insects have you covered.

Those in search of the perfect gift for a special someone need look no further than New York's Bronx Zoo. For the bargain price of $15, you can name a Madagascar hissing cockroach after your beloved... and they say romance is dead!

"You don't always have the right words, but you can still give them goosebumps," the **Bronx Zoo** explains. "Name a Roach for your Valentine, because roaches are forever."

It seems Shirley Bassey was way off the mark. Why buy diamonds when you can buy Dictyoptera?

For a more vengeful Valentine's, a similar scheme at **El Paso Zoo** in Texas offers the opportunity to get one up on an ex – by naming a roach after them and watching as it's **fed to meerkats** (as well as other insectivores including iguana and skink).

REVENGE IS A DISH BEST SERVED COLD, AND PREFERABLY TO A MEERKAT

Revenge is a dish best served cold, and preferably to a meerkat, which the appropriately named "Quit Bugging Me" event knows all too well.

However, if you prefer not to trust your hopes of romance or revenge to a cockroach, perhaps you should consider looking elsewhere in the animal kingdom: it's absolutely jam-packed full of **bizarre mating rituals**. You could create a masterpiece, like the Japanese puffer fish, or take a leaf from birds' books and practice your dance moves. If that fails, or you're feeling unforgiving, there's always the approach of the female praying mantis, who is known to bite the heads off her lovers.

We think we'll stick to the roaches... for now.

EXERCISE, TEABAG STYLE

When it comes to silliness, no one does it better than Monty Python. Fans of the comedy troupe's infamous 1971 sketch "The Ministry of Silly Walks" may have dismissed it as lighthearted tomfoolery, but, it turns out, it might not be so silly after all. In fact, strutting about à la Mr Teabag – John Cleese's character in the sketch – could be better for cardiovascular health and calorie burning than your run-of-the-mill walking style.

It may not be the most sophisticated way of getting around but, if you can swallow your pride, you might want to consider walking "Teabag style" to help you hit physical activity targets, a small study published in **The BMJ** hints.

Scientists measured the energy expenditure of 13 adults as they attempted to mimic the walking styles of characters Mr Teabag and Mr Putey, played by Michael Palin. When compared to their normal way of walking, the Teabag walk was found to be particularly energy intensive, using around 2.5 times as much energy.

Oxygen uptake when taking the Teabag approach was more than double that of normal walking, meaning it qualifies as vigorous-intensity exercise. One minute of Teabag walking was associated with an 8 kcal/min increase in energy expenditure for men and 5 kcal/min for women.

And so, the researchers suggest, sacrificing your reputation and swapping to Teabag style for 11 minutes a day could help you achieve the standard recommendation of 75 minutes of vigorous-intensity physical activity a week. Upping this spell of silliness to between 12 and 19 minutes a day could also improve cardiorespiratory fitness and reduce mortality risk.

Mr Teabag's not looking so silly anymore, ey? Never judge a person until you've walked a mile in their shoes, as the saying goes.

