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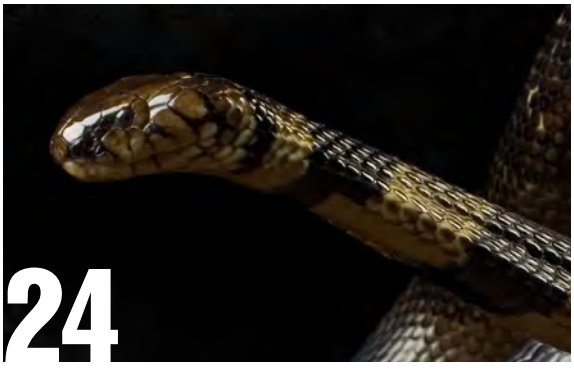
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Q How do sea urchins move?

— Anonymous

A Despite living in the ocean, sea urchins can't swim. Instead, these round, spiky invertebrates move along the seafloor using hundreds of tube feet. To extend the feet, the urchin pushes liquid from water sacs inside its body into a foot. When water is pulled back into the sacs, the foot relaxes. Tube feet often end in suckers that secrete a gluelike substance, which allows for a better grip. To detach, the sea urchin releases another chemical that dissolves this glue. Coordinating the movement of its many tube feet allows a sea urchin to crawl along at a slow pace.

Q How many galaxies do we have?

— Kimora

A Some 100 billion to 1 trillion stars, including our sun, make up our galaxy, the Milky Way. But how many other galaxies exist "is a tricky question," notes Steven Finkelstein. He directs the Cosmic Frontier Center at the University of Texas at Austin. Although telescopes have mapped much of the sky, most images they've produced can't see very distant galaxies. The Hubble Space Telescope's Ultra Deep Field view, he notes, "only covers a tiny part of the night sky (about the size of Lincoln's eye if you hold a penny at arm's length)." If what is seen there is representative of the universe, there should be billions of galaxies, he says. Observations from the newer James Webb Space Telescope suggest there could be trillions. "Still," Finkelstein adds, "this is just in our observable universe — which is a tiny part of the entirety of the cosmos. So the true answer may be infinite!"

NATALIEJEAN/SHUTTERSTOCK

Q Why does the Earth spin?

— Molly A.

A Earth, as viewed from above the North Pole, spins counterclockwise, from west to east, completing one rotation about every 24 hours or so. Just about everything in the solar system spins. All of this swirling and whirling started when the solar system first formed some 4.6 billion years ago. As gigantic clouds of gas and dust move through space, gravitational nudges make the clouds rotate. Sometimes, these clouds collapse under the weight of their own gravity. As a cloud collapses, it flattens into a disk and spins faster and faster. At the center, a bulge of dense material gloms together in a process called accretion, forming a star. That star keeps spinning and so does the disk around it. Some material in the disk swirls together to form planets, moons, asteroids and comets. All of these objects will keep moving in the same counterclockwise direction — unless they collide or interact with something that changes their path. That might be why Uranus appears to spin on its side.

Do you have a science question you want answered?

Reach out to us on Instagram (@SN.explores), or email us at explores@sciencenews.org.

PLANTS

DNA reveals secrets of East Asia's favorite sweet bean

Red adzuki beans were first cultivated in Japan thousands of years ago

Red adzuki beans are a beloved staple in East Asia. They make a sweet paste that cooks can tuck inside mochi, swirl into mooncakes and layer beneath custard in taiyaki. But despite the beans' popularity, when people began using them has remained murky — until now.

Scientists have analyzed the DNA of nearly 700 varieties of adzuki across Asia. Some of these plants grow in the wild. People have been farming — or cultivating — other types. The beans' genes now suggest that adzuki was first cultivated in Japan between 3,000 and 5,000 years ago.

The investigation also uncovered DNA tweaks, or mutations, that gave rise to the beans' rich red hue.

"I was surprised by basically everything," says Cheng-Ruei Lee. He studies evolutionary genetics at National Taiwan University in Taipei. That field of science looks at how variations in DNA lead organisms to evolve new traits. Lee is part of a team that shared its new findings in *Science*.

Adzuki beans grow in pods on bushy plants. They have a naturally sweet, nutty flavor. Fossils of ancient beans hinted that Japan's Jomon people might have grown adzuki. The Jomon were hunter-gatherer-fishers who lived as early as 16,000 years ago.

Through farming, adzuki beans got a makeover. Wild beans are pale with dark mottled spots. The farmed varieties are red all over.

Lee's team found one mutation in the beans' DNA that affects how they process pigment. That allows red pigments to spread across the coats of their seeds. The deletion of another piece of DNA, or gene, gets rid of the mottled pattern that's still seen in the wild.

The researchers tracked how those two mutations emerged over time. They also looked at a third mutation seen in the farmed beans. This gene reduces the odds that a bean pod will break open. For farmers who want to easily harvest whole beans, that's a useful trait. But it's not very helpful for wild plants, which rely on their pods bursting to spread seeds.

All three mutations seen in farmed beans began to spread around 10,000 years ago. That was long before people started farming the plants in Japan.

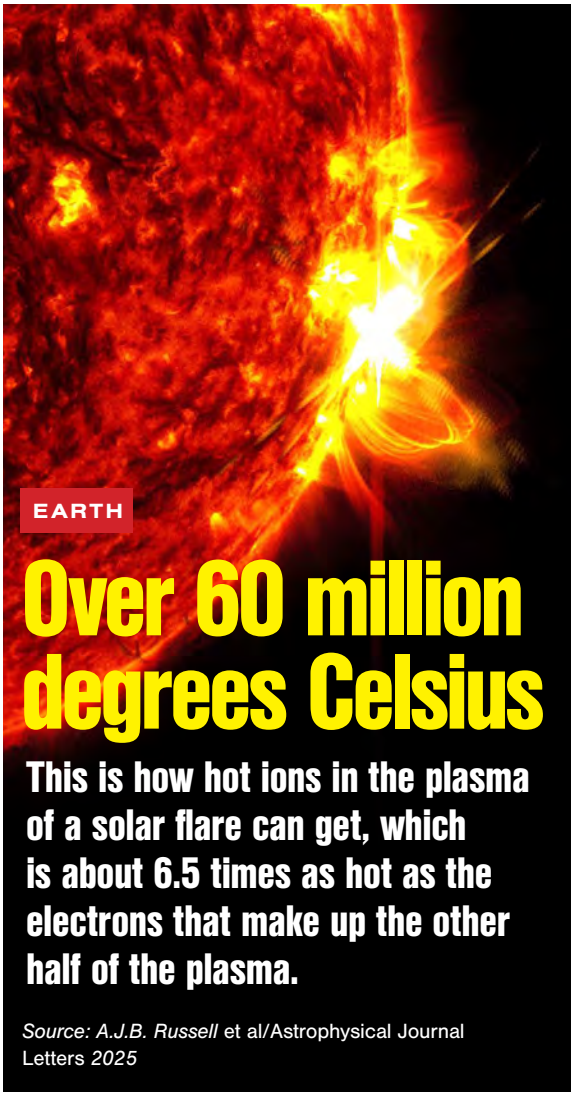
Many Chinese mooncakes (below) and other East Asian treats are stuffed with a sweet paste made from red adzuki beans. But where people first cultivated these beans had long been a mystery.

LIVEBEAR CHEN, KUNGFU01/SHUTTERSTOCK

Since these traits are of little help in the wild, Lee says, their early spread may reflect human preferences. The Jomon people are known to have used red coloring in their pottery.

The new findings bolster the idea that the Jomon people were more than foragers. They could have been shaping their perfect red bean, eventually domesticating it between 3,000 and 5,000 years ago. Fossils had already offered some evidence for that, Lee notes. Finally, he notes, there "is evidence from plant genetics, too."

— CELINA ZHAO



EARTH

Over 60 million degrees Celsius

This is how hot ions in the plasma of a solar flare can get, which is about 6.5 times as hot as the electrons that make up the other half of the plasma.

Source: A.J.B. Russell et al/Astrophysical Journal Letters *2025*

NASA/SDO; FOTOHUNTER/SHUTTERSTOCK

HUMANS

To our brains, your red is my red

Scans reveal a common brain pattern when people see colors

Colors, such as red, trigger similar neural activity across different people, a brain scanning study has found.

Is my red the same as your red? It's a classic puzzler, one that's fun to debate with your friends and family. Do colors look the same to you as they do to me? Now two neuroscientists weigh in. They published their research in the *Journal of Neuroscience*. And their answer is a resounding maybe.

There were two possibilities when it comes to how brains react to color, says Andreas Bartels. He works at the University of Tübingen and the Max Planck Institute for Biological Cybernetics in Germany. Perhaps everyone's brain is unique. Each might have its own snowflake pattern of nerve cells responding when a person sees red. Or it could be that seeing red kicks off a standard, predictable pattern of brain activity. And that pattern might not vary much from person to person.

The answer is overwhelmingly the second option, the new study suggests. "There are commonalities across brains," Bartels says.

Bartels and his colleague Michael Bannert started with 15 people. Each person saw shades of reds, greens and yellows. As people viewed the colors, the scientists monitored the activity of nerve cells spread across visual brain areas. The researchers then used those data to predict which color each person saw.

The results showed that neural reactions to colors are somewhat standard. They don't seem to vary much from person to person.

But these findings can't answer the question of how it *feels* to see red, Bartels says. How your brain creates inner experiences that are unique to you is a much bigger question about consciousness. And it's one that will no doubt continue to be debated for a long time.

— LAURA SANDERS

PHYSICS

Melting ice can slingshot itself along this grooved surface

The slick finding could lead to windows that de-ice themselves

On some surfaces, chunks of melting ice need no push to skate — or even seemingly slingshot themselves.

This finding was inspired by the Racetrack Playa mystery in Death Valley, Calif. There, boulders weighing up to 16.6 kilograms (36.6 pounds) seemingly dragged themselves as much as hundreds of meters (yards) across a flat, dry lakebed.

In 2014, scientists traced the rocks' travels to rain freezing beneath the stones. As it warmed, light breezes sent windowpane-thick sheets of ice sailing along atop their own meltwater. These toted the rocks with them. Some rocks cruised along at rates of 2 to 5 meters (6.6 to 16.4 feet) per minute!

Researchers at Virginia Tech in Blacksburg have now designed a surface that achieves this same effect, without wind. Ice chunks can self-propel along the surface at speeds much faster than the Death Valley boulders.

This was "a shocker," says mechanical engineer Jonathan Boreyko. He and his colleagues described their new surface in *ACS Applied Materials & Interfaces*.

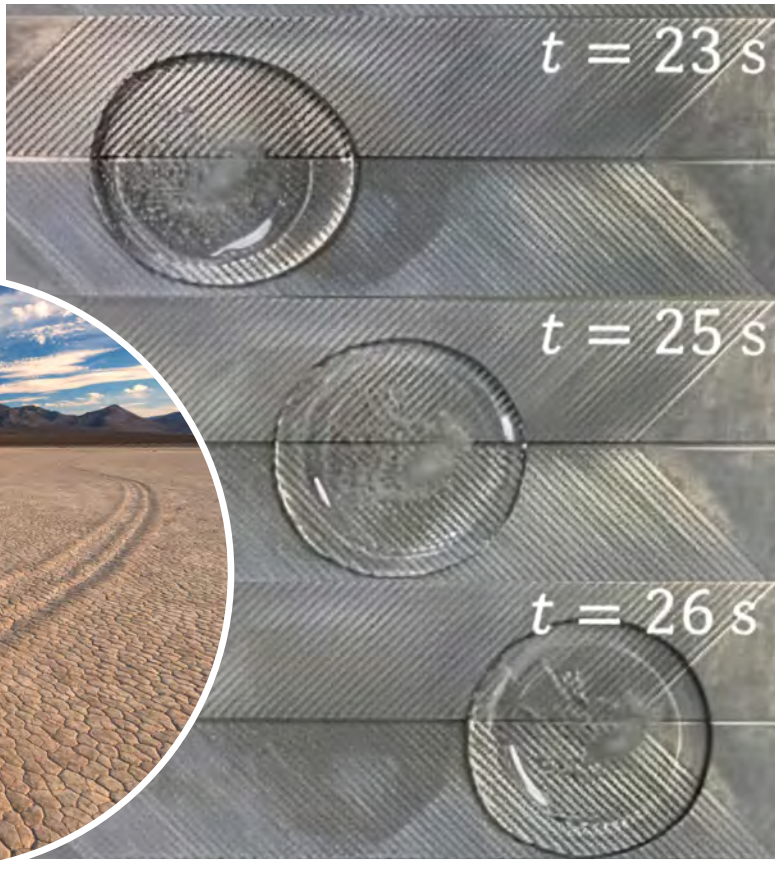
To create a mini racetrack for ice, the team cut angled grooves into a piece of aluminum. The grooves guide water from the melting ice to flow in one direction. As predicted, that meltwater ferried the remaining ice — like "a person tubing on a lazy river," Boreyko says.

A second version of the surface, coated with a waterproof spray, was more surprising. The researchers expected the ice to move a bit faster, says Boreyko. Instead, it lagged at first. Then it suddenly accelerated — almost like a slingshot. The ice sailed across this surface 10 times faster than in the first experiment.

This slingshot effect came from "a giant mismatch in surface tension" at the front and back of the ice, Boreyko explains. "Finally, that force is so dramatic that it unsticks the ice from the surface and slingshots it across."

Xuehua Zhang is a materials engineer in Canada at the University of Alberta in Edmonton. She can imagine several uses for the slick discovery. One idea: Develop new ways to de-ice surfaces.

Boreyko had that idea as well. His lab is currently looking into how the slingshot effect might be used to sweep ice off surfaces such as car windshields. — *Sarah Wells*

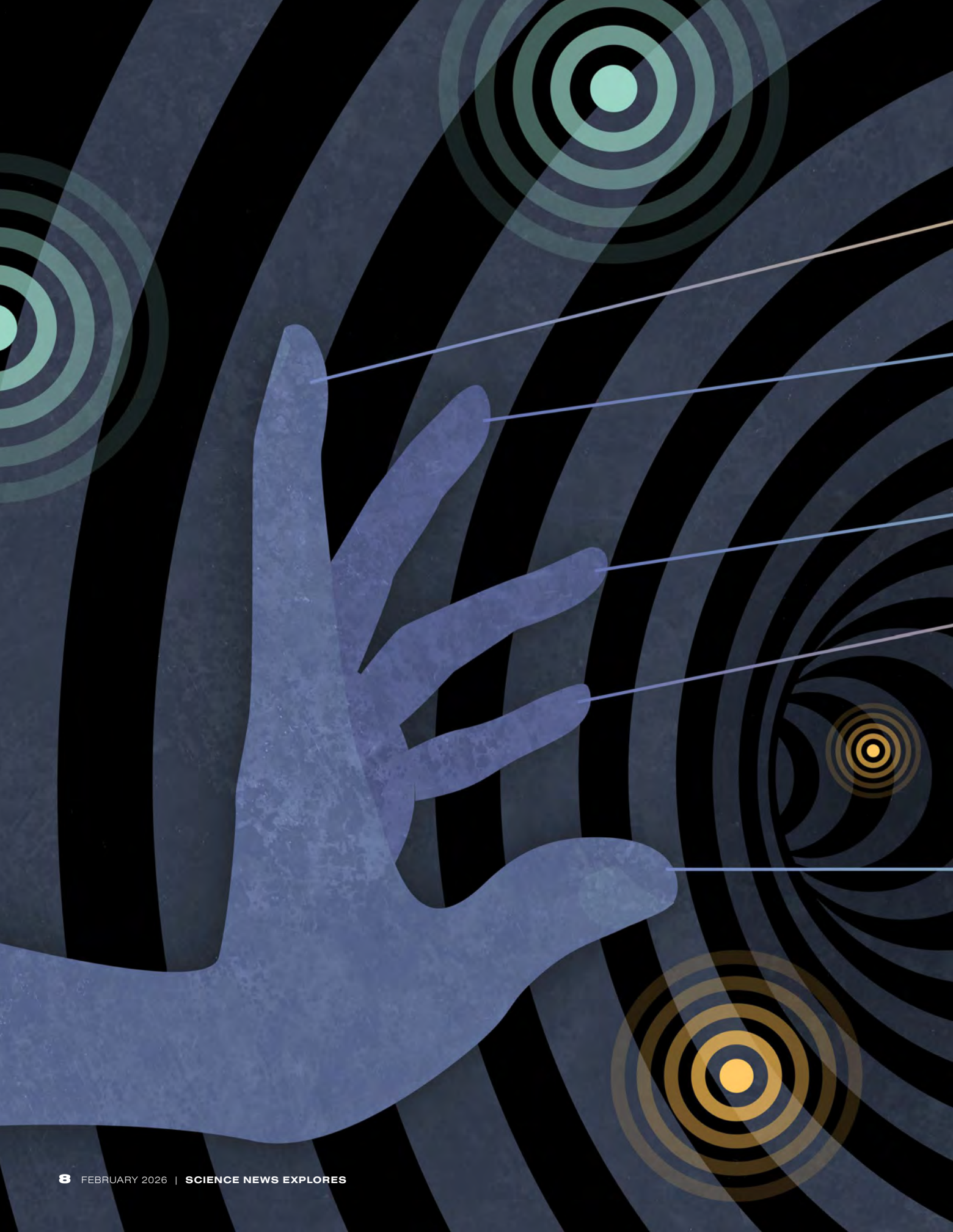


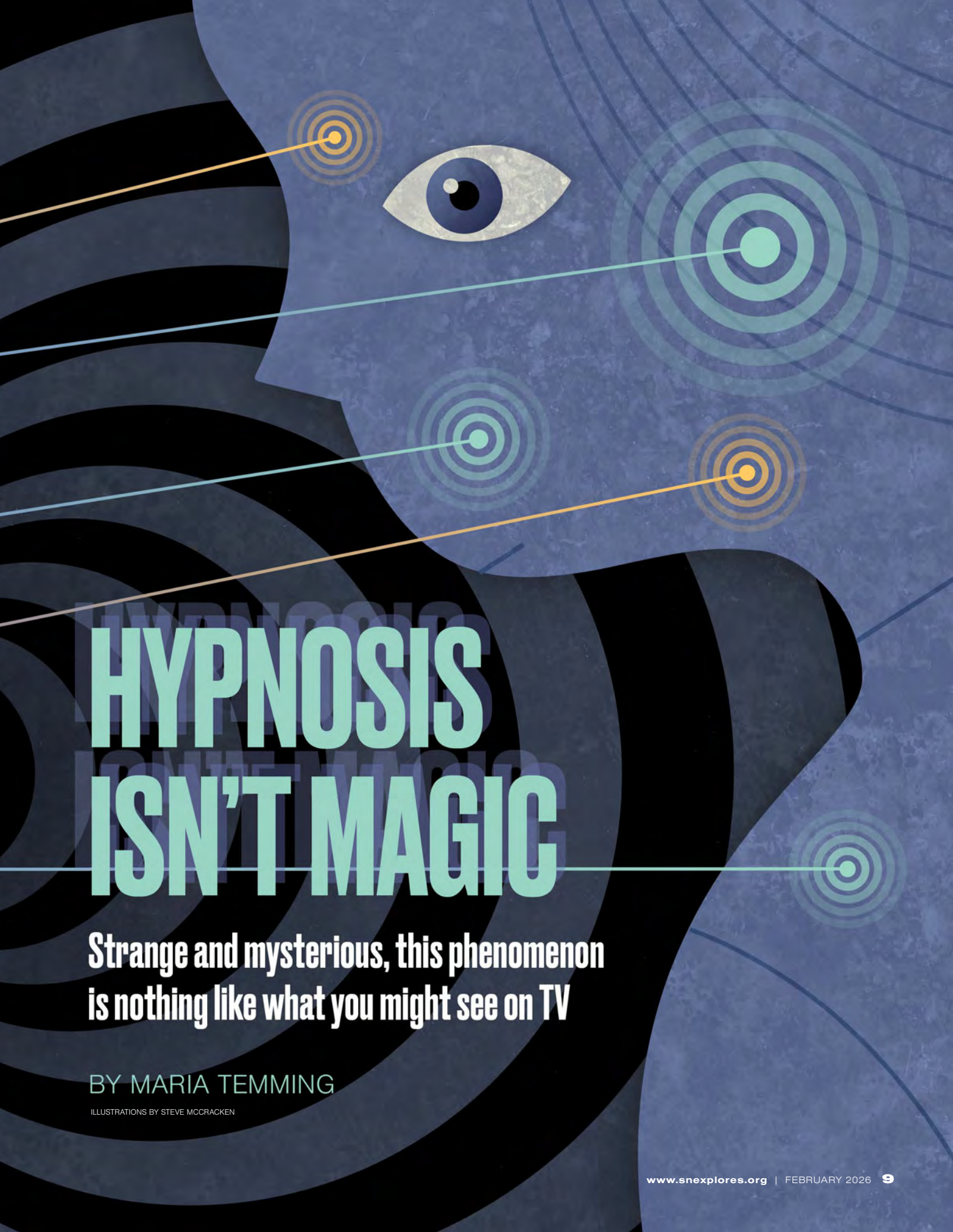
This series of three images shows how a piece of ice slingshots forward as it melts on an aluminum plate etched with a herringbone pattern. The "t" indicates how many seconds have passed.

The trail behind this boulder reveals its mysterious movement across Racetrack Playa in Death Valley.

BILL45/SHUTTERSTOCK; J.T. TAPOCIK *ET AL*/*ACS APPLIES MATERIALS & INTERFACES* 2025

Think you know what you're seeing? Find out on page 32





HYPNOSIS ISN'T MAGIC

Strange and mysterious, this phenomenon is nothing like what you might see on TV

BY MARIA TEMMING

ILLUSTRATIONS BY STEVE MCCRACKEN

When Tina Hesman Saey was in middle school, she saw a hypnotist perform at a student assembly. At first, she was skeptical. She'd seen hypnosis on TV, and it seemed like a magic trick: flashy, but fake. After all, a hypnotist couldn't really turn a bunch of strangers into mindless puppets ... could they?

Sitting on the gym bleachers, Saey watched her classmates volunteer to be hypnotized. Prodded by the hypnotist, each kid did a silly task, like hop on one foot. But Saey wasn't impressed. "They're just pretending," she thought. To prove it, she raised her hand.

The hypnotist had Saey sit in a chair and close her eyes. Then, he started speaking. Afterward, the hypnotist told her to put both hands behind her head and lace her fingers together. "Try to pull your hands apart," she recalls him suggesting. "You won't be able to do it, because your fingers are stuck."

Saey scoffed. But when she tried to separate her hands, the strangest thing happened: Her fingers felt stuck! "It made me feel really frustrated," laughs Saey, now 57. Later, when the hypnotist told her to straighten another student's bowtie, she again tried to ignore the suggestion. But again, she gave in to the urge to follow it.

"If he had told me to do something really bad, I think that I could have overcome that," Saey says. Yet when it came to the hypnotist's harmless suggestions, she had a baffling impulse to just go with them.

"I didn't really understand what hypnosis was, and I'm not sure I still do," says Saey, now a reporter for *Science News* in Washington, D.C.

Scientists often define hypnosis as a procedure that coaxes someone into a specific state of focused attention. In that mindset, some people report feeling as though suggested sensations are real. A suggestion might be as simple as a person's fingers being stuck together. Or it might be as extreme as not feeling pain during surgery.

Studies of the brain and behaviors suggest that hypnosis is a real experience. Research has even offered some clues about who can be hypnotized, as well as what they can — and can't — be compelled to do. But scientists are just starting to piece together how the brain achieves such feats of altered perception.

YOU'RE *NOT* GETTING VERY SLEEPY

On stage or screen, hypnosis is often played as some sort of enchantment. A hypnotist murmurs magic words — perhaps while swinging a pocket watch — and voilà! Their victim falls into a sleepy trance during which they must obey any command.

There's a lot wrong with that picture, however.

For one thing, hypnosis doesn't require any special powers. A hypnotist is just someone "saying things to another person," explains Amanda Barnier. They're not using "magical words," she adds. "They're just words." A cognitive scientist, Barnier works at Macquarie University in Sydney, Australia.

The first step in hypnosis is called induction. A hypnotist might start by telling someone to close their eyes, relax and listen closely. "It's really an invitation to focus less on the external world," Barnier says. The idea is to focus more on the hypnotist's words.

Once someone is in a deeply attentive state of mind, the hypnotist then starts making specific suggestions. These are often phrased as statements: Your eyelids are too heavy to open. A fly is buzzing near your ear. Your hand has gone numb.

Some people report that these suggestions feel real — and outside their control.

People are often shocked by how they respond to such suggestions, Barnier says. Her team has hypnotized people to not recognize their own reflection or to feel like someone else is controlling their arm. "The genius of the thing is actually in the hypnotized person," Barnier says. People can hypnotize themselves by listening to recorded inductions. It's their own brains shaping their experience.

That also means people can choose to not engage with suggestions if they don't want to. "They haven't flipped into some state where they're just being programmed," Barnier says. In lab tests, people can't be *forced* to do anything under hypnosis. "If it sits uncomfortably with them," she says, "they will open their eyes and say, 'No.'"

WHO'S HYPNOTIZABLE

Not everyone who hears the suggestion that they see a stranger in the mirror will feel that's true. Some people simply are more hypnotizable than others. Scientists measure where someone falls on the hypnosis spectrum by giving them suggestions of increasing difficulty.

Most people can experience easy suggestions, like their eyelids getting heavier. Very few experience difficult suggestions, such as seeing or hearing something that isn't there. Or suddenly *not* being able to see or hear something that is there.

Why do people vary? "That's one of the lingering big questions," says Devin Terhune. He's an experimental psychologist at King's College London in England.

"A lot of people think hypnosis is wacky. Rather than being strange and weird, it's actually a really valuable skill. But we don't really know enough about [it]."

— AMANDA BARNIER

"Some of the factors are ... your beliefs and expectations," Terhune says. The more someone expects hypnosis to work on them, the more likely it will. People who are more prone to absorption may be more hypnotizable, too. Absorption is when you get sucked into an imaginary world and tune out your surroundings.

Terhune's research also hints that people who are less aware of their control over their own actions may be more hypnotizable. But any of these factors — or others — could play a role, he adds. "It seems rather to probably be a complex mixture of many different abilities."

REALITY CHECK

Anyone who's never been hypnotized may doubt that any of this is real. "It's a kind of a psychological phenomenon that freaks some people out, because it's like ... 'How do I know you're just not lying to me?' " Barnier says. Hypnosis researchers have had to come up with clever tricks to answer that question.

In one method, scientists invite two groups of people to work with a hypnotist they've never met. One group consists of highly hypnotizable people. They're told to go through a hypnosis session as normal. The other group is full of people who aren't hypnotizable. They're told to fool the hypnotist into thinking they're hypnotized.

The fakers act somewhat differently, Barnier says. "They can't quite work out the nuances of what a genuinely hypnotizable person will do."

In one experiment reported in 1959, for example, a hypnotist suggested someone hallucinate that a researcher was sitting next to them. Then, the hypnotist had the person turn around. The real researcher was sitting behind them.

When asked, the fakers claimed they could only see the researcher they'd been told to hallucinate. They assumed this is what a hypnotized person would say. But they were wrong. People who felt like they were truly in a hypnotic trance said they saw both researchers — the real and the hallucinated one.

Scientists have also taken brain scans of people during hypnosis. These studies have only examined small groups of people. But the scans hint that when someone says they're experiencing a hypnotic suggestion, their brain activity matches that claim.

Some scientists have used brain scans to try to tease hypnosis apart from everyday imagination. "Regions that become active when you imagine something are distinct from those that become active when you're responding to a hypnotic suggestion," Terhune says.

INSIDE THE HYPNOTIZED MIND

If people truly can see, hear or feel things that aren't real during hypnosis, the natural next question is *how*.

"We're not aware of a specific brain region or network that might be facilitating response to suggestion," Terhune says. Basically, scientists can't yet point to some "hypnosis center" in the brain. But they're on the hunt for brain regions that might be involved.

One team recently ran a series of studies looking at the brains of people experiencing hypnosis or just normally awake. Each experiment involved a few dozen people with lots of experience being hypnotized. The scientists tracked brain activity after people listened to a series of statements designed to lull them into hypnotic states. They also scanned people's brains after they listened to a list of facts not designed to induce hypnosis.

The scans taken during hypnosis revealed changes in brain connectivity across several brain regions. These included the parietal, occipital and temporal areas. "Those regions are involved in a lot of different functions," notes Mike Brügger. For instance, they play roles in our perception of ourselves and our awareness of our bodies. Brügger is a neuroscientist. He worked on this research at the University of Zurich in Switzerland.

Brain-chemistry data showed changes in the levels of a molecule known as myo-inositol. This change happened when people reported being in an especially deep hypnotic state. It's not clear, though, why this brain chemical in particular might be involved in hypnosis, Brügger adds.

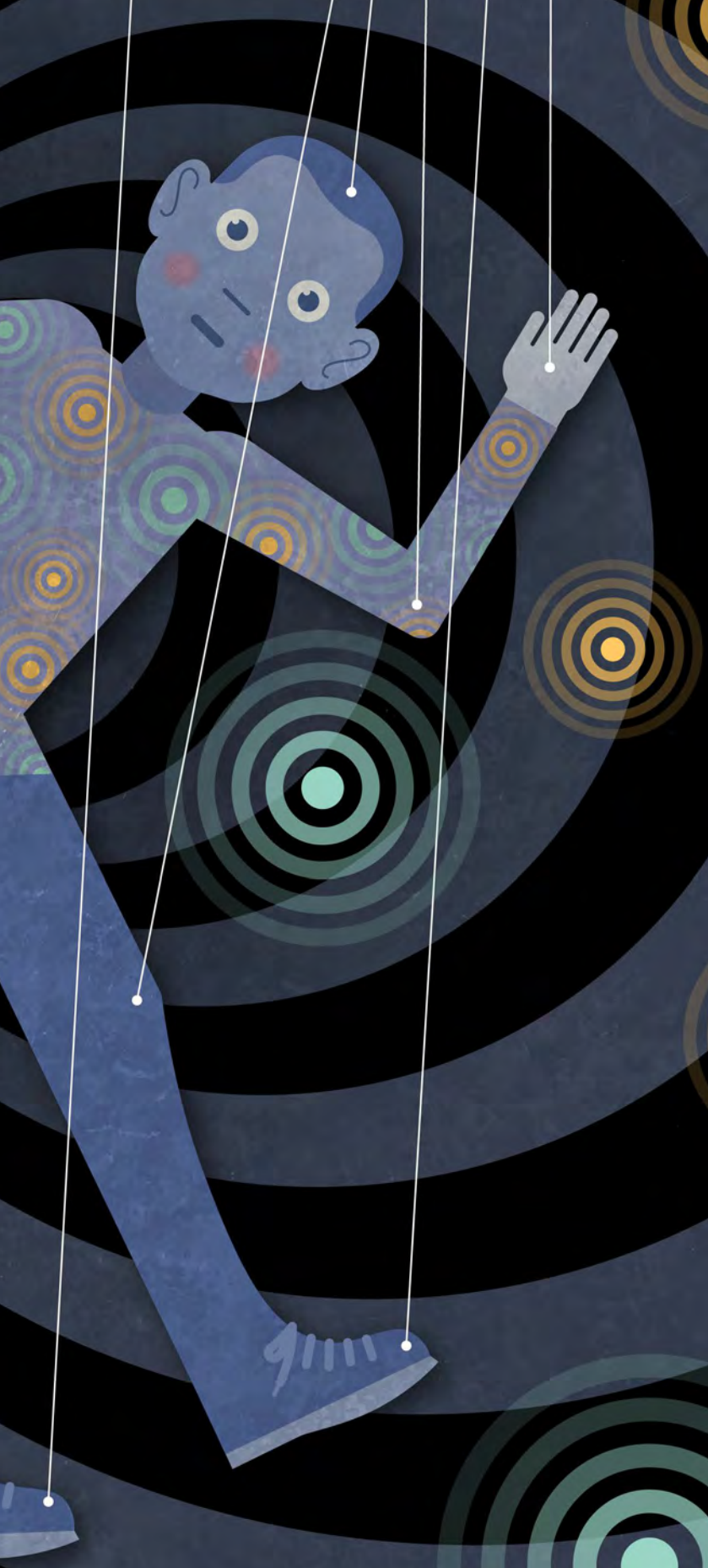
Together, the findings offer a few more pieces to the hypnosis-brain puzzle. But much more research is needed to fill in the picture.

HELPFUL HYPNOSIS

The science of how hypnosis works may not yet be settled. Still, people around the world use hypnosis all the time — and not just for entertainment. Some therapists offer to hypnotize patients so that they will feel less pain, sleep better, quit smoking or achieve other goals.

Scientists have run many clinical trials to investigate how much hypnosis can affect a range of health issues. These studies have found "certain conditions for which hypnotherapy is very effective, some it's moderately effective and then some areas where it's not effective at all," says Gary Elkins. He's a psychologist at Baylor University in Waco, Texas.

Hypnosis is well known to help some people manage pain, he notes. That includes short-term pain from injuries and medical procedures. It also includes long-term, or chronic, pain. "People have been able to undergo major surgical procedures



under hypnosis," Elkins says. "But those are highly hypnotizable persons."

In 2021, scientists reviewed 20 years of research on hypnosis to treat pain. These studies had examined pain from injuries, medical conditions and procedures. All compared people who received hypnosis to groups that did not. Hypnosis did seem to lower people's pain. On average, it was about as useful as other mental techniques for soothing discomfort, such as mindfulness.

Hypnosis also seems promising for managing anxiety, Elkins says. A hypnotist might treat someone's nerves by suggesting that they feel safe, confident and relaxed.

In 2019, researchers conducted a review of hypnosis research for relieving anxiety. Hypnosis seemed about as helpful as muscle-relaxation techniques and a type of talk therapy known as cognitive behavioral therapy. It was even more helpful when paired with one of these other types of therapy.

Hypnosis may ease other stress-related problems, too. Whether hypnosis can lead to behavior changes, though, such as quitting smoking, is another question, Elkins says. "The research is mixed."

Even for well-studied uses such as pain and anxiety, hypnosis is no magic cure. "Hypnosis isn't good for everything for every person under every situation," says Barnier, at Macquarie. Yet its uses in medicine strikingly show the mind's ability to shape our experiences of reality. And to Barnier, these benefits offer strong motivation to continue plumbing the depths of this mysterious state of mind.

"A lot of people think hypnosis is wacky," Barnier admits. "Rather than being strange and weird, it's actually a really valuable skill. But we don't really know enough about [it]."

AI, MAKE ME A VIDEO GAME

Artificial intelligence can already generate text and images, so why not entire games?

BY KATHRYN HULICK

Artificial intelligence generated this image to look sort of like a scene from the game Minecraft. People are now using AI to create code, dialog and other content for video games. A type of AI called a world model can even generate playable game environments. What role do you think AI should play in game-making?

SHUTTERSTOCK AI GENERATOR/SHUTTERSTOCK

If you have an idea for a story or a picture, you can easily grab a pencil and start writing or sketching. But it's different if you want to make a video game. Turning your ideas into reality usually requires visuals. And sound. And code to make those and other elements run.

Putting all this together isn't easy, notes Matthew Guzdial. He used to run a club for gamers. There, Guzdial met young people who "had all these elaborate visions for the kinds of games that they wanted to make." But they usually didn't have the technical skills to create those games. He says it was "heartbreaking" for them to realize that.

Now, as a computer scientist at the University of Alberta in Edmonton, Canada, Guzdial is working to solve this problem. "I want to empower people to be able to make games on their own," he says. Artificial intelligence, or AI, might be able to help.

Generative AI can produce all sorts of things, including stories, images, music, videos — and computer code. So you can ask AI chatbots like ChatGPT, Claude or Grok to write the code to run a video game.

John Hester tried this out. A retired software developer, he lives in Southern California. Last February, he asked Grok 3 to write him code for a version of Pac-Man that he could play on his computer.

"It came up with a very primitive version," Hester says. In a back-and-forth conversation, he told the bot what changes he'd like. Some two hours later, he had "a playable, functional game." And he wrote none of its code himself.

"I was very impressed," he says.

In the future, game studios might be full of creative people that "just come up with the concept of games and what they want them to look like," he says. They could then prompt an AI model to do the rest.

Some game developers, however, aren't so sure this is the future they want. "There's a taboo," says Gillian Smith, "that's forming around AI-generated content." Smith directs an interactive media and game-development program at Worcester Polytechnic Institute in Massachusetts. Game artists, especially, resist using generative AI in their work, Smith's research has found.

Different types of AI have been a part of game development for decades. But now generative AI models are raising new questions about what role this tech could — and should — play in game-making.

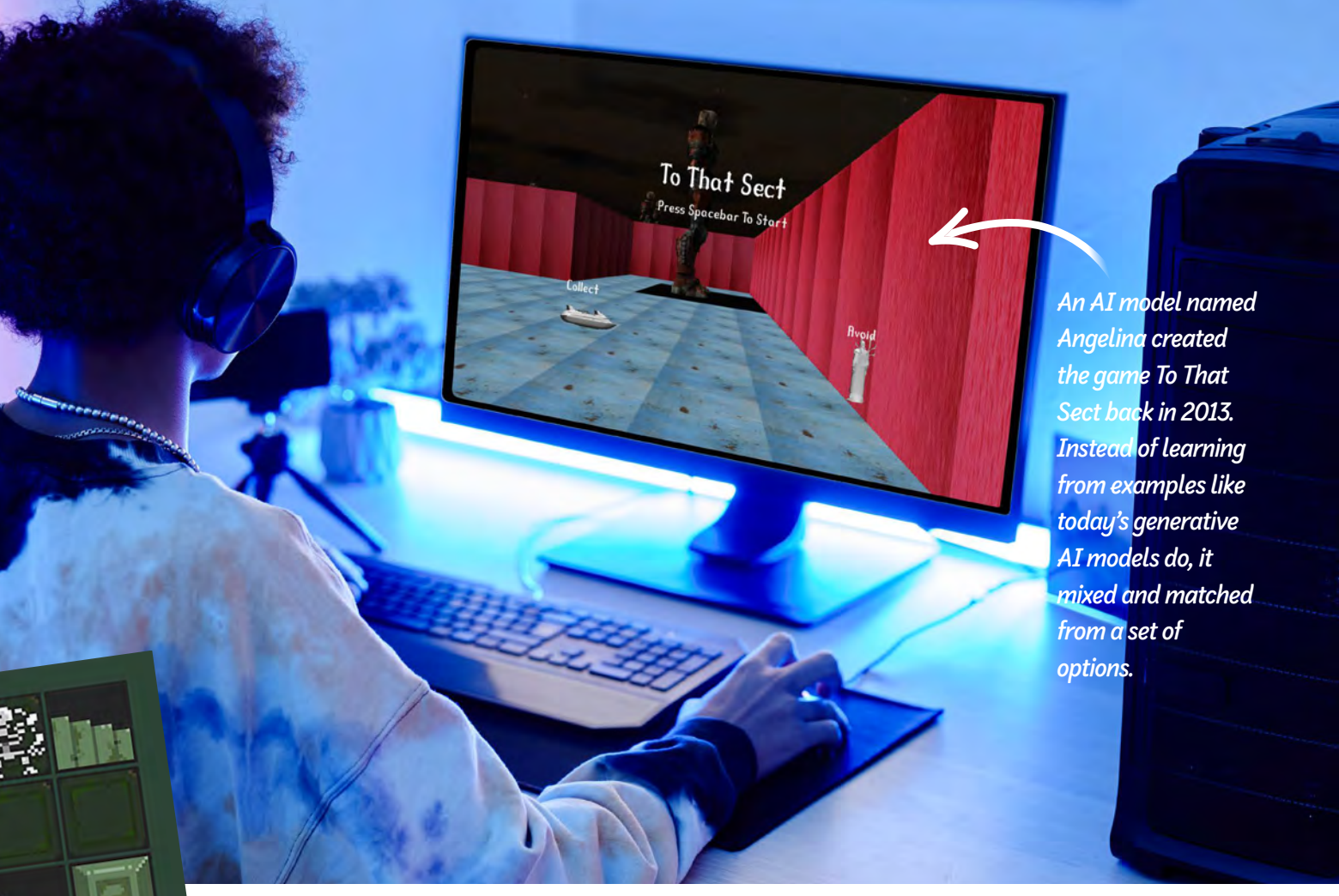
To make a version of Pac-Man (left), all John Hester had to do was ask Grok 3, an AI model, to code it for him. "You're just talking to the AI in English. It's doing all the coding," he says.

J. HESTER/GROK 3; M. COOK

THE O.G. OF AI GAME CREATORS

In 2013, Angelina entered a game jam. In this competition, participants created their own game based on a theme within a time limit. Angelina wasn't a human. It was an AI that Mike Cook had designed. Cook is a researcher and game designer at King's College London in England. Angelina was the first piece of software to participate in a game jam.

Angelina's entry — To That Sect — isn't the AI's best work, Cook admits. The game involves wandering around a red-walled maze collecting boats and avoiding floating statues. This odd, somewhat creepy game didn't even come close to winning the competition. But it was a milestone for AI-based game design.



An AI model named Angelina created the game To That Sect back in 2013. Instead of learning from examples like today's generative AI models do, it mixed and matched from a set of options.

In the puzzle game Before Venturing Forth, designed by the AI model Angelina, you move multiple heroes all at once, trying to avoid the skeletons.

SEVENTYFOUR/ISTOCK/GETTY IMAGES PLUS, TO THAT SECT; ADAPTED BY A. LEVY

Angelina — the AI behind the games To That Sect (above) and Before Venturing Forth (above left) — uses search techniques to find bits and pieces from existing games to build new ones.

On its own, Angelina had put together a game world, complete with items, rules, music, colors, textures and other aspects.

More recently, Cook developed a new AI game designer called Puck. One game Puck designed is like a reverse Connect Four. Here, you try to avoid getting four in a row. Cook named it Antitrust.

The AI systems behind Angelina and Puck both use search techniques. They design games by combing through a vast space of possibilities.

As Cook describes it, "we break a game up into little puzzle pieces." For Angelina, those puzzle pieces included game rules, art, music and more. Cook only selected options from existing games or collections of game elements that he had the rights to use. Puck, in contrast, only uses rules for its pieces that were inspired by grid-based puzzle games, such as Connect Four, Candy Crush Saga or Tic-Tac-Toe.

Puck and Angelina each search for new and interesting ways to put their pieces together. They test out these combos and choose the best results.

"Working with AI creatively is really fun," says Cook. An unexpected or weird idea from Angelina or Puck might "help you think in a different way."

Guzdial has also created a game-making tool based on search techniques. It's called Mechanic Maker. Rather than putting together new ideas for games, it helps people achieve their own ideas.

A DREAM OF MINECRAFT

Cook and Guzdial's AI tools for games are intriguing. Still, they're not what most of the world is paying attention to right now. What's stolen the spotlight in the last few years has been generative AI. It's based on what's known as deep learning.

Generative AI models work differently from Angelina, Puck and Mechanic Maker. Rather than being programmed to search through a set of options, they learn from a huge number of examples. They use artificial neural networks to recognize patterns in data. Then they follow those patterns to create something that's new but also resembles past examples.

This has angered many human creators, however. They say such bots mimic their work without permission. Despite that criticism, some video games now use generative AI.

In the game Origins, you play a detective questioning a cast of chatbot-powered characters. In Astrocade, you describe things you want to add to a game. Then generative AI creates 3-D objects and characters with which you can interact. Roblox Cube is a tool Roblox creators can use to generate 3-D objects and environments.

To play an AI-generated version of Minecraft, you can try a demo called Oasis. The companies Decart and Etched released it in 2024. (This demo is not affiliated with Microsoft, the owner of the real Minecraft game.) Oasis is based on a new type of generative AI called a world model. It builds virtual environments you can move through. Millions of hours of online video of people playing Minecraft went into training the world model behind Oasis.

And the result is quite weird. Oasis is like "a dream of what Minecraft is, or a memory of what it is," says Cook. "It isn't an actual game."

In real Minecraft, a map and rules govern everything around you. Not here. Whatever's on the screen now feeds into the AI world model. It predicts what you will see next based on what you're seeing now. You can walk around and mine blocks. But everything you see is a video that the AI model generates on the fly.

Later in 2024, Google DeepMind released a demo of Genie 2. This world model generates video of a 3-D environment that you can explore. And it can create any world you desire — not just one based on Minecraft.

These projects might pave the way for an unusual new type of game experience. You might soon be able to ask for any sort of game world you want. Capybaras in space, maybe? Or perhaps a city made of rainbows?

"That brief experience of the thing coming to life" would delight many people, says Smith. But then what? "They wouldn't know what to do with it after a little bit." Exploring just to see what you see might get old quickly.

GIANT ROBOT OR HELPFUL POKÉMON?

Cook sees other drawbacks to using generative AI to create all or parts of video games. He compares these models to "huge robot suits that you see in anime." These can be helpful — but only one person gets to drive. Plus, they're too big and complex to really understand, Cook says. With generative AI, typically only big companies get to make decisions about how the models work.

Something like Puck, on the other hand, is more like a Pokémon, Cook says. "Small, cute, friendly." It doesn't need to study huge numbers of examples to learn how to create something.

You can download Puck for free and run it on your personal computer. And you can build onto it or customize it however you want.

When the creative person is in control, AI is more likely to be beneficial, Cook says.

This looks like a video game, but it's really an AI-generated simulation of the battle game Bleeding Edge.

"Describing a game experience is very different than playing that game experience," says Matthew Guzdial. So with his tool Mechanic Maker, you move characters and objects to demonstrate how a game should work. An AI model then figures out what code to write to describe the rules of the game.

M. GUZDIAL/UNIVERSITY OF ALBERTA

Generative AI world models, such as Microsoft's Muse, use artificial neural networks to recognize patterns in data. They can then follow those patterns to create new playable game worlds. These worlds lack rules or maps, so the gameplay often feels odd and glitchy.

MICROSOFT RESEARCH/MUSE; MACMILLAN PUBLISHERS

Generative AI also could be put to use supporting creative people, says Katja Hofmann. She develops generative AI tools at Microsoft Research in Cambridge, England.

Her team interviewed game developers about what they'd want or need from a world model to support their creative process. The group used this feedback to develop a generative AI world model called Muse. It learned to simulate one video game, called Bleeding Edge. In that game, teams of fighters battle in a cyberpunk world.

Microsoft's Xbox Game Studios owns the company that made Bleeding Edge. Players had all accepted an agreement that gave permission for their online gameplay to be recorded. This amounted to 500,000 hours of gameplay data (or more than 50 years' worth of time!). It all went toward Muse's training.

Usually, testing a new idea for a game or a level requires a team of coders, artists, designers and others working together. With a world model, however, a single designer might be able to sketch out an idea and play through it.

For example, a game designer might sketch a level with some platforms leading upward toward a treasure chest. The designer could then feed this image to Muse so that it could generate what might happen as someone plays the level. If the generated player isn't finding the platforms, the designer could rethink their placement.

Obviously, if you set out to build a brand-new game, you won't have 500,000 hours of gameplay to train an AI. Hofmann says her team has simulated a single level of a game using just a few weeks' worth of data.

"I love video games," she says. World models, she thinks, could make telling stories through games "easier and more effective." But the process has to start and end with people who want to tell a story, Hofmann says. Otherwise: "What's the point?"

MIMICKING VS. CREATING

In the end, we all want new, fun games to play. The right AI tools could empower more people to create games. AI tools could also make possible new types of games. After all, "tools shape what we're capable of creating," points out Smith.

Guzdial would love to live in a world "where people make little playable experiences to try to explain something." For example, a teacher might make a game to help their students learn a new concept.

However, using generative AI or world models to spit out lots of automated game content "might lead to more boring stuff being made," cautions Cook. A person's creative work reflects their experience of living in the world. And today's generative AI can only mimic what people have already created.

Tessa Kaur, editor at *The Gamer* magazine, writes that AI-generated dialog doesn't produce compelling characters. AI "simply cannot be creative enough," she writes. When you care about game characters, it's "because someone took the time to craft that [dialog] for you, over many rewrites and with deep thought."

Smith agrees. When humans make a game, they share a part of themselves. Or they explore challenging themes and ideas. They could use the AI version of a giant robot suit or cute Pokémon to help achieve this. But on its own, a piece of AI-generated content has no self to share or ideas to explore.

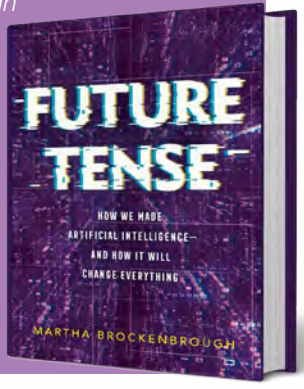
Long-lasting, fun game experiences, says Hofmann, come from "someone who wants to tell a story."

READ MORE

Future Tense:
How we made artificial intelligence — and how it will change everything

By Martha Brockenbrough

From video games to classrooms, artificial intelligence is used in so many parts of our world. So what's next? Learn more about the past and future of AI with this book.



This game designer shares neurodivergent experiences through gaming

Susannah Emery designs games that raise awareness about social issues

In Susannah Emery's video game, Life (Re)Sounding, players won't be fighting off alien invasions or monsters. Instead, gamers navigate everyday tasks from the perspective of someone who is neurodivergent. Neurodivergent people often learn or sense the world differently than others.

Life (Re)Sounding draws from her experiences as a neurodivergent person. With the game, Emery hopes to show how to better understand and accommodate the needs of neurodivergent individuals. "It's designed to show that it's the world itself that causes the challenges that we face, rather than ourselves," she says.

In one level, players must clean up trash scattered around a room. Every time the player tosses trash into a bin, the lights brighten — until it becomes too bright to see. "I experience a lot of light sensitivity," says Emery. "It [becomes] this horrible white, bright mess, which can happen to me if I'm somewhere for too long."

At Adelaide University in Australia, Emery designs games about social issues. These offer ways to interact with everyday experiences that are often misunderstood, she says. In this interview, she shares her experiences and advice with *Science News Explores*. (This interview has been edited for content and readability.) — *Aaron Tremper*

Q How did you get to where you are today?

A After earning my undergrad degree in multimedia, I moved to a remote community belonging to the Anangu people in the Northern Territory to teach. Many of the kids didn't want to come to school. They weren't engaging with the lessons but really loved video games. I thought about how to combine the two.

The Nintendo Wii console and Wii Sports game came to mind. I drove two and a half hours to buy them from a secondhand store. That Monday, I fired up the game and covered up the scoring. Instead, I had the students keep score on the whiteboard. After that, our attendance rate skyrocketed.

I was inspired by seeing how video games could make kids invested in their learning. I ended up doing an honors degree studying the connection between education and games. I co-designed a game with the community that combined First Nations knowledge and the Australian curriculum. I loved it so much that I enrolled in a Ph.D. program, looking at how games can raise awareness of domestic violence.

Q How is artificial intelligence (AI) impacting the work that you do?

A I think AI is really powerful and can do some really cool stuff. It shines in helping us bring our ideas to life. But to be engaging, games should be about human stories. We all have such cool stories that live inside us. These include our past experiences and future dreams. When AI becomes the creator, those games start missing those. AI can code like a boss. But it hasn't gone through the same things you have.

Q What would you recommend to those who are interested in the gaming industry?

A Get started making your own games. That could be making them on paper in a way similar to Dungeons and Dragons. Or you could use free game engines such as Scratch and Twine. Make games with your friends and play. Playing and practicing is what it's about.

DANIEL DOWN PHOTOGRAPHY; LIKE GLASS GAMES; S. EMERY

Susannah Emery designs games focused on social issues. In Life (Re)Sounding (insets left and center), players complete everyday tasks from the perspective of someone who is neurodivergent. She also mentors aspiring game designers and speaks at live events as a Women in Games Ambassador.

PHYSICS

Why are skis so long?

Let's strap mini skis to an action figure and find out!

By Science Buddies

While watching the Winter Olympics, you might wonder why skis are so long. This equipment is designed and tested carefully to give athletes as much of an edge as possible on the slopes. But why would big planks on your feet help you glide over snow? A mini skier helps explain.

OBJECTIVE *Find out why skis are so long*

EXPERIMENTAL PROCEDURE

1. Create a layer of "snow" by pouring flour about 2 centimeters (0.75 inch) deep onto a plate. Sweep the top with a piece of cardboard to create a flat surface.

2. Stand an action figure on the flour and pick it up. Did it make footprints?

3. Stand the action figure on the snow and press down. How easy is it to sink the action figure into the flour?

4. Stand the action figure on the snow and try to knock it over to the side, front or back. How easy is it?

5. Create mini skis by cutting two rectangles out of cardboard. Each one should be a little shorter than the action figure's height and double the width of its feet.

6. Glue the skis to the action figure's feet and smooth the flour's surface.

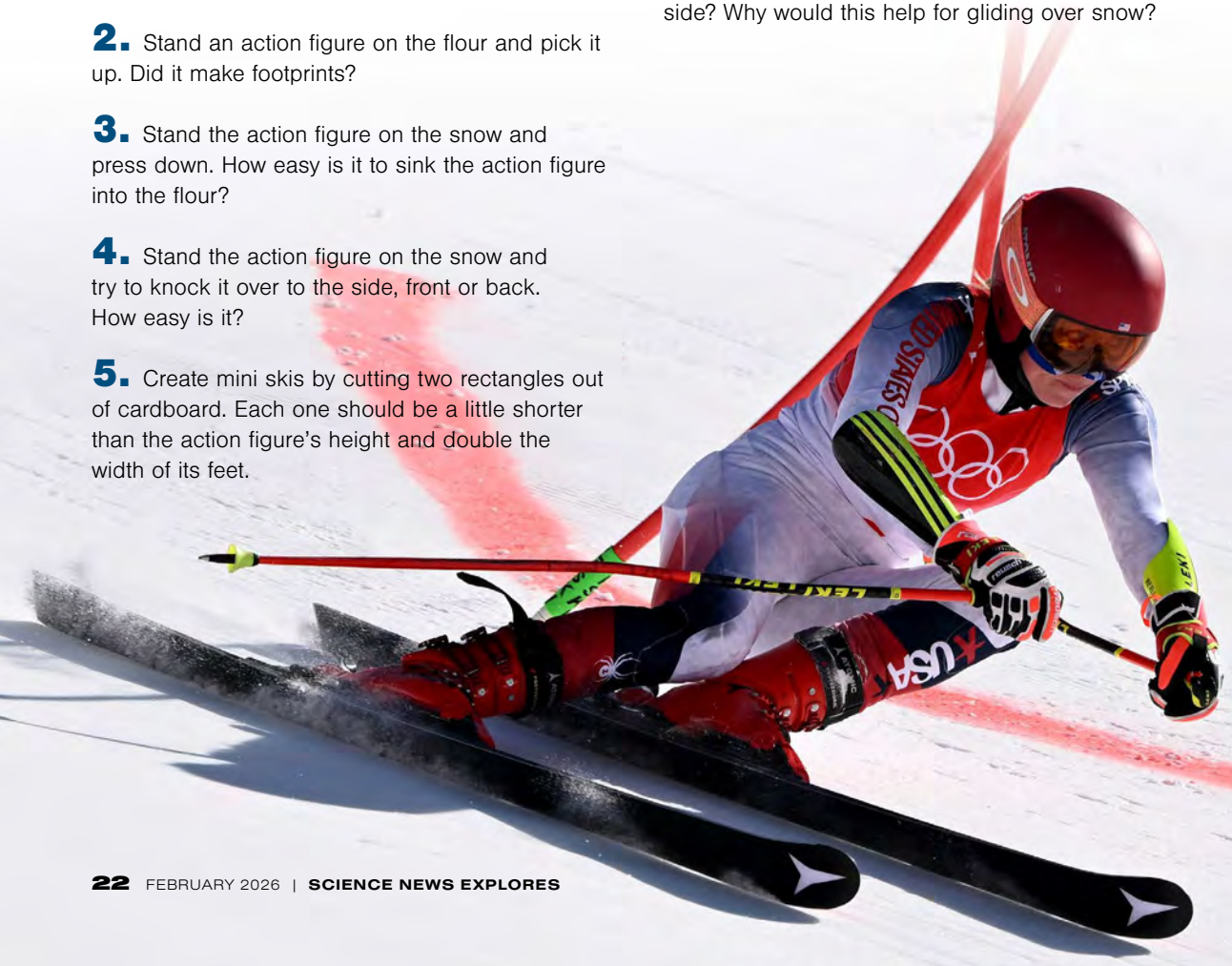
7. Stand the action figure on the snow and pick it up. Are its footprints shallower or deeper than before?

8. Stand the action figure on the snow and press down. Is it easier or harder than before to sink it into the flour? Why would that be helpful for sliding over snow?

9. Try knocking over the action figure. Is knocking it to the front or back as easy as to the side? Why would this help for gliding over snow?

Find the full activity, including how to analyze your data, at snexplores.org/skis. This activity is brought to you in partnership with Science Buddies.

SCIENCE BUDDIES



Team USA's Mikaela Shiffrin competes in a skiing event at the 2022 Winter Olympic Games in Beijing.

FABRICE COFFRINI/CONTRIBUTOR/GETTY IMAGES

Ants' Amazing Teamwork

Written by Maria Temming
Illustrated by JoAnna Wendel

If you've ever seen ants build a nest or form a neat line to carry crumbs home, you know these insects are good team players.

This is Ofer Feinerman. He studies social insects at the Weizmann Institute of Science in Rehovot, Israel. He wondered: Are ants as good as humans at working as a team?

To test ant vs. human teamwork, his team set both species the same challenge: get an awkwardly shaped object through a cramped maze.

Ants working solo or in small groups struggled to solve the maze.

Groups with dozens of ants solved the maze much more efficiently. When these groups hit a wall, they had enough momentum to slide along it until they found an opening, or back away if they found a dead end.

Single people solved a human-sized version of the same maze much faster than lone ants. But human groups only did slightly better than individuals.

And when humans were told not to speak or gesture to each other, they really ran into trouble. Sometimes, they did even worse than ant teams!

Luckily, the human maze solvers weren't sore losers. A lot of people were impressed that ant teams did so well in the two-species tournament.

HEALTH

New antivenom could protect you from 13 types of snakes

It uses antibodies from the blood of a man bitten 202 times

CENTIVAX

Tim Friede remembers his worst snakebites in screaming detail. The first was from an Egyptian cobra. The second, an hour later, came from a monocled cobra. Both snakes were highly venomous. Each bite occurred at Friede's home in Wisconsin. And neither was an accident.

"Was it stupid? Yes," he says. But, he adds, he had been in it for the science.

Friede let the cobras bite him on purpose. To date, he's logged 202 snakebites. "It always burns," he says. "And it's always, always painful." He had to be airlifted to a hospital after those first back-to-back cobra bites, nearly 20 years ago. He would go on to spend four days in a coma.

Friede has been "self-immunizing" himself against some of the world's deadliest snakes. The process involves milking venom from snakes. Then he'd inject tiny doses into his body, followed by increasingly larger ones.

Think *The Princess Bride*, says Jacob Glanville. In that movie, Westley built up immunity to the poisonous (and fictional) iocaine powder by gradually exposing himself to it over time. That's essentially what Friede did, says Glanville. He's the president and CEO of the biotech company Centivax.

Friede slowly and carefully injected ever-bigger amounts of venom into his body over months and years. His body eventually built up immunity to more than a dozen venomous snakes. These include cobras, mambas and rattlesnakes.

> "It always burns. And it's always, always painful."
>
> — TIM FRIEDE, SPEAKING OF SNAKEBITES

Afterward, he'd let snakes bite him. Without that slow preparation, bites by "most of those snakes would have killed him," Glanville says.

Instead, Friede survived.

SORT OF LIKE A PAINFUL VACCINE

More than 600 species of venomous snakes slither across the planet. Creating an antivenom for each one takes time and money. Glanville wanted to create an antivenom that could target toxins from many types of venomous snakes at once. He thought Friede — who'd been bitten so many times and by so many snakes — could help.

All of Friede's injections left his bloodstream with what may be a one-of-a-kind mix of snake venom antibodies. These are proteins that help our bodies recognize and fight off threats. Such threats include disease-causing microbes — and toxins found in venoms. Friede's antibody mix, made into an antivenom, might be helpful for accidental snakebite victims.

Don't try this at home! Tim Friede once had to be airlifted to a hospital after two back-to-back snakebites.

Antivenoms can stop the effects of snakebite toxins. Glanville and his team used antibodies from Friede's blood to make a new antivenom. The antivenom cocktail they developed from it can now quash the effects of several venoms.

The team made it from a combo of two of Friede's antibodies plus a toxin-blocking drug (varespladib). This mix completely protected mice from lethal doses of venom from 13 species of snakes. It partially protected mice from the venoms of six more. The researchers shared their findings in *Cell*.

So far "this is perhaps the best combination published," says Andreas H. Laustsen-Kiel. He's a biotechnologist at Technical University of Denmark in Kongens Lyngby. He didn't take part in the new antivenom work. But, he notes, "It's an experimental antivenom." It still needs to be tested for safety and how well it works in people.

Across venomous snakes, there are about 10 toxin families that pose key targets for antivenoms, says study coauthor Peter Kwong. He studies the structures of proteins from viruses and other toxin sources at Columbia University in New York City. The newly developed snake-antivenom cocktail targets three toxin families. That's enough to move on to the next phase of testing.

The researchers are now looking to work with veterinary groups in Australia to potentially treat dogs bitten by snakes.

And, Glanville adds, they can always look for more antivenom ingredients in the billions of antibodies they found in Friede's blood.

Friede retired from snakebites and venom injections in 2018 (after 202 snakebites and 654 immunizations). Today, he's in his late 50s and healthy. He has had regular liver and kidney checkups. Those ensure that his history of venom exposures hasn't damaged these organs.

"Tim did something remarkable, and we think it could change medicine," Glanville says. But, he emphasizes, no one should be injecting themselves with snake venom. "We are actively discouraging anybody from trying it," he says. "No one ever needs to do it again."

— *Meghan Rosen*

Tim Friede (opposite) injected himself with doses of snake venom over and over. It built up immunity in his blood to bites from venomous snake species, such as this water cobra.

T. FRIEDE

PHYSICS

Real levitation doesn't need superpowers

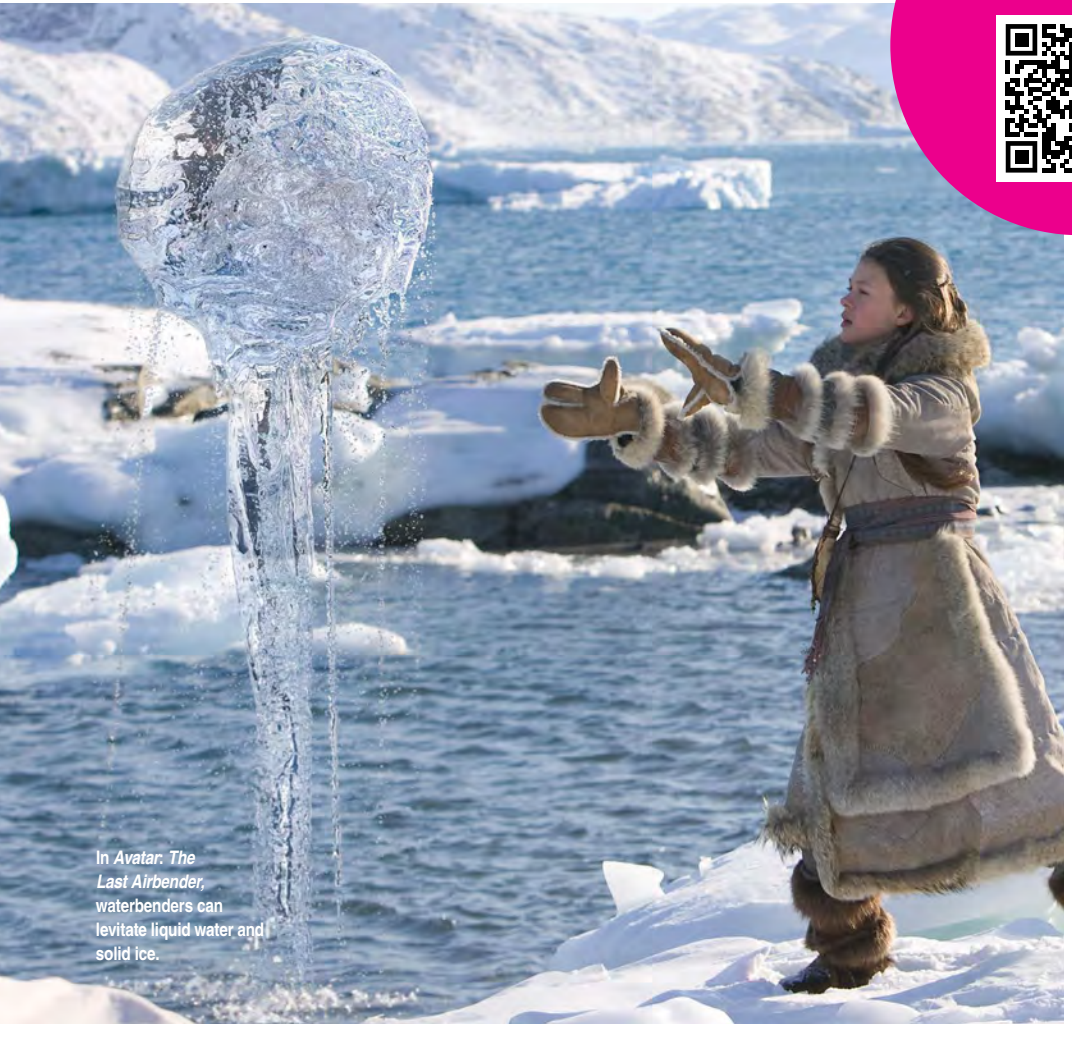
You can defy gravity using sound waves, magnetism or even electricity

With a swish-and-flick of his wand, Ron Weasley yanks a troll's club high above its head in *Harry Potter and the Sorcerer's Stone*. Through martial arts moves, element benders in TV's *Avatar* series launch boulders and waves of water skyward. And a casual gesture is all Marvel's Scarlet Witch needs to fling away enemies.

Fictional heroes require magic (or super) powers to lift objects without touching them. In the real world, though, you need physics. Sound, magnets and electricity can all create upward forces strong enough to cancel out gravity.

Suspending objects in midair could transform lab experiments, transportation and more. Just don't expect real levitation techniques to toss boulders or bad guys without some outrageous — and dangerous — upgrades.

SEE VIDEOS HERE!



In *Avatar: The Last Airbender*, waterbenders can levitate liquid water and solid ice.

ENTERTAINMENT PICTURES/ALAMY

LET'S GET LOUD

Have you ever felt loud music thumping in your chest at a concert? Then you know how strong sound waves can be. Acoustic levitation devices use those vibrations to hold objects aloft.

"You can think of it as a very complicated surround-sound system," says Luke Cox. An acoustic levitator may contain hundreds of little speakers. Those speakers typically blare noise at a frequency of 40 kilohertz. Humans can't hear these sounds. But when measured in sound-pressure levels, it's louder than a jet engine, notes Cox. A mechanical engineer, he leads the company Impulsonics in Bristol, England.

These sound waves create alternating spots in the air of high- and low-intensity noise. This force pushes objects away from the loud areas. That means items placed in quiet areas will stay there, as if tucked into invisible pockets. Fine-tuning the noise blasted by each speaker can steer those pockets around to move an object.

Acoustic levitation can lift all types of solids or liquids. But it can only support very small, lightweight materials. Among the heaviest are Styrofoam puffs (like those inside beanbag chairs).

Taller and wider objects need longer, lower-frequency sound. Cox estimates that lifting a person would take at least 275-hertz waves, which are 1.25 meters (some 4 feet) long. Bass guitars play notes about that low. But the music from a levitator would also have to be devastatingly loud to lift someone.

Running the device would probably require several power plants or a large nuclear reactor, Cox muses. You'd also need to shield anyone you levitated from the heat generated by that amount of power. Otherwise, your nuclear-powered bass solo might literally melt their face off.

MIGHTY MAGNETS

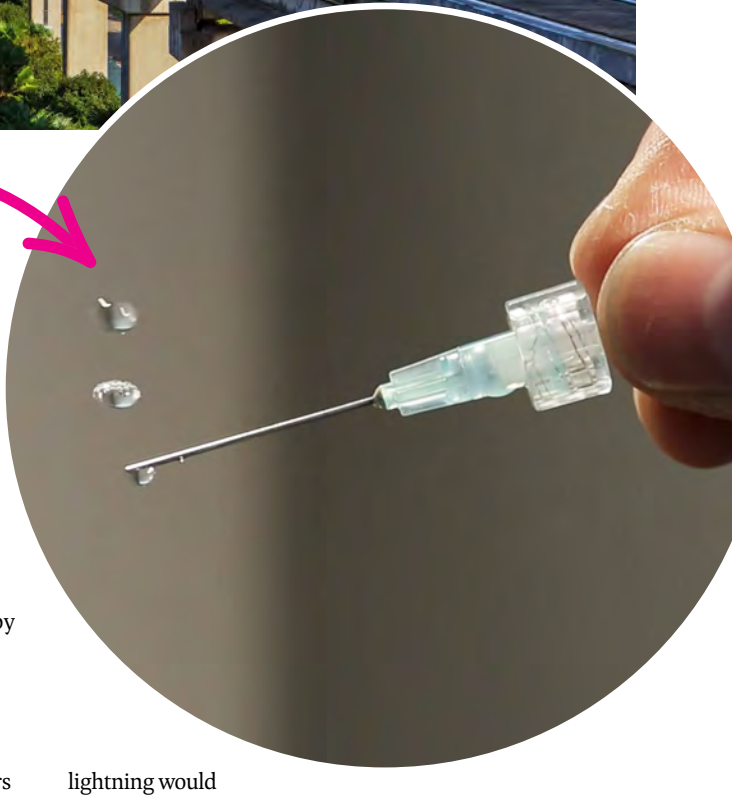
Magnets, meanwhile, already safely lift objects much bigger than people off the ground.

Consider a maglev train. Magnets on cars and tracks interact to create an upward force. It lets the train hover about 10 centimeters (4 inches) above the track. This allows the train to glide nearly friction-free and travel twice as fast as trains that roll on rails.

Magnetic levitation isn't limited to magnetic metals, notes Eric Severson. He's a mechanical engineer at the University of Minnesota in Minneapolis. Diamagnetic materials such as graphite, gold and even water can also accomplish this feat. Around a strong magnet, these materials can become weakly magnetized and start to repel the magnet. This repulsive force can overcome gravity.

"You could theoretically make a person float," Severson says. But you'd need a huge magnet. In 1997, two scientists used a much smaller magnet to levitate a frog nearly 18 centimeters (7 inches) in the air. Made from two coiled wires, the resulting magnetic field was 16 teslas. That's about 10 times as strong as the magnets used to lift cars in junkyards.

One of the researchers estimated that you'd need a 40-tesla field to lift a person. That magnet would need 1 gigawatt of power, or roughly half the power produced by the Hoover Dam.



Acoustic levitation can lift all kinds of materials, solid or liquid.

SKY'S THE LIMIT

Ballooning spiders already have levitation figured out. These critters once perplexed Charles Darwin by alighting on his ship some 100 kilometers (60 miles) offshore.

When spinning out a long thread of silk, ballooning spiders charge themselves up electrically, explains Igor Bargatin. This happens thanks to triboelectricity. "They lift off in the Earth's electric field," Bargatin says. "After that, they're just carried by the wind." Bargatin is a physicist and engineer at the University of Pennsylvania in Philadelphia.

Though possible for lightweight spiders, such levitation won't work for large objects, he says. Imagine trying to float a human. The charge needed would be large enough to create lightning around you, Bargatin says. Not only would it be dangerous, this lightning would also keep you from building up enough charge to take off.

Real-world levitation likely won't ever measure up to fictional superpowers. Still, it needn't be flashy to be useful.

Acoustic levitation could assemble tiny electronic components or lab samples without touching them. That would cut the risk of contaminating them.

Severson uses magnetic levitation to lift motor parts, allowing them to spin faster without wearing down. And scientists are dreaming up new uses for levitation, too — ones that play to different techniques' natural strengths and won't risk frying anything during takeoff.

— *Maria Temming*

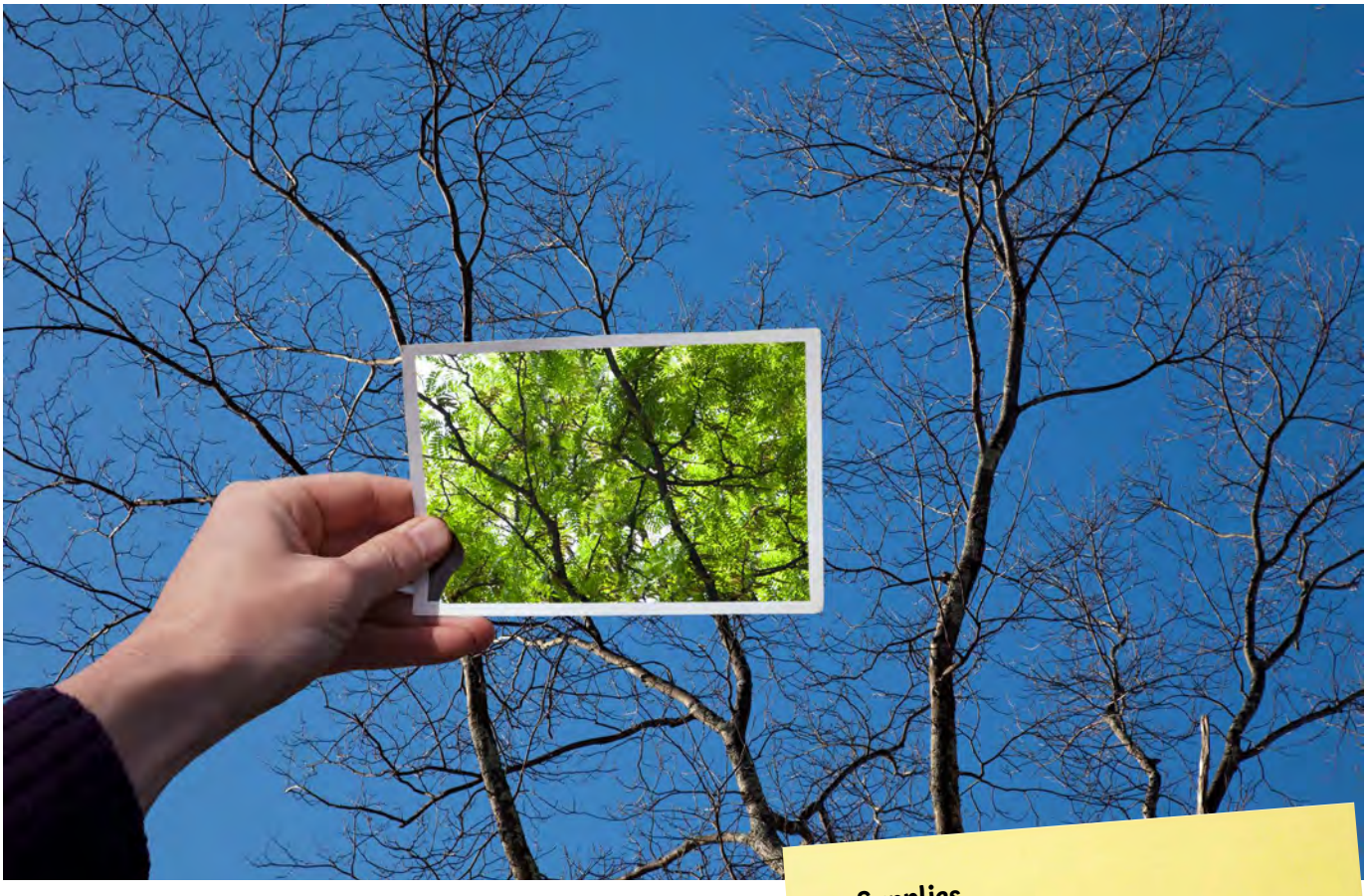
By hovering above their tracks, magnetic levitation (or maglev) trains (top) can travel about twice as fast as trains that roll on rails.

CYO BO/SHUTTERSTOCK; *OCTOBER 19, 2012: ACOUSTIC LEVITATION FOR MEDICINE* BY U.S. DEPARTMENT OF ENERGY, UNITED STATES GOVERNMENT WORK

PLANTS

How to identify trees in winter

No leaves? Pay attention to buds, bark and branches



If you live where it gets cold in winter, the trees around you may look a little bare at this time of year. Many trees shed their leaves to save energy during the chilly season. This can leave trees looking dreary — and largely the same as each other. Still, it's possible to ID many trees even when their branches are empty. It just requires taking a closer look at other parts of the plant.

Tree identification is difficult but can be learned with practice. And it's arguably more important than ever.

Plant and tree identification help scientists manage forests and protect these ecosystems from climate change. And you don't need to be a scientist to benefit from tree-ID skills. Learning to pick out different species can help you appreciate the diversity of life right in your own backyard, neighborhood or nearby woods.

"I am still constantly amazed and curious about what's out there," says Steven Roberge. He's a forest ecologist at the University of New Hampshire Extension in Durham. "I've been a forester for almost 25 years now, and there's not a day in the woods where I don't see or experience something new."

— *Sophie Hartley*

Supplies

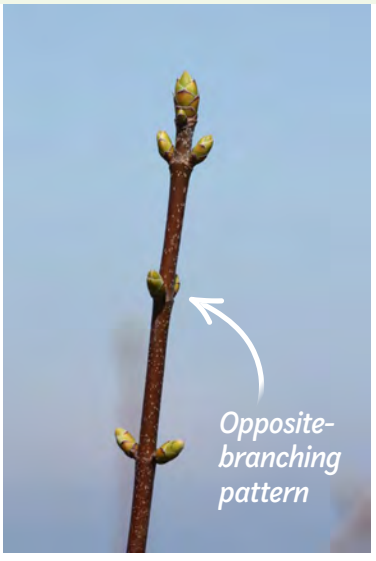
- A field guide to tree identification in your area (check your library!)
- Plant-identification apps, such as Seek
- Street tree map (available online in some cities)
- Magnifying glasses to help you zoom in on buds and bark to spy details

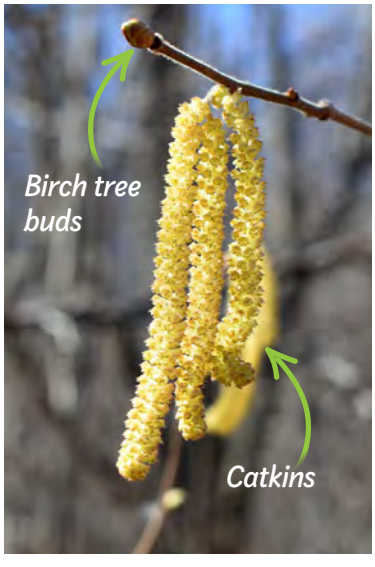
THOMAS JACKSON/STONE/GETTY IMAGES

Branches

Trees usually grow new arms in two distinct patterns. You can sometimes see this by looking at how smaller twigs (the newest growth) break off from larger branches (older arms that grow out of the trunk). Many tree species alternate growing new twigs on each side of the older arm. Others grow new twigs in pairs, on opposite sides of the original branch.

If you find an opposite-branching pattern, you're in luck. You can now rule out most tree species. Opposite branching often means it's a maple, ash or dogwood (the acronym MAD can you help remember this trio). These trees can be found in many places across North America. Many other common trees in the United States — such as oaks, birch and locusts — sprout branches in an alternating pattern.





Buds

Buds are tiny, scaly nubs. Baby leaves spend the winter inside them. Come spring, new twigs can grow from buds, too. Buds vary in shape, size, color, texture and more.

If the tip of a twig bears four or more stubby buds, for example, it might be some type of oak. On birches, meanwhile, the buds are usually accompanied by catkins — dangling clusters of tiny flowers that are soft to the touch. Hawthorn trees guard their buds notoriously well. Spiky thorns grow up and down their branches, in between the buds. And ash trees often grow tiny brown buds the same shape and color — though not the same taste — as candy: Hershey's Kisses.

If you can't see the budded tips of any twigs high in a tree, try looking down. Twigs with buds often get snapped off by squirrels, beetles and the wind. One might be waiting for an ID right at your feet.

Bark

Bark is like a tree's armor. It keeps the plant warm, hydrated and protected from pests. "When I look at a tree, I look at the bark," says Roberge. "I'm looking at the color. I'm looking at the texture and how it feels. Is the bark flaky? Is it papery? Does it curl?"

While many North American trees have gray trunks, there are a handful of species that stick out in the crowd. Beech trees, for instance, are wrapped in smooth and silvery bark. Paper birch trees have white bark that peels and curls, almost like paper. London plane trees, popular on city sidewalks, have trunks with bark that seems to be falling off to reveal soft, light-colored wood beneath. And if you spot a tree that looks like it has thousands of burnt potato chips glued to its trunk, you might be fortunate enough to have found a black cherry.

TOP IMAGES: LEFT: PASCAL DELOCHE/GODONG/STONE/GETTY IMAGES; RIGHT: LEONID EREMEYCHUK/500PX/500PX PLUS/GETTY IMAGES; ASH TREE BUDS: WHITEWAY/ISTOCK/GETTY IMAGES PLUS; BIRCH TREE BUDS: IRINA KHABAROVA/ISTOCK/GETTY IMAGES PLUS; BLACK CHERRY TREE: CHHE/WIKIMEDIA COMMONS/PUBLIC DOMAIN; PAPER BIRCH TREE: DANITA DELIMONT/GALLO IMAGES ROOTS RF COLLECTION/GETTY IMAGES

SPACE

What are the chances of an asteroid hitting Earth?

The odds of a big space rock striking the planet are higher than you might think

The odds of an asteroid striking Earth during a person's lifetime are greater than those of getting struck by lightning.

Our solar system is peppered with large rocks, called asteroids. If a big asteroid plummets to Earth, there are many possible outcomes. The space rock could splash into the ocean and not harm anyone, for instance. Or it could wipe out a city. People have a hard time understanding the chances of an asteroid strike. So scientists have calculated the likelihood and compared it with other events — with some surprising results.

"If a large or a medium asteroid were to hit the Earth, it would be something that almost everybody on the planet would be aware of," says Carrie Nugent. She's a planetary scientist at Olin College of Engineering in Needham, Mass. While killer asteroids have hit before, such as the one that finished off the dinosaurs 66 million years ago, Nugent says not to worry. "We try to put this event, which is actually a preventable event, in context with other preventable events."

Nugent worked with six undergraduate students from Aalborg University in Denmark. Using a computer program, they simulated a group of asteroids similar to real near-Earth objects. They fed these modeled asteroids into a program called JPL Horizons. Anyone can use that program to look up predicted locations for objects in the solar system. For this project, the students determined whether

ROMOLO TAVANI/SHUTTERSTOCK

each simulated asteroid would cross paths with Earth.

That allowed the team to estimate the frequency of asteroids bigger than 140 meters (460 feet) across. That's around the size of a small cruise ship, Nugent says. An asteroid of this size would hit Earth roughly every 11,000 years. The researchers shared their findings in the *Planetary Science Journal*.

That number is still pretty hard to understand. So Nugent compared the chances of an asteroid hitting Earth with other events that people may experience. The chances of being alive during an asteroid strike, she found, are higher than that of being struck by lightning. But a person is more likely to expire in a car crash.

— Carolyn Wilke

DATA DIVE

1. Which of the listed events is the most likely to happen during a person's lifetime? What is the chance of it occurring?

2. Which of the listed events is the least likely to happen during a person's lifetime?

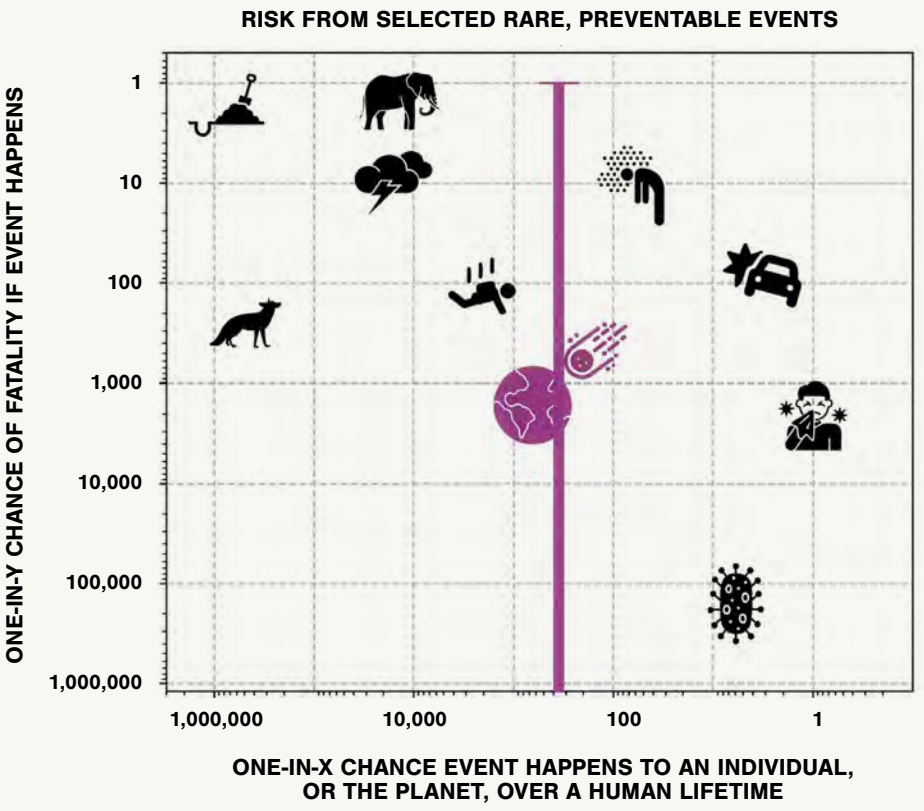
3. What is the chance of an asteroid hitting Earth during a human's lifetime?

4. If a person were to contract rabies, what's the likelihood that they die from it? What about influenza?

5. Why do you think that the bar showing the chance of fatality from an asteroid is so large?

C.R. NUGENT *ET AL/THE PLANETARY SCIENCE JOURNAL* 2025

COMPARING RISKS



Nugent's team calculated the chances of near-Earth object (NEO), such as an asteroid, hitting Earth in a person's lifetime. They compared this with the likelihood of other preventable events. The chance of an asteroid hitting the Earth is shown by the purple marker. The chance of such an asteroid killing a person is shown by the vertical purple bar.

The graph is presented on a logarithmic scale. That means each grid line differs by a factor of 10 from the one next to it. The x-axis gives the one-in-X chance that an event happens to an individual or the planet. For instance, the chance of being hit by lightning is 1-in-11,000. The y-axis gives the one-in-Y chance that a person dies if the event happens. So someone hit by lightning has a 1-in-10 chance of dying.

Unlike most graphs, the label numbers on the x-axis get smaller moving to the right. And on the y-axis, they get smaller going up. This is because a one-in-X number is like a fraction with "1" on top and the "X" number on the bottom. The bigger the label number on these axes, the smaller the likelihood of that event happening.

ANSWER

Knotted strands of 500-year-old hair tell a surprising story

Inca commoners, not just the elite, may have used them to keep records

Hundreds of years ago, the Inca used complicated knotted strings — called *khipus* — for record-keeping. A new analysis suggests a surprise: These were not only used by the ruling elite.

The Inca once ruled a large empire along the Andes in South America. They had no system of writing. Instead, they used khipus to keep records. People might record astronomical events, for instance, or population size.

One intricate khipu, found at a German auction, caught Sabine Hyland's attention. It was "beautifully made, with fine braiding and variation in cord size," she says. "It must be royal," she recalls thinking. An anthropologist, Hyland works at the University of St. Andrews in Scotland. She is also part of a team that analyzed the khipu. But its owner was likely a commoner, the researchers reported in *Science Advances*.

The khipu's main cord was made of human hair folded in half and twisted. Radiocarbon dating tests showed it dated back to 1498.

The researchers measured elements in the hair to learn what types of food the person had eaten. The hair's owner seemed to have eaten mostly greens and other vegetables, such as potatoes. They ate no fish and little meat or corn. It points to what a commoner would eat, Hyland says. That "was a complete shock."

— *Javier Barbuzano*

A single strand of hair in the top cord was 104 centimeters (41 inches) long. It would have taken more than eight years to grow!

In Incan tradition, hair is believed to carry the signature of a person. "It must have been something pretty special for the person to sacrifice their hair," says Sabine Hyland (inset). She suspects that the knots were used for recording ritual offerings.

S. HYLAND; GABRIEL BUTI

INSIDE THE MIND OF A YOUNG SCIENTIST

A Thermo Fisher Scientific Junior Innovators Challenge finalist answers three questions about her science

Science competitions can be fun and rewarding. But what goes on in the mind of one of these young scientists? **Zeynep Demirbas**, a finalist at the 2025 Thermo Fisher Scientific Junior Innovators Challenge, shares her experience.

Q What are the main takeaways from your project?
A Zeynep researched whether artificial intelligence, such as ChatGPT, should be used for mental health treatment. Her data led her to conclude that this type of AI, known as a large language model — or LLM — should not replace human therapists. "We should be mindful with AI, because it doesn't really have an acceptable grade in mental health," Zeynep says. "That doesn't mean that LLMs are bad, because they're for general use. They're not necessarily meant for mental health."

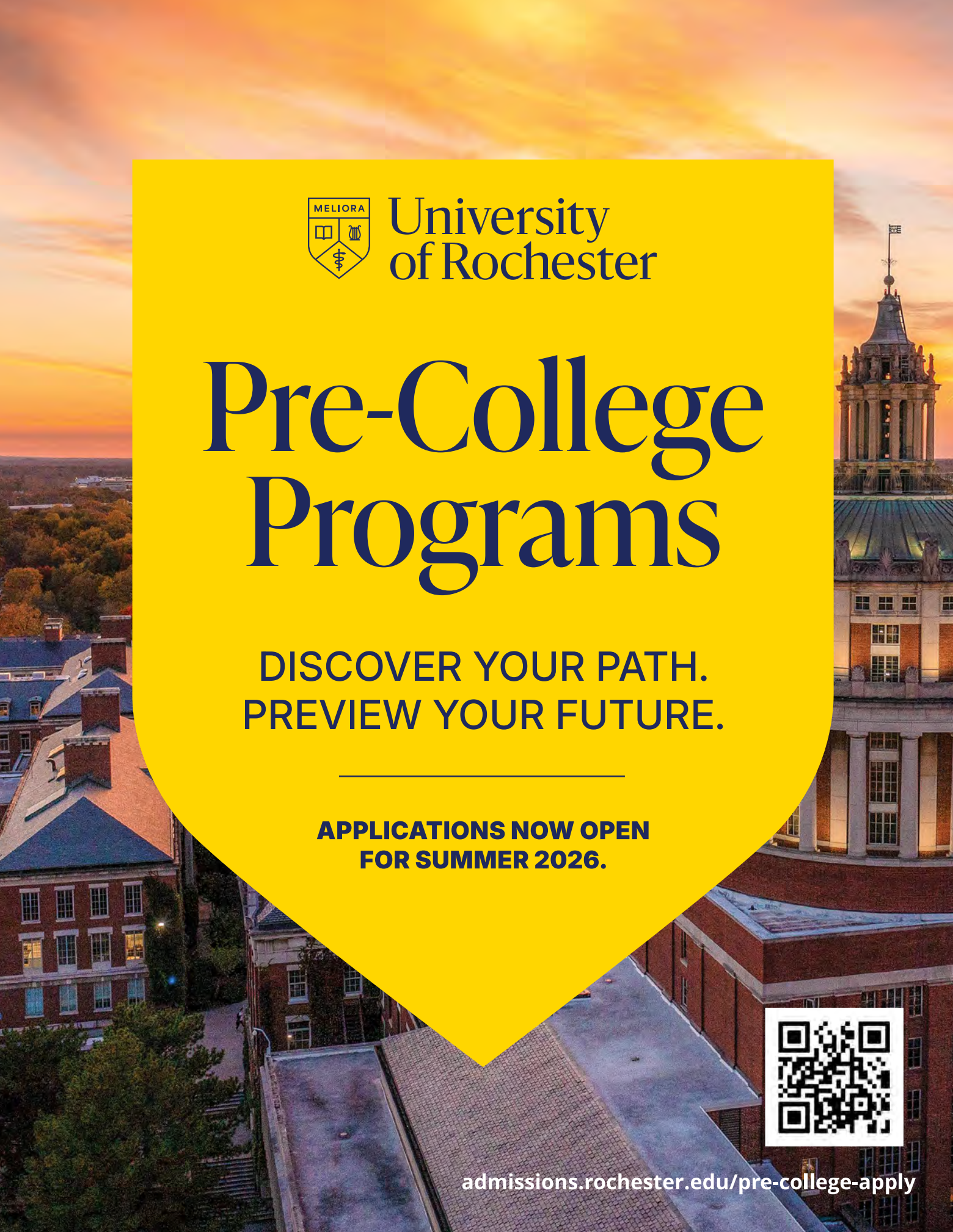
Q What was your reaction to seeing the results?
A ChatGPT performing badly was "really surprising," Zeynep says. It did even worse than the "random-forest" model, a model that makes predictions by using a collection of decision trees, sort of like a super-complex flow chart. Random-forest is "supposed to be a very simple and old technique," Zeynep says. "That was very interesting — how something so small and simple was able to beat an LLM [like ChatGPT] that used millions of parameters and had so much coding go into it."

Q How could you take this project further?
A Since LLMs are trained on texts written by people, they can pick up human biases, Zeynep says. She's curious whether LLMs would show biases similar to those of human doctors. "One way I feel I could expand it is seeing whether LLMs carry biases toward different genders," Zeynep says. "How would it respond [differently] if it was girls or guys?"

2025 Thermo Fisher Scientific Junior Innovators Challenge finalist

Zeynep Demirbas

An aspiring computer scientist, Zeynep, 14, compared how well several LLMs could detect human stress. Her findings suggest free chatbots aren't suitable substitutes for human therapists. Zeynep did this project as an eighth grader at Transit Middle School in East Amherst, N.Y.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