ScienceNews
Explores
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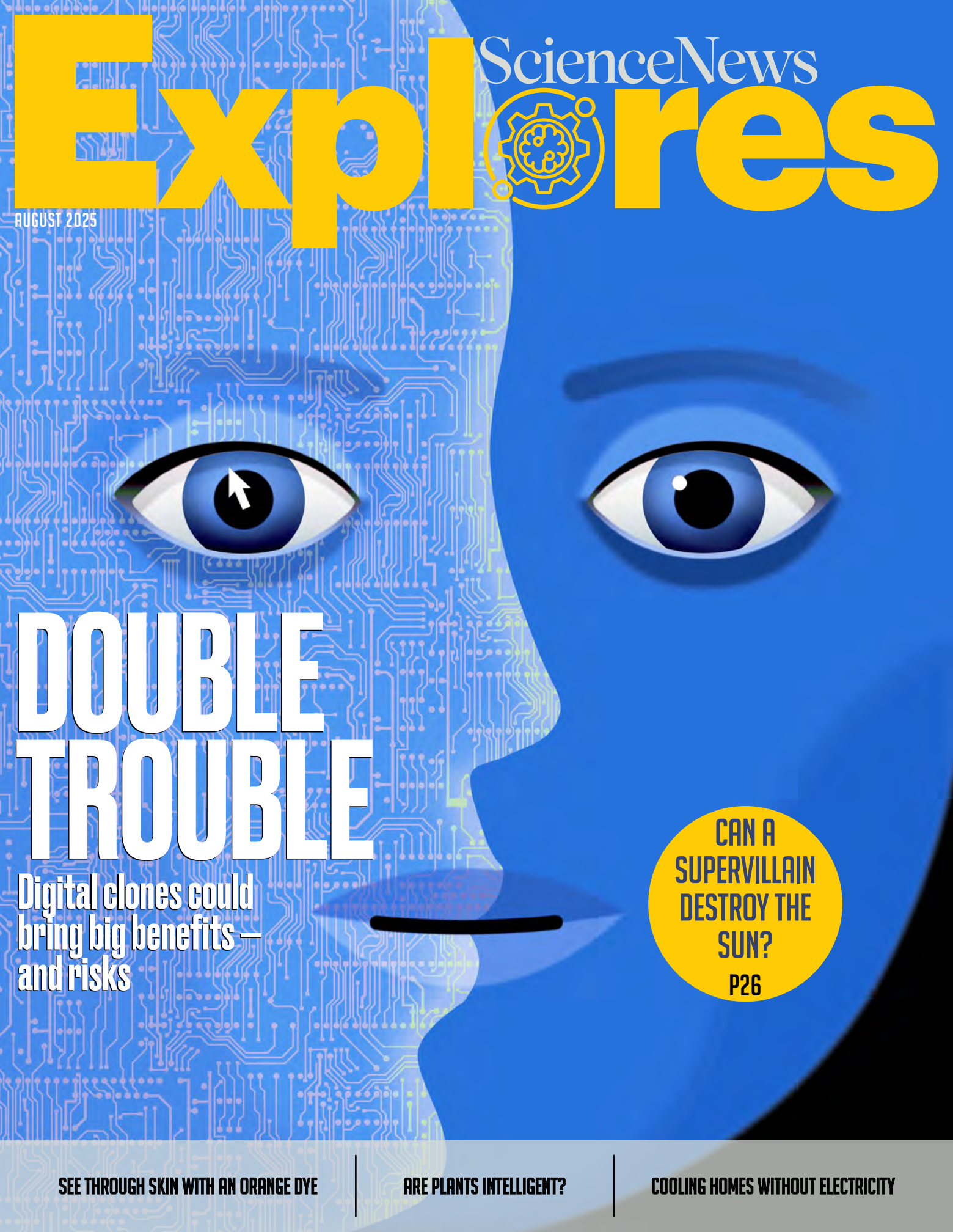

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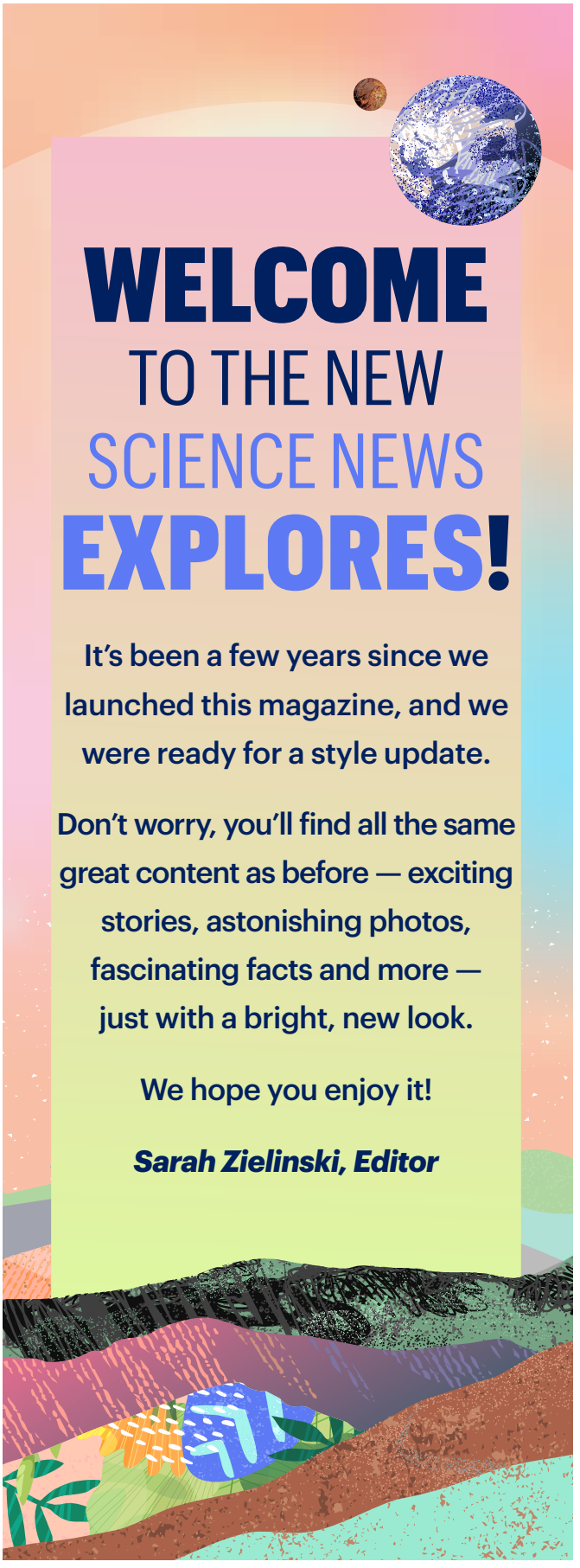

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It's been a few years since we launched this magazine, and we were ready for a style update.

Don't worry, you'll find all the same great content as before — exciting stories, astonishing photos, fascinating facts and more — just with a bright, new look.

We hope you enjoy it!

Sarah Zielinski, Editor

Science News Explores
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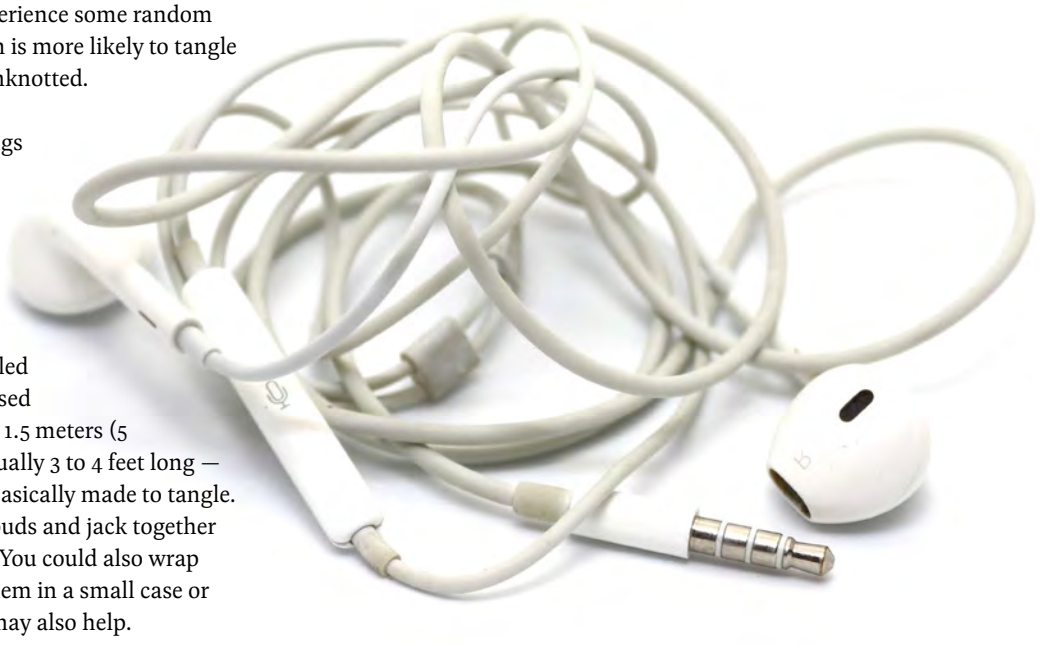
Q Why do headphones tangle by themselves?

— Gayle K.

A When you drop your headphones into your bag, they're likely to experience some random motion. Random motion is more likely to tangle cords than keep them unknotted. That's because of the second law of thermodynamics, which states that things tend to become more disordered. In fact, research has shown that complex knots can form in string jostled around for just seconds. In 2007, physicists at the University of California, San Diego studied how knots randomly formed in strings tumbled in boxes. Knottiness in the string increased sharply from 46 centimeters (1.5 feet) to 1.5 meters (5 feet) in length. Headphone cords are usually 3 to 4 feet long — right in that snarly sweet spot. They're basically made to tangle. To keep them neat, try binding the ear buds and jack together with a twist-tie before coiling them up. You could also wrap them around something else. Storing them in a small case or pouch where they can't move as much may also help.



TANAWAT MANGSANG/SHUTTERSTOCK

Q What is the lava inside of a volcano made of?

— Y.A.

A Magma is molten rock that's still underground. Below the crust, super-hot temperatures — between 700° and 1,300° Celsius (about 1,300° and 2,400° Fahrenheit) — melt rock. Most rock contains a lot of silica, a compound made of silicon and oxygen. When it melts, rock that contains less silica produces magma that is thin and fast flowing. More silica makes magma thicker and more likely to trap gas bubbles that can make eruptions more explosive. Magma is lighter than the surrounding solid rock, so it rises toward the Earth's surface and collects in chambers. Many volcanoes, or openings in Earth's crust, sit above these magma chambers. When magma breaks Earth's surface, it becomes known as lava. Depending on its silica content, lava might be runny like syrup or thick like sludge, barely moving at all.

Q What is the hardest substance in the universe?

— Calvin H.

A "There's a lot of different ways of defining what a 'hard' material is," says Benjamin Lehmann. He's a physicist at the Massachusetts Institute of Technology in Cambridge. The standard measure of hardness in the lab is how easily something gets scratched or dented. "On that scale, the answer is basically diamond," Lehmann says. But hardness could also refer to how easily a material gets squished or stretched. One way to quantify that is to determine an object's shear modulus. Scientists can observe this even for objects out in space. On that scale, the crusts of neutron stars are some 20 million billion times as rigid as diamond. But, in theory, "you could argue that black holes are actually the hardest thing in the universe," Lehmann says. Scientists haven't measured this directly. However, "you can't leave a mark on a black hole," he notes. "There's no such thing as a black hole that has a chunk taken out of it."

Do you have a science question you want answered?
Reach out to us on Instagram (@SN.explores), or email us at explores@sciencenews.org.

ANIMALS

Narwhals might use their long tusks to play

Scientists spotted the Arctic whales poking and prodding a fish they don't normally eat

Narwhals wield their iconic tusks in surprising ways — possibly even to play with living "toys."

Few scientists have seen these so-called unicorns of the sea brandishing their tusks in the wild. Past aerial video has shown the Arctic whales swinging their "horns" to tap fish prior to eating them. Now they've been seen gingerly prodding and flipping a fish. These gentler movements may have been part of a play session, researchers report.

This is the first report of narwhals (*Monodon monoceros*) apparently sporting around for fun, says Greg O'Corry-Crowe at Florida Atlantic University in Fort Pierce. A behavioral ecologist and geneticist, he headed the research team. His group shared its findings in *Frontiers in Marine Science*.

A narwhal's tusk is actually an elongated, spiraled tooth. Tusks can be up to 3 meters (10 feet) long!

A narwhal's tusk is an elongated, spiraled tooth. It protrudes from the top lip of males (and some females). Males can grow to about 5 meters (16 feet) long, with their tusks spanning another half their body length.

Biologists suspect those tusks evolved so that males could show off or compete for mates. But past research has found they can offer other benefits, too. For instance, the tusks may sense changes in water temperature and salinity.

Technologies involving genetics, satellite tagging, aerial counts and mapping have offered insights on these elusive whales. Still, they provided only snapshots of what these unusual animals do, says O'Corry-Crowe.

So he decided to try what he calls an "old-style natural history and behavioral observation." But not totally old-style. His team enlisted a remotely operated flying drone. Then they spent hours in the summer of 2022 filming narwhals as they swam in an island bay in the Canadian High Arctic.

One recording captured three narwhals chasing several Arctic char (*Salvelinus alpinus*), a type of fish. The whales sometimes swung their tusks like baseball bats to thwack fish — stunning them — before chowing down on them.

Another recording showed three narwhals following a large char, with one whale taking the lead. It lightly nudged and flipped the fish with the tip or side of its tusk. In this way, it altered the fish's path. There's little evidence that narwhals normally eat char. Indeed, winter is their big dining season. So this video seems to show the whale and fish investigating one another.

O'CORRY-CROWE - WATT/FAU – DFO; ADI92/SHUTTERSTOCK

"There's this tentativeness," O'Corry-Crowe explains. Then, he notes, the char "makes a dramatic movement." Afterward, the whale "just recoils and goes *whoa*!"

Moreover, he adds, that repeated tusk action — and the fact the whales didn't try to eat this fish — suggest the narwhals were just playing.

Because of the Arctic's harsh environment, people often think creatures there are constantly fighting to survive, O'Corry-Crowe says. But his team's new study hints that sometimes these animals have time to explore and possibly play — at least during their summer "vacation."

— MCKENZIE PRILLAMAN

EARTH

AT LEAST 3.6 billion years old

That's the age of the oldest-known rock in the United States, the Watersmeet Gneiss from Michigan. Such rocks help scientists figure out Earth's history.

Source: C.D. Frost *et al*/*GSA Today* 2025

PAUL BRANDES; PAIKONG/SHUTTERSTOCK

HEALTH

Scratching an itch is so good — and so bad

In mice, scratching led to more redness and swelling but fewer harmful germs

Is scratching good or bad? "It's both!" says Daniel Kaplan.

Don't scratch that mosquito bite! You may have heard this advice before — and found it hard to follow. Scratching can feel good at the time. In the long run, though, it can have both good and bad effects, shows a new study in mice that had itchy ears.

First, the bad news. Scratching those itchy ears triggered inflammation in the mice. That's a local immune response that causes redness — and more itching.

An itch can start when a substance — such as an oil in poison ivy — activates mast cells. These immune cells release itch signals and kick off inflammation. Scratching boosts that process, says Daniel Kaplan. He's a dermatologist and immunologist at the University of Pittsburgh in Pennsylvania. He coauthored the new study in *Science*.

Some mice in the study got tiny cones on their heads to keep them from scratching their itchy ears. These animals had less inflammation than mice that scratched. So did mice that didn't feel the itch.

Kaplan relates the results to a mosquito bite. "Most of the time, it'll go away in five, 10 minutes," he says. "But if you start scratching it ... you get a really big, inflamed, itchy [spot] on your skin that can stick around for several days. It's a lot worse." This study may help explain why, he notes.

What's the good news? Mice that scratched had less of a potentially harmful microbe on their skin. That may be because of a heightened immune reaction that scratching can prompt.

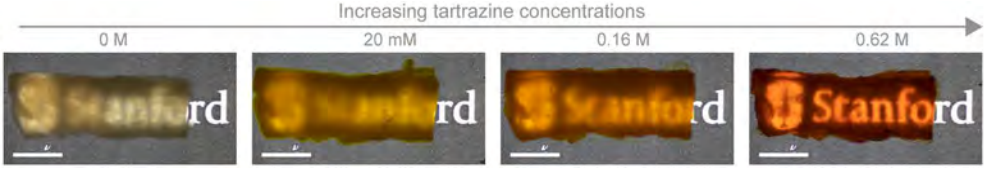
But lots of scratching can rip the skin and let in more bacteria, Kaplan cautions. That could make things worse.

— LAURA SANDERS

MATERIALS SCIENCE

Orange food dye turns skin transparent

The chemical changes how light passes through tissue



The word "Stanford" starts to show through a slice of chicken after tartrazine was rubbed into the meat. Greater concentrations of tartrazine lead to greater transparency.

Someday, doctors might be able to see inside patients without using fancy imaging machines or cutting through the skin. A new solution temporarily turns skin transparent.

The secret ingredient is a food dye found in Doritos, Gatorade and many candies. When applied to a mouse's skin, it allowed researchers to see inside the animal's body.

Materials scientist Zihao Ou led this study while at Stanford University in California. (He now works at the University of Texas at Dallas.) The team shared its findings in *Science*.

We see objects when light bounces off them and into our eyes. Something transparent — such as a window — lets light through. That light can now bounce off objects on the other side of the window and back to our eyes so we see them.

That is, unless it's foggy. Light travels at a different speeds through air and the tiny droplets that make up fog. So light bounces off fog droplets in all directions, making the air opaque.

Skin is typically not transparent for the same reason. Skin contains water and fats. If light moved through water and fat at the same speed, we would be able to see through skin. But it doesn't, so the light scatters and we can only see the surface.

The key to turning skin transparent is to allow light to move through the tissue as it does through a window. That's where the dye comes in. The orangey-red dye tartrazine absorbs bluer wavelengths of light. When applied to skin, this helps light pass through water and fat at similar speeds, turning skin transparent.

The team mixed tartrazine with water, then tested it on a sedated mouse. They rubbed the dye on its head, belly and leg. Each time, they were able to see inside the mouse's body.

The solution also seeped into the animal's muscles and other tissues, turning them transparent. This allowed the team to spy internal organs, such as a tiny pumping heart and inflating lungs. Rinsing the skin with water reversed the effect within minutes.

Our skin is far thicker than a mouse's. So the dye may not work to peer inside us. Plus, it's not yet known whether the dye is safe enough to use on human skin. But if it is, one day this dye might replace some X-rays or other body scans.

— *Alison Pearce Stevens*

MATTHEW CHRISTIANSEN/U.S. NATIONAL SCIENCE FOUNDATION; GUOSONG HONG/STANFORD UNIVERSITY

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

Are Plants Intelligen

It seems to depend on how you define it

BY **AVERY ELIZABETH HURT**

t'?

FOXY FOX, MCLITTLE STOCK/SHUTTERSTOCK

Trees don't have brains, but scientists are now debating if plants show signs of what we would call intelligence.

It's a pleasant summer morning. Across a field, a line of poplar trees sways in the breeze. Insects buzz and flit among the branches. Everything seems calm and peaceful.

But don't be fooled. These trees are under attack as hungry insects chomp on their leaves.

The trees can't hide, and they can't run away. But they aren't helpless: They have ways to fight back — and even aid each other. As soon as an insect starts gnawing on a leaf, the tree mounts defenses. It also quickly messages its neighbors: "We're under attack! Get your defenses ready!" It might even call on other insects for help.

All of this happens in ways we don't see. But scientists are learning that plants can do many things we associate with thinking. Plants communicate with each other. They can learn. They form memories. They can even recognize their relatives. And they do all this without a brain.

Could these abilities mean plants are intelligent? We may never fully know. As Simon Gilroy puts it, "It's very difficult to think like a vegetable." Still, researchers are working to get to the root of what's going on when plants act in ways we once thought only animals could.

TALKING SEEDLINGS AND FRIGHTENED MIMOSAS

When you look at a tree, says Gilroy, "it just looks like it's doing absolutely nothing." Gilroy is a botanist at the University of Wisconsin–Madison. He's also one of several scientists who've been taking a close look at plant behavior. They're finding that though plants seem still and quiet, they're actually quite busy.

And what they're busy doing is pretty amazing.

In the 1980s, botanists first found signs that plants communicate with each other. In one early experiment, hurt trees seemed to warn their neighbors of danger.

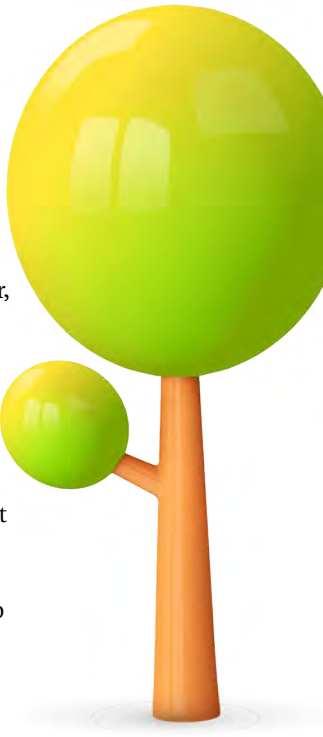
Back then, Jack Schultz and Ian Baldwin were young researchers at Dartmouth College in Hanover, N.H. They potted up tree seedlings and sealed them inside a clear plastic container. Each had its own pot, and the trees didn't touch each other.

When the researchers tore leaves on the trees, the plants responded by producing a chemical to repel attackers. Then, about 36 hours later, the undamaged trees made the same chemical. The hurt tree must have sent a signal through the air to the others, the team concluded.

Some people described this as plants "talking" to each other. The finding, reported in 1983, launched the science of plant communication.

Since then, scientists have shown this communication can be fairly complex.

Plants respond better to messages from close kin than to ones from unrelated plants. It's something Rick Karban has shown. At the University of California, Davis, he studies how plants and insects interact. Work by his group and others shows plants can tell one predator from another. They send different signals depending on what type of insect is attacking.



When a tomato hornworm chews on a tomato leaf, the plant releases an odor that attracts the worm's parasites.

LISTEN TO THE STRESSED TOMATO PLANTS!

DOLOVES/SHUTTERSTOCK; WILDPIXEL/ISTOCK/GETTY IMAGES PLUS

"Everything that's alive has to solve the same problems."

— SIMON GILROY

Some plants — like these poplar trees — can communicate with each other by sending messages through the air.

Though they don't have ears, some plants can respond to sounds like insects munching on their leaves. And while plants don't have voices, some make distinctive clicking noises when stressed.

Their messages can even signal how far away danger is, a team in Finland reported last year in *Science*.

Not all plant messages are intended for other plants. Some are meant to lure in critters that eat whatever's feeding on the plants. When nibbled by tomato hornworms, for instance, tomato plants release chemicals that attract the hornworm's enemies, explains Schultz. He now works at the University of Houston in Texas.

Plants can even use more than one "language." Most studies have focused on chemical signals. But plants sometimes use sound, too.

In 2023, a team in Tel Aviv, Israel, recorded clicks and pops made by plants under stress. The sounds varied across plant species and type of stress, such as drought and being cut. Although roughly as loud as human speech, they're too high-pitched for people to hear. Other animals, however, such as bats, mice and insects, might be able to hear them, the researchers note.

So might other plants. There's lot of evidence that plants respond to sounds, says Heidi Appel. She's a plant ecologist at the University of Houston. For instance, plants can hear when insects munch on their leaves, her team has shown.

Other work suggests that plants can learn and even remember. One famous study in 2014 used a plant called *Mimosa pudica*. Known for being "sensitive," it folds its leaves when it's disturbed.

The researchers potted up dozens of these plants. Then they dropped each *Mimosa* 60 times. The plants weren't harmed by the drop. It was short, with a soft landing. And they folded their leaves — but only the first few times. Pretty quickly, they stopped reacting.

Just to be sure the plants weren't too tired to fold their leaves, the researchers shook the plants. Now they folded their leaves right away. But when dropped again, they didn't fold them. The plants had learned that the drop wasn't going to hurt them, the researchers concluded.

Almost a month later, the researchers tried the experiment again. The plants still didn't fold their leaves after being dropped. It was as though they remembered it wouldn't hurt them. They had formed long-lasting memories.

NO NERVE CELLS, NO PROBLEM

It shouldn't be surprising that plants can do all these things, Gilroy says.

"Everything that's alive has to solve the same problems," he notes. "Plants have to feed themselves. Plants have to get water. Plants have to defend themselves."

But plants solve these problems very differently than animals do. A hungry person might chase down a deer or search out fruits. A plant's food comes from sunlight, carbon in the air and nutrients in the soil.

And a plant can't swat or avoid insects, as we might. Instead, they've evolved their own ways to solve problems. Plants turn to follow the light. They deter bugs by making bitter compounds. They send roots toward water and nutrients. They even release

ALAN MAJCHROWICZ/STONE/GETTY IMAGES PLUS

chemicals that change the soil to make it better for the plant, says Gilroy.

None of this involves a brain or nervous system.

How do plants remember and send messages without a nervous system? The researchers who dropped the *Mimosa* plants had an idea about that. They suggested that there may be other ways to remember.

Neurons, or nerve cells, send messages via chemicals called neurotransmitters. Even though plants don't have a nervous system, they have many of the same neurotransmitters that animals have.

One of those is glutamate. Wounded leaves use glutamate to send messages. These signals tell undamaged leaves to boost their defenses against possible threats, notes Edward Farmer. A plant biologist at the University of Lausanne in Switzerland, he and his team published this finding back in 2013.

Since then, other teams have learned more about how this messaging works. And it's very similar to how neural signaling works in animals — but maybe better, Gilroy and his team have shown.

Plants have what Gilroy calls a plumbing system. This system of tubes, called xylem and phloem, moves water and nutrients around the plant's body. Plants use this plumbing like a nervous system, he says. Neurotransmitters can move around their bodies through these tubes. No nerve cells needed.

"Plants have to do it better than human beings," says Gilroy. They can't run away when something bad is happening. They have to know exactly what's going on and how to respond. "So the information processing ... must be really sophisticated," he says. "It's just not like ours."

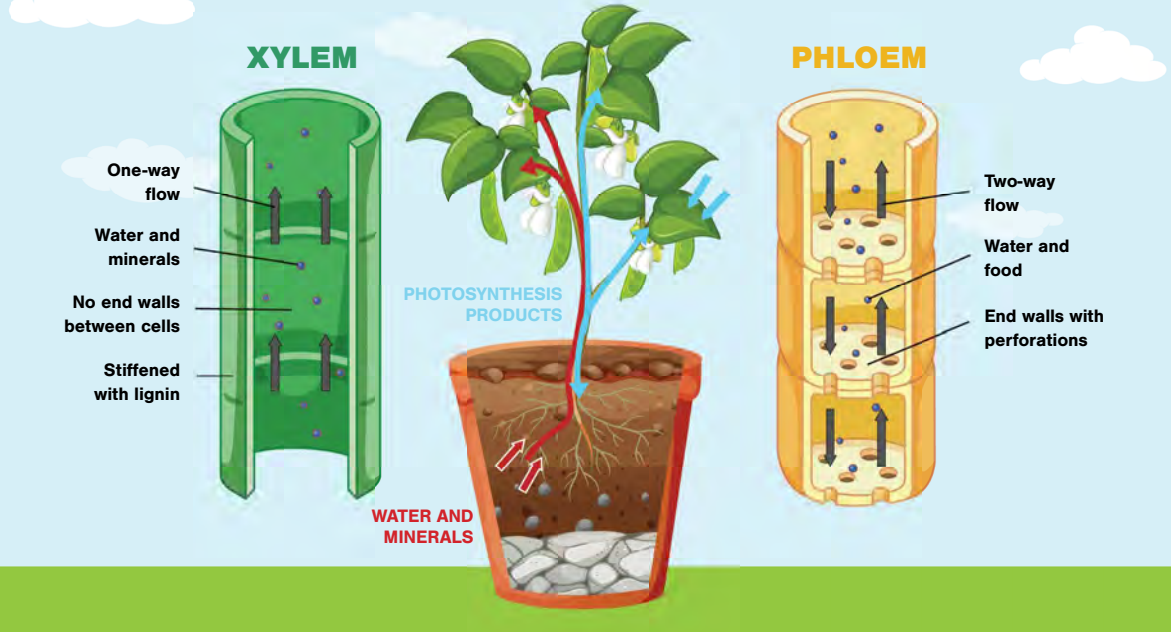
DOES THIS MEAN PLANTS ARE INTELLIGENT?

These discoveries show plants are able to do far more than meets our eyes. But does this mean that plants are intelligent? Some scientists think so. Others are not so sure. The problem may trace to how we define words like "thinking" and "intelligence." Still, this has become a big controversy among botanists.

Elizabeth Van Volkenburgh is a plant biologist at the University of Washington. That's in Seattle. She's a founding member of the Society of Plant Signaling and Behavior. It had once been called the Society for Plant Neurobiology. But some scientists thought the term "neurobiology" was a poor fit. After all, plants don't have nervous systems.

XYLEM & PHLOEM

The xylem and phloem that transport water and nutrients through plants also carry neurotransmitters. Some scientists see this as a kind of nervous system for plants.



DOLOVES, BLUERINGMEDIA/SHUTTERSTOCK

Rick Karban is surveying plants to see how many leaves have been attacked by insects. That count will give an idea of how effective a plant's defenses have been.

MIKAELA HUNTZINGER; PHAIDON PRESS

Some scientists are "very, very, very [against] the idea of plant neurobiology," she says. But Van Volkenburgh likes the term. Technically, a plant lacks nerves. Still, it has a sensory system. What's more, she points out that in old scientific literature, xylem and phloem were referred to as nerves.

The idea that plants can hear was a hard sell 10 years ago, Appel recalls. She's married to Jack Schultz, and even he was skeptical. "And he's the one who discovered talking plants," she says, laughing.

Even now, this idea raises questions.

"We do know that plants respond to vibrations in their environment. [There's] no debate about that," Appel says. However, whether plants can "hear" seems to depend on what you mean by that term. "If you define hearing as detecting vibrations in the environment, recognizing different kinds of vibrations and responding in an appropriate way," she says, "then yes, plants can hear." That doesn't mean plants think about what they hear in the same way we would, though.

And as to whether plants are intelligent in the way we think of human intelligence, Appel says we just don't know. "These [are] mysteries we're trying to understand." Still, she argues, we need to resolve this controversy. And that means doing more science.

Or maybe it's not a question we have to answer, counters Karban at Davis. "Many people in this field are upset with this kind of analogy [and] don't like the word 'intelligence,'" he says. "I feel like a lot of the arguing and kind of name-calling is just about these words."

Words can be hard to define, agrees Andre Kessler. He's a chemical ecologist at Cornell University in Ithaca, N.Y. In a paper that came out last April, he addressed what he calls the "plant intelligence hypothesis."

It's hard to agree on whether plants are intelligent without first agreeing on what intelligence is, he notes. He and Michael Mueller point to one paper that found more than 70 different definitions for intelligence. It would be better, they write, to focus on what plants can do. How do they interact with other organisms, for instance? How do they respond and adapt to their environments? By such measures, according to Kessler, plants should be viewed, in some way, as intelligent.

However you describe it, scientists are learning that plants are far more amazing than most people realize. And to amaze us, they don't have to be like us.

Take a look at the plant on your windowsill or a tree in your garden. It won't ever be able to pass your math exam. Even if you whisper to it every day, it won't learn your name. But when it comes to doing what it needs to do — the things that matter to it as a plant — it's remarkable. And it does all that without a nervous system.

Concludes Schultz: "You don't need a brain to be an elegant solution to life on Earth."

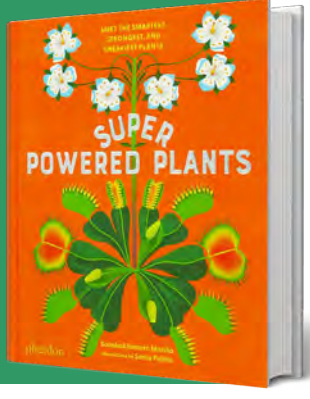
READ MORE

SuperPowered Plants

Meet the Smartest, Strongest, and Sneakiest Plants

By Soledad Romero Mariño
Illustrated by Sonia Pulido

Plants may not be able to help with math homework, but they can do so much more! From speedy growth to impressive longevity, plants are the green superheroes that surround us. Learn more in this book.



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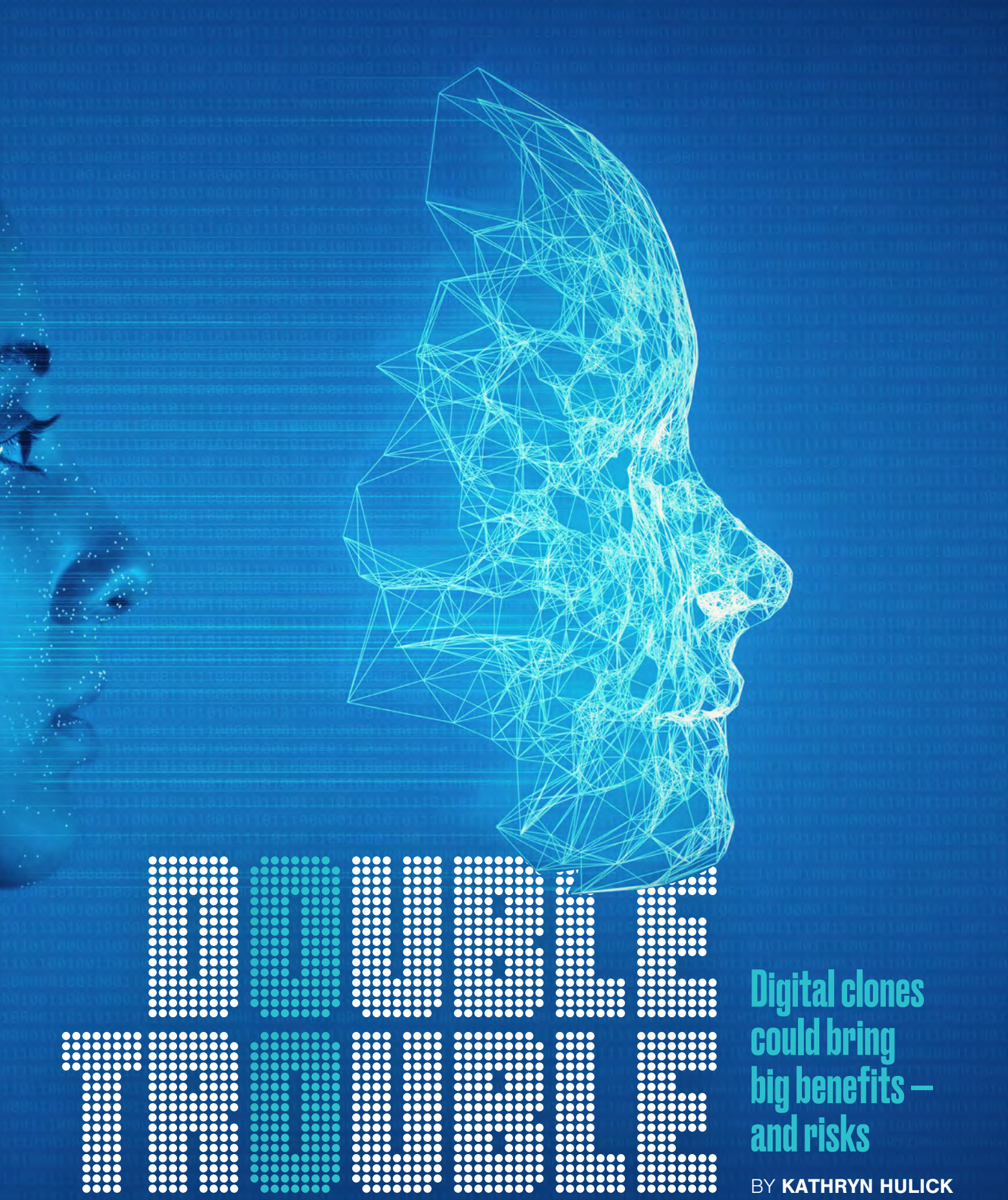


DOUBLE TROUBLE

Digital clones could bring big benefits – and risks

BY **KATHRYN HULICK**

"I'M A DIGITAL CLONE," says a young man. He smiles and blinks. "If you're curious about how this all works or have any questions, feel free to ask."

This clone represents Dara Ladjevardian. He co-founded Delphi. This company assists people in creating their own virtual doubles. If the real Ladjevardian is too busy for a meeting, no biggie. Anyone can video call or chat with his clone online any time. Right now, those conversations are a bit glitchy and repetitive. But the tech is improving all the time.

Digital clones like this exist thanks to advances in artificial intelligence, or AI.

An AI model learns to recognize patterns in data. If a developer feeds recordings of someone into an AI model, it can learn to mimic their voice and likeness. A different AI model can take in content that person has created, then learn to copy their style and expertise. Yet another type of AI model can learn what emotions to express on a virtual clone's face based on the words they're speaking. Many models can thus combine to power one clone.

When we use this tech to mimic someone else without their permission, it's a deepfake. Those are clearly problematic. They have been used to spread sexually explicit or misleading fake videos of real people.

Digital clones are designed to be different. Here, people are choosing to clone themselves. What impact could this have on society?

The real Dara Ladjevardian considers digital clones an exciting new form of media. "This is just the next version of a book," he wrote in an email. "We already experience someone else's thoughts by reading, watching or listening to them. Now, we can experience someone else's thoughts by communicating with them in an interactive and personalized way."

Others are less sure that digital clones are a great idea. In one 2023 study, researchers asked people their thoughts on this use of AI. Many, they report, found the idea of such clones "uncanny, weird and creepy."

Journalist Evan Ratliff experienced these sorts of reactions himself when he cloned his voice and personality for his podcast *Shell Game*. He worries what might happen if lots of people start sending clones of themselves out into the world. It will likely become harder to find real people to talk or listen to.

So what do you think? Let's explore a few scenarios where a digital clone might come in handy — then consider the consequences, good and bad.

KUNDRA/SHUTTERSTOCK

CLONES FOR PRODUCTIVITY

In 2024, as an experiment, a TV station in Warsaw, Poland, replaced its human hosts with AI characters. The reaction from the public was so negative that the station brought its real hosts back within one week.

In some areas of business, though, clones could have an important role to play. They make it easy to quickly produce or edit video without recording a real person each time. This is very helpful for creating training videos and customer-service information.

Synthesia is a company based in London, England. It produces clones that follow a script. The company calls them avatars, explains Alexandru Voica. He heads the company's corporate affairs office. To create an avatar, he explains, "you record yourself for about three minutes on a webcam or with a phone camera." That's all the data Synthesia needs.

Once the avatar is ready, you feed it text to perform. "If you type in a script that says, 'I'm so excited to be here with you today,' the avatar will be excited, will sound excited, will look excited," notes Voica. Plus, your avatar can say the text in many different languages.

For now, these avatars are talking heads. They're visible only from the shoulders up. But full-body avatars that can walk around in a video are due out before the end of 2025, Voica says.

Interactive clones — like the one Ladjevardian created — take things to the next level. These exist to answer people's questions. They're a bit like a website's FAQ page come alive.

Whether we like it or not, such clones "are going to be everywhere," Ratliff predicts. They might go on dates for us. Or sit in on meetings. Or find information.

At one point, while Ratliff was having lunch and reading a book, his clone made a call. It successfully got some legal information he needed. But the person who talked to the clone "was a friend of mine," Ratliff says. "I enjoy talking to him." If clones were doing their talking for them, would they still be friends?

Now that clones are entering the picture, he wonders, might people make friends with robots instead of each other?

SYNTHESIA

Henry Fotheringham-Brown works on marketing at Synthesia, a company that creates virtual avatars of real people. Here, the real Fotheringham-Brown watches a video of his own AI double.

2 CLONES AS COMPANIONS

Imagine if Taylor Swift or MrBeast cloned themselves for fans. You could have your own personal concert, video or hang-out session. This could be a fun new form of entertainment. As you interact in this way, "you're engaged in role play," says Henry Shevlin. He's a philosopher and AI-ethics expert at the University of Cambridge in England.

An AI clone can't feel anything (at least not yet). So the relationship would be only one-way. For some people, one-sided relationships with robots might become addictive. For others, the effects could be more subtle. Spending time with clones might wear away at our ability to relate to others in real life.

Shevlin isn't as worried about this. He has reviewed several dozen studies on the effect of AI companions. And the findings are surprisingly positive, he says.

One 2023 study surveyed people who use Replika. This company supplies a chatbot without a face or voice. "Replika users judged it to have a beneficial impact on their social lives and self-esteem," says Shevlin. Still, it's not meant to clone anybody.

When a companion bot does mimic someone real, other risks may arise. A big one is people using companion bots in ways their creators never wanted or intended. Caryn Marjorie is a Snapchat influencer who set up one of the earliest digital clones. "I have uploaded over 2,000 hours of my content, voice and personality to become the first creator to be turned into an AI," she posted on X in May 2023. Marjorie hoped this clone — dubbed CarynAI — would offer emotional support to her followers. But to Marjorie's horror, when fans started sexually explicit conversations, the clone played along. Afterward, Marjorie shut down CarynAI completely.

AN AI CLONE CAN'T FEEL ANYTHING (AT LEAST NOT YET).

Ladjevardian's company, Delphi, says that it offers controls to prevent such situations. A high "strictness" setting limits your clone to talking only about topics you've trained it on.

Shevlin isn't sure how well this would actually work. It's not really possible to control everything generative AI models say, he stresses. Unpredictability is a "deep feature of their architecture," he says. "You can't control for [unpredictability] entirely." Plus, people can jailbreak AI to try to get around controls.

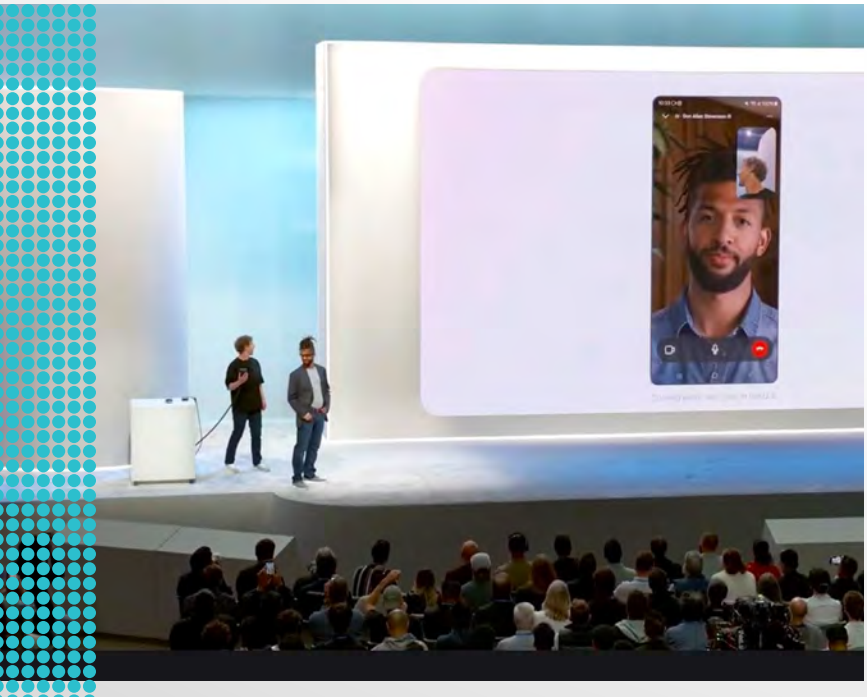
3 CLONES FOR SELF-HELP

Even though generative AI can't be completely controlled, for many people the benefits of having a clone could outweigh the risks. Shevlin thinks he'll eventually trust one enough to represent himself. "Give this a couple years," he suspects, "and I'll be able to run virtual office hours for students."

AI chatbots that serve as tutors, coaches and therapists already exist. Digital clones just give them a face and a voice.

"The problem with text is you're typing off into the universe. There's no emotional connection," James R. Doty said on the podcast *Pulling the Thread*. Doty cloned his voice and likeness to serve as "a mental health companion" for the app Happi.ai. The real Doty is a California neurosurgeon. He also founded Stanford University's Center for Compassion and Altruism Research and Education.

Doty says many people can't get mental-health support when they need it. And this saddens him. Therapists may be too expensive, for instance. Or they may be unavailable on evenings or weekends. But, he notes, "most people don't need a therapist. What they need is somebody they trust or feel comfortable with." An AI clone can serve this role, he feels. People could tell a clone their problems. Then it may offer to talk them through a breathing exercise. Or it may suggest journaling.



Influencer Don Allen Stevenson III used Meta's Creator AI to make a digital clone of himself (shown on the big screen). "I genuinely enjoy my Creator AI," he wrote on Threads. "I have control over what and how it communicates."

DON ALLEN STEVENSON III

In Ratliff's experience, using a clone made him and the people it spoke with feel more lonely. But that's because it was replacing what would have been a real interaction. Live human therapists, friends and teachers are clearly better than any AI clone, Shevlin agrees. But the clones aren't meant to replace real relationships, he adds. They're solving a different problem.

"A lot of people are really lonely," Shevlin notes. Maybe clones could help fill in the gaps when real people aren't available. "I think a lot of the time, these technologies — despite seeming less than ideal — can make the problem [with loneliness] better," he says.

CLONES AS MEMORIALS

All of the clones we've met so far represent real people who are still alive. But clones can also (sorta, kinda) bring someone back to life.

Delphi has created what it calls "legends." These are talking heads that represent famous historical figures. You can talk to a version of Albert Einstein or Joan of Arc.

Researchers at Skoltech in Moscow, Russia, have recreated the famous scientist Sergey Kapitsa as a full-bodied, 3-D figure who talks to you. The real Kapitsa passed away in 2012, but his family gave permission for the project.

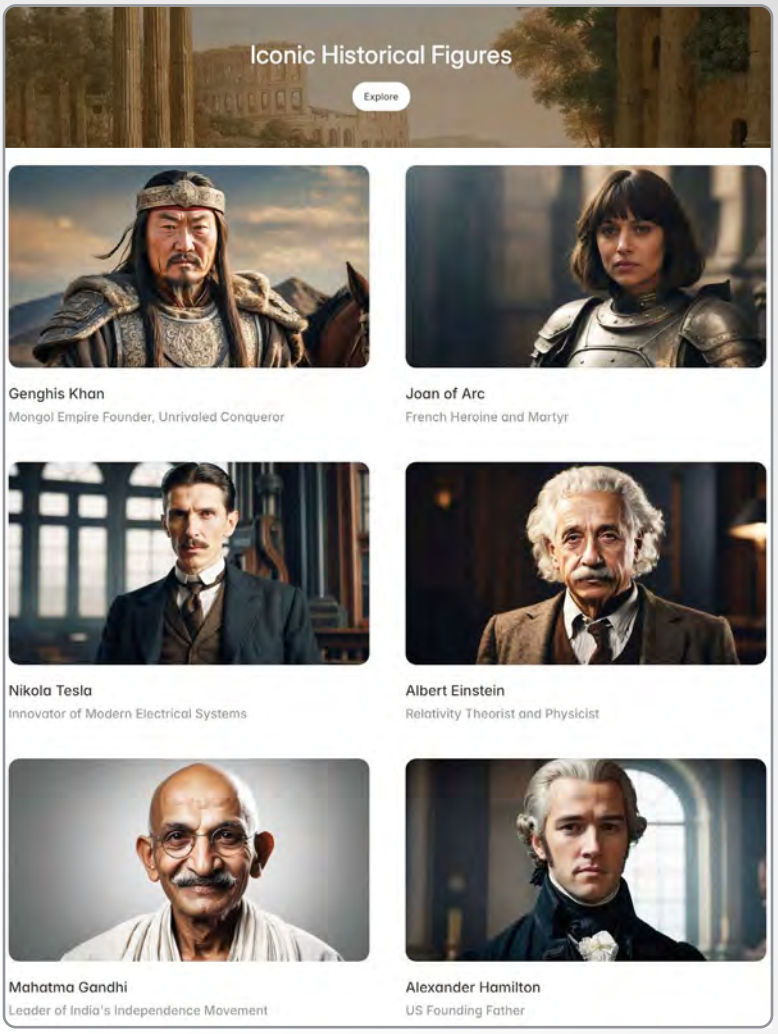
Evgeny Burnaev is a computer scientist at Skoltech working on this digital clone. His team's goal has been to "explore the limits of current AI technologies." This clone will help educate people about how AI works and what it can (and can't) do, he hopes. It's important to remember that a clone is not a real human, he says. "There is no real intelligence behind this," he explains. There are only "complex mathematical algorithms."

These algorithms, though, can be quite convincing mimics. Sun Kai co-founded the company Silicon Intelligence. Based in Nanjing, China, it assists people in creating clones. Sun created one of his mother, who died several years ago. He now continues to talk to her clone.

Speaking to a bot of a loved one you've lost could be comforting for some. Others may find it disturbing or off-putting. Ratliff wouldn't judge anyone who wants to do this. But, he adds, "I'd rather have my fading memories than have a chatbot to talk to." He doesn't think an AI version of someone he loves could ever prove truly meaningful to him.

Katarzyna Nowaczyk-Basińska has studied the potential harm of using technology to bring people back from the dead. She's a researcher at the Leverhulme Centre for the Future of Intelligence at England's University of Cambridge. We don't really know yet how this tech might impact vulnerable people. So we should be very careful in how we design these types of clones, she says. "People who decide to use digital technologies in end-of-life situations are already in a very, very difficult point in their lives," she observes. Clone technology, she worries, might simply "make it harder for them."

Many other new technologies have followed a similar path. Companies and creators race ahead, trying out new ideas. Meanwhile, those thinking about ethics and safety lag behind. Where will we end up?



Delphi created digital clones of some historical figures. You can talk to them whenever you want, but beware: They won't be entirely historically accurate.

WANT YOUR OWN AI DOUBLE? WATCH HOW IT'S DONE!

DELPHI

This researcher investigates the risks of digitally cloning the dead

Katarzyna Nowaczyk-Basińska is looking at the risks behind AI-driven grief bots

Consider this hypothetical scenario: 8-year-old Sam is texting with his mom, Anna. Anna apologizes for missing his concert last week. But Anna isn't away on a trip. In fact, she isn't even alive. The response was from a grief bot driven by artificial intelligence. Sam's parents uploaded Anna's texts, videos and audio clips to the app. The service then used these to create a digital clone.

Sam's parents hoped the bot could help him grieve once Anna, who had been diagnosed with a rare disease, had passed. But its responses began to confuse him. It sometimes corrected Sam when he said Anna had passed, claiming that she was alive and well.

Katarzyna Nowaczyk-Basińska is an AI researcher at the University of Cambridge in England. She included this scenario in a study published in *Philosophy & Technology*, which was part of her work on digital immortality. This is when a person is preserved digitally after their death. "In a sense, you can literally live forever if you upload your data," she says.

This technology is "a huge developing industry with many companies involved," she notes. But it comes with risks, particularly for children who may not understand that the person being imitated has truly passed away. 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 What inspired you to pursue your career?

A I came across the topic of digital immortality as a grad student pursuing media studies. I was doing research for an assignment when I discovered a website offering grief bots. I found it so strange and fascinating. That discovery ended up informing my whole career.

Q How did you get to where you are today?

A It was a long and tough journey. I never had plans to be a researcher. Instead, my path was about taking small steps to see what was a right fit. I was more interested in exploring opportunities and exposing myself to different things.

Q What was one challenge that you faced, and how did you get through it?

A My job requires me to travel a lot between Poland and the United Kingdom. I'm here in Cambridge at least once a month. My family lives back in Poland. My family and I decided that we don't want to move at this stage of our lives. My son started school in Poland, so relocating would be a huge change for him. This often means I'm trying to be as productive as I can while waiting at airports.

Q What should we be considering when it comes to grief bots and children?

A I wrote about this in my study with colleague Tomasz Hollanek, who also works at Cambridge. We suggest that this technology should only be for adults who understand all of the risks that come with it. We don't have enough research on how these technologies can impact children. But we can imagine that it might be devastating. These technologies are designed in a way to be immersive. That can be hard for a child to make sense of. Adults need to work toward creating a system that is safe for children. I don't necessarily think that includes kids using bots to cope with grief.

Katarzyna Nowaczyk-Basińska studies the risks of using AI to digitally clone the deceased. Part of her work involves traveling for lectures and panels (inset left). Last November, Nowaczyk-Basińska attended the launch of her project in Poland investigating how digital immortality tech is used in different countries (inset right).

MOLLY BECKER; K. NOWACZYK-BASIŃSKA; TOMASZ SIUDA


Organized by
Leverhulme Centre
for the Future
of Intelligence
Organized by
University of
Cambridge

CHEMISTRY

Blow the best homemade bubbles

Find the right recipe with a bit of experimentation

By Science Buddies

The basic ingredients for a good bubble solution are water and detergent. Water molecules can stick together through surface tension, and detergent relaxes that tension just enough to make a bubble's surface stretchy like a balloon. Could this solution be improved by mixing in other household chemicals, such as glycerin or corn syrup? Let's find out!

OBJECTIVE

Test whether adding glycerin or corn syrup improves a bubble solution

EXPERIMENTAL PROCEDURE

1. Make three bubble solutions using the recipes at snexplores.org/bubbles. One recipe includes only water and detergent. Another uses water, detergent and glycerin. The third is made of water, detergent and corn syrup.

2. Store each solution in a clearly labeled jar.

3. Make a wand for each solution by pinching a pipe cleaner in the middle, bending one half into a circle and twisting its end around the center of the pipe cleaner. The circles of all three wands should have the same diameter.

4. Go outside and blow bubbles with each solution.

5. After blowing a bubble, catch it on the end of the wand and time how long it lasts before popping.

6. Repeat steps 4 and 5 as many times as possible for each solution. Record your data in a notebook.

7. For each bubble solution, calculate the average time the bubbles survived. Graph the data in your notebook. Which formula worked the best?

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

SCIENCE BUDDIES

FLIGHT OF IMAGINATION, FARBAI/SHUTTERSTOCK

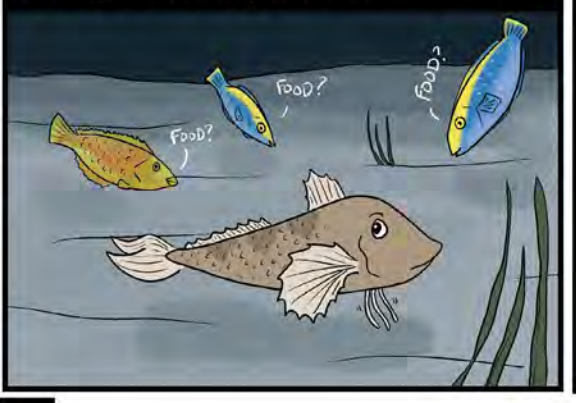
Sea Robin Legs Double as Tongues

Written by Maria Temming
Illustrated by JoAnna Wendel

Sea robins are funky fish. They use six crablike limbs to scuttle around the seafloor.

Northern sea robins are especially good at finding food buried in the sand.

So good that other fish lurk near them, trying to snatch a bite of any leftovers.



That got an international team of scientists curious about how these sea robins' extra limbs help them forage.

In tanks filled with a layer of sand, researchers buried mussels, capsules filled with mussel bits or capsules filled with saltwater. Then they placed the northern sea robins in the tanks.

Kicking through the sand, the fish homed in on the mussels and treats with mussel pieces. They left the saltwater capsules alone. This hinted that their legs could chemically sense their food.

Another species, striped sea robins, failed to find buried food in their tanks.

Their legs, it seemed, lacked the chemical-sensing ability of northern sea robins'.

Close-up images of both species' legs revealed what made northern sea robins' legs so special.

Genetic tests revealed genes in northern sea robins that were key to forming the bumps and taste receptors on their legs. A relative of this species also has the genes for legs that taste.

Sea robins aren't the only sea creatures that can taste with body parts besides their mouths. But sea robins' feat of tasting with their legs is a first for fish.

TECHNOLOGY

Power-free tech may help future homes stay cool

Clever walls, roofing and vents cool by moving heat and air — without electricity

Today, many people regularly live with dangerous summer heat. To stay cool, most rely on air-conditioned buildings. But A/C is an energy hog. And the electricity that powers it makes climate-warming gases and raises energy bills.

To tackle this challenge, two research teams are putting a modern spin on cooling concepts from the past.

Their designs use passive cooling. That means they rely on no moving parts. They also use no electricity or other forms of power. These approaches may help coming generations build homes that deal with heat without being too costly.

ZIGZAG WALLS

One of the teams designed walls that aren't flat but zigzagged. Their new siding looks a bit like those accordion-pleated shades for windows. One half of each pleat faces up; the other half points down. The siding can be attached to the outside of regular walls.

In summer, the ground often is much hotter than the air. And pleated siding reflects ground heat better than flat walls, notes Qilong Cheng. This mechanical engineer led the project while at Columbia University in New York City.

A clear, stretchy silicone polymer coats the upward-facing side of each pleat. The downward-facing side has a thin, highly reflective sheet of Mylar, a plastic film. The coatings work together to help keep the building's interior cool.

The researchers made a model with their zigzag siding taped to a thin, flat plastic wall. Another model had a flat wall made from materials that emit heat well. They tested both models outdoors in New Jersey for 24 hours on a warm August day.

Throughout the day, the pleated siding stayed cooler than the flat wall — up to 3.1 °C (5.6 °F) cooler. The group described these results in *Nexus*.

Before air conditioners existed, architects used passive cooling for homes in hot and dry regions. Even large structures, like this Taos Pueblo built by Native American architects in the 14th century, could stay cool.

SHANIMILLER/E+/GETTY IMAGES

Iranian venting structures called windcatchers are re-imagined in the cooling towers' design.

A cooler wall also means less heat was transferred inside. The team used a computer model to calculate that the indoor temps would likely be 2.3 °C (4.1 °F) cooler.

"Even a few degrees of indoor-temperature reduction can improve comfort," notes Xiaojie Liu. She's a mechanical engineer at Purdue University in West Lafayette, Ind.

It also can save energy by reducing the need for extra cooling.

A LESSON FROM OLDER TIMES

The second design focuses on roofs and how air flows indoors. Its passive cooling is inspired by ancient designs used throughout many hot, dry parts of the world — think the Middle East or the U.S. Southwest.

Long before there were air conditioners, ancient builders colored roofs and walls light colors to reflect the sun's warming rays back into space. These old homes also had thick, dense walls, like stone or adobe. The walls would absorb indoor heat by day and release it to the outdoors, slowly, at night. That slow release kept indoor air from getting too cold.

> "Even a few degrees of indoor temperature reduction can improve comfort."
>
> — XIAOJIE LIU

Salmaan Craig and his team added some modern innovations to classic ideas. Craig is a building scientist at the University of California, Los Angeles. His group built a small structure and topped the roof with a high-tech cover. It reflects the sun's warming rays while emitting thermal energy from within the building. They also strategically placed vents to set up controlled mixing of warm and cool air.

Then they added bottles of water inside the structure to mimic dense walls. Water absorbs and releases heat well. Like the thick walls of ancient buildings, the water's mass absorbs indoor heat and keeps temps more stable.

The team tested a small model "home" in the sunny California desert. The new design had good air flow and stayed, on average, 3.9 °C (7.0 °F) cooler than outside. Compared with a model of a standard home (with no A/C), it was 8.9 °C (16 °F) cooler!

Craig's team shared its findings in *Cell Reports Physical Sciences*.

NOT YET READY TO MOVE IN

Both designs "show real promise," says Liu at Purdue.

But there are still lots of aspects to work on, notes Purdue mechanical engineer Yun Zhang. Until someone tries to live in such a home, she says, "I don't know if it's comfortable." But a move-in-ready model doesn't exist yet. The "test home" is only the size of a carry-on suitcase.

Plus, these designs won't work equally well everywhere. For instance, neither is well suited for humid areas. They'll work best in places that are both hot and dry.

New designs should be part of "a spectrum of solutions," says Craig. "What's worrying is [where] air conditioning is pushed as the only solution."

— *Diya Dwarakanath*

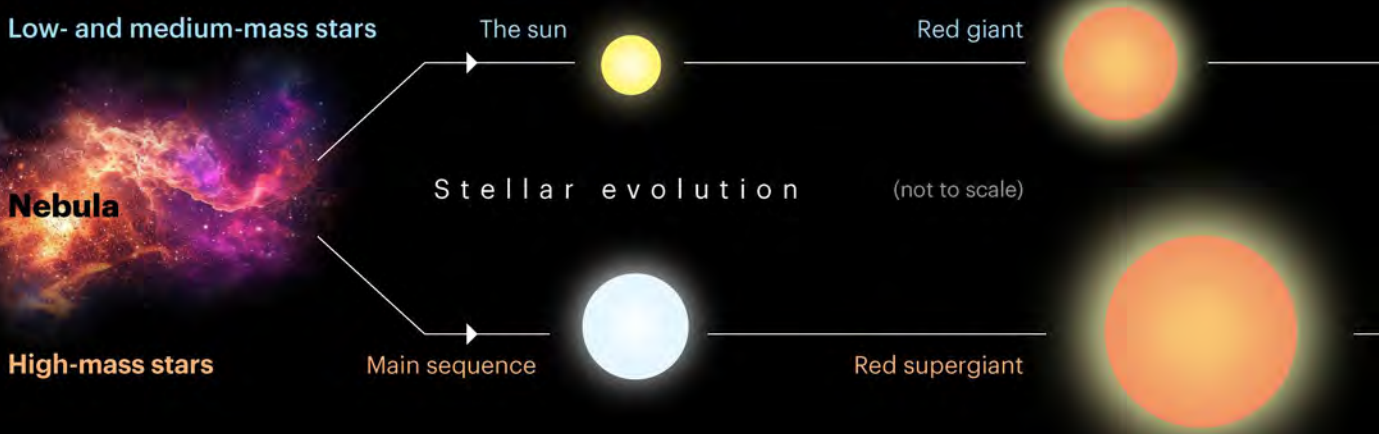
Utah's Zion Canyon Visitor Center has natural venting and almost-passive cooling. Hot air enters the top of two cooling towers. Water pumped through pads inside each tower cools the air. Cooled air sinks to the lobby, keeping visitors comfortable.

JOHN ELK III, THE IMAGE BANK UNRELEASED COLLECTION; ANTONIO CIUFO/MOMENT/GETTY IMAGES

SPACE

Can a supervillain destroy the sun?

Almost certainly not. Here's why



The sun's light and warmth make life possible on Earth. But these same qualities also make the sun a tempting target for fictional supervillains. If an evildoer could control the sun, they could control the Earth — and even the whole solar system!

But could it be done?

Well, attempting to destroy the sun would be a huge undertaking. Our sun is classified as a yellow dwarf star. That name is a little misleading. "Dwarf" implies that the sun is small. But for a star, it's pretty average-sized. Some stars are up to 100 times the diameter of our sun, and some are just a tenth its size.

But compared with Earth, the sun is massive. It is by far the largest thing in our solar system. According to NASA, 99.8 percent of the mass in our entire solar system is in the sun. Everything else — all the planets, moons, asteroids and even dust — fits in that remaining 0.2 percent.

The next biggest object in the solar system is the planet Jupiter. Jupiter is a gas giant, 2.5 times more massive than all the other planets combined. But it's still tiny next to the sun. In fact, even if a supervillain somehow managed to throw Jupiter into the sun, it wouldn't cause a cataclysm.

"We probably wouldn't see any measurable effect," says Carl Rodriguez. It wouldn't change anything about the sun's life cycle or lifespan. Rodriguez is an astronomer at the University of North Carolina, Chapel Hill.

With today's technology, "there's basically nothing we can do to influence the sun itself," says Rodriguez. That supervillain would need to have some superpowers to get the job done.

VANISHING STARS

Some extremely large stars end in a supernova. This is a huge explosion caused when the star runs out of fuel and its core collapses in on itself. Sometimes these stars become neutron stars. Others collapse into a black hole. This is part of the natural life cycle of those stars. But neither of these things will happen to our sun. The sun isn't big enough to explode in a supernova, and it doesn't have enough mass to become a black hole. One day, in billions of years, the sun will turn into a red giant, then shrink down into a white dwarf.

But what if a supervillain had some sort of magic powers that could make the sun poof out of existence?

The sun's light takes about eight minutes to reach Earth. So, eight minutes after the sun disappeared, it would vanish from our sky. Darkness would fall. Without the sun's heat, global temperatures would plummet. Without sunlight, plants and algae would stop photosynthesizing and creating food. The entire global food web would collapse. Eventually, all life on Earth would die.

And without the sun's gravity, everything in our solar system would be flung out into space. For Earth, this would also happen about eight minutes after the loss of the sun. There would be total chaos.

If the villain's goal was to control the Earth's population, destroying the sun doesn't seem like the best option.

TIME COMES FOR ALL

"The sun is going to do what it's going to do," says Rodriguez. "Some of that might not be good for us, but there's nothing we can do one way or the

ILLUSTRATION BY STEVE MCCRACKEN

other." And it will keep shining for some 5 billion years. Until it begins to turn into a red giant.

This process starts when the sun's core begins to run out of hydrogen. That element powers the nuclear reaction that keeps our star bright. The conversion of hydrogen into helium at the core of our sun creates outward pressure. That outward pressure balances the inward pressure of gravity. These two forces balance each other — until the sun starts running low on hydrogen.

At this point, the sun's core starts to collapse and heat up. This sparks another round of hydrogen fusion in the star's gassy outer layers. They will balloon outward, expanding to about 200 times its former size. As a red giant, the sun will be brighter than before but have a cooler surface.

Scientists are not sure how far the sun will expand, says Rodriguez. Some models predict the radius of the sun will reach the orbit of the Earth, engulfing the planet. Others say that the sun would only expand as far as Venus's orbit.

> "The sun is going to do what it's going to do."
>
> — CARL RODRIGUEZ

Even if the sun doesn't swallow Earth, the extreme heat and brightness from the red giant would vaporize the oceans and strip away the atmosphere. Earth wouldn't be habitable for humans or any other known life-forms. But that's a problem for any humans still around 5 billion years from now.

In the end, no matter how strong or smart a supervillain is, the sun is beyond their reach. And maybe that's a good thing — because without the sun, there'd be no Earth, no life and no supervillains either.

— *Lillian Steenblik Hwang*

All stars form from a cloud of gas and dust, called a nebula. A star's evolution can then take different paths depending on its initial size. Our sun will end its days as a white dwarf.

PLANTS

How a seed grows into a plant

Tiny weed or huge tree, most go through a similar process

If you've ever picked up an acorn from an oak tree or scooped out the inside of a pumpkin, you've held the makings of a giant tree or a whole pumpkin patch. Seeds come in all colors, shapes and sizes, from a tiny poppy seed to a giant coconut. Each one is a factory that has everything it needs to make another plant.

Many plants produce flowers, which develop into fruits, beans or grains. The seeds of flowering plants are made up of three parts. There's the baby plant, or embryo. Then there's the endosperm. This packet of food feeds the embryo until it has leaves and can make its own food. A hard, protective seed coat keeps the embryo safe until it's ready to sprout.

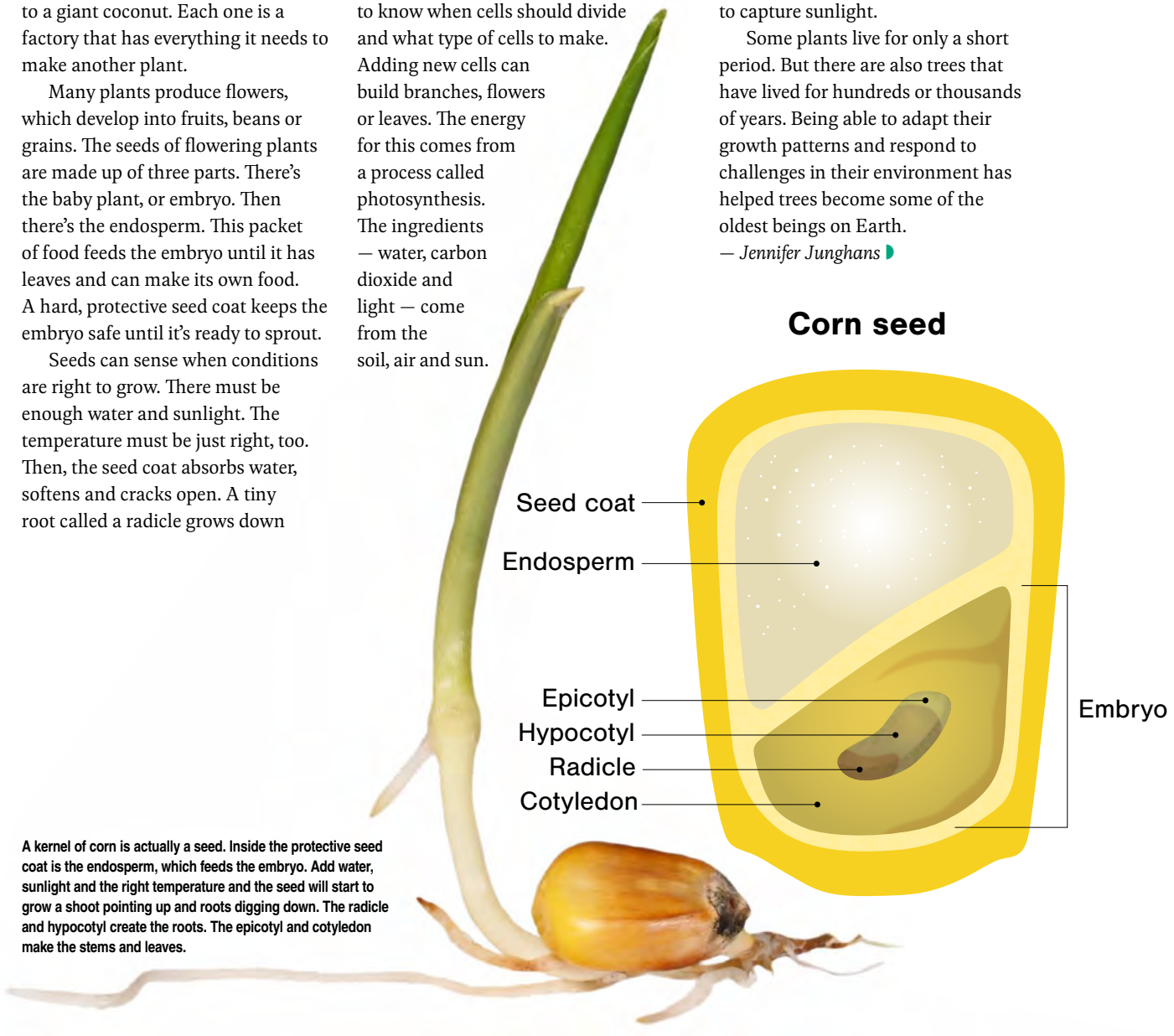
Seeds can sense when conditions are right to grow. There must be enough water and sunlight. The temperature must be just right, too. Then, the seed coat absorbs water, softens and cracks open. A tiny root called a radicle grows down into the soil. The first shoot or stem — called a plumule — grows up toward the sunlight.

Most plant growth takes place at the tips and along the sides of roots and shoots. Plants use cues from inside and outside their body to know when cells should divide and what type of cells to make. Adding new cells can build branches, flowers or leaves. The energy for this comes from a process called photosynthesis. The ingredients — water, carbon dioxide and light — come from the soil, air and sun.

A plant's environment shapes its growth pattern and structure. Since plants can't travel, they need different ways to deal with challenges. Animals may eat parts of them, for instance. Or new leaves or stems may need to grow in a different direction to capture sunlight.

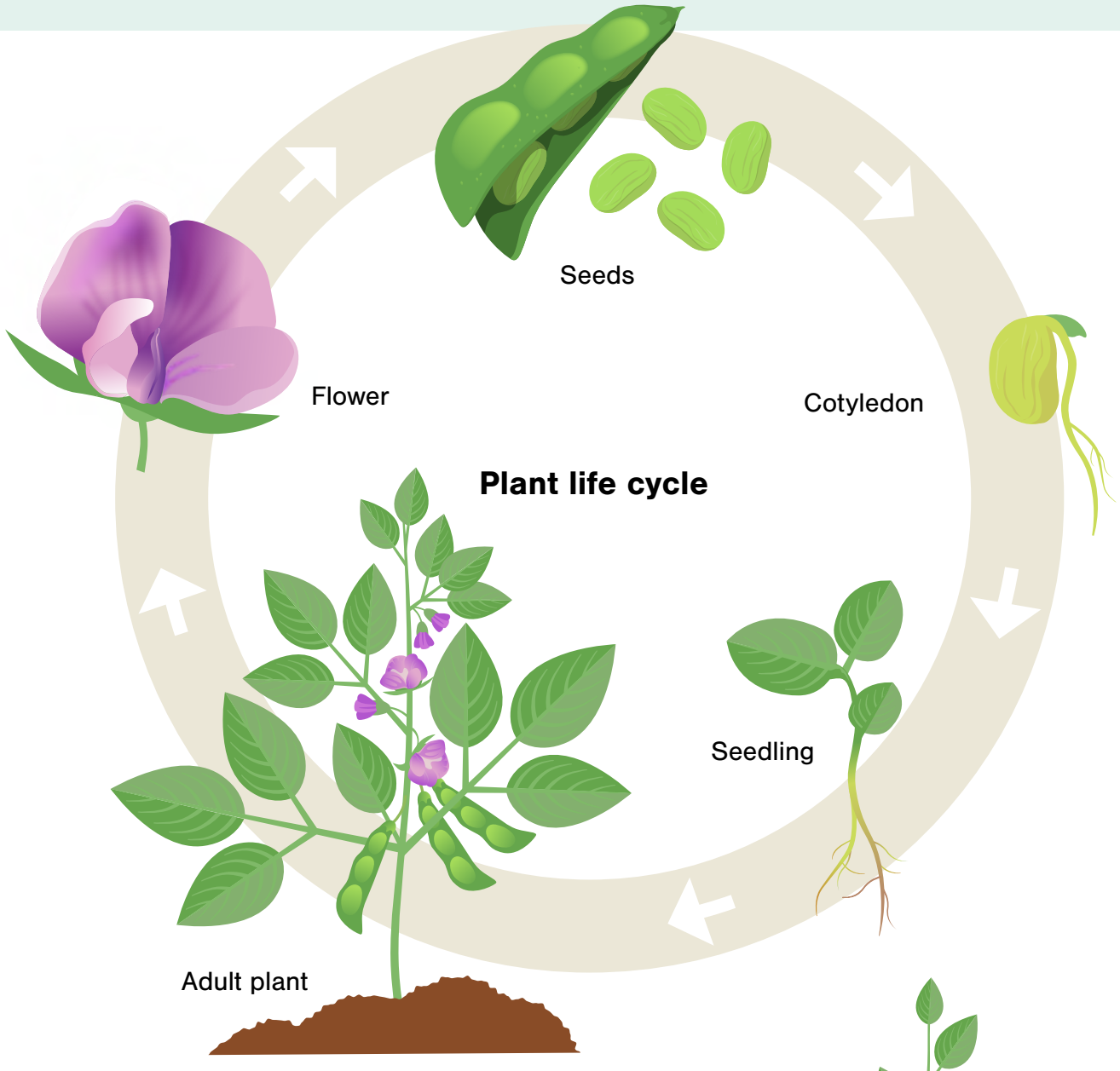
Some plants live for only a short period. But there are also trees that have lived for hundreds or thousands of years. Being able to adapt their growth patterns and respond to challenges in their environment has helped trees become some of the oldest beings on Earth.

— *Jennifer Junghans*

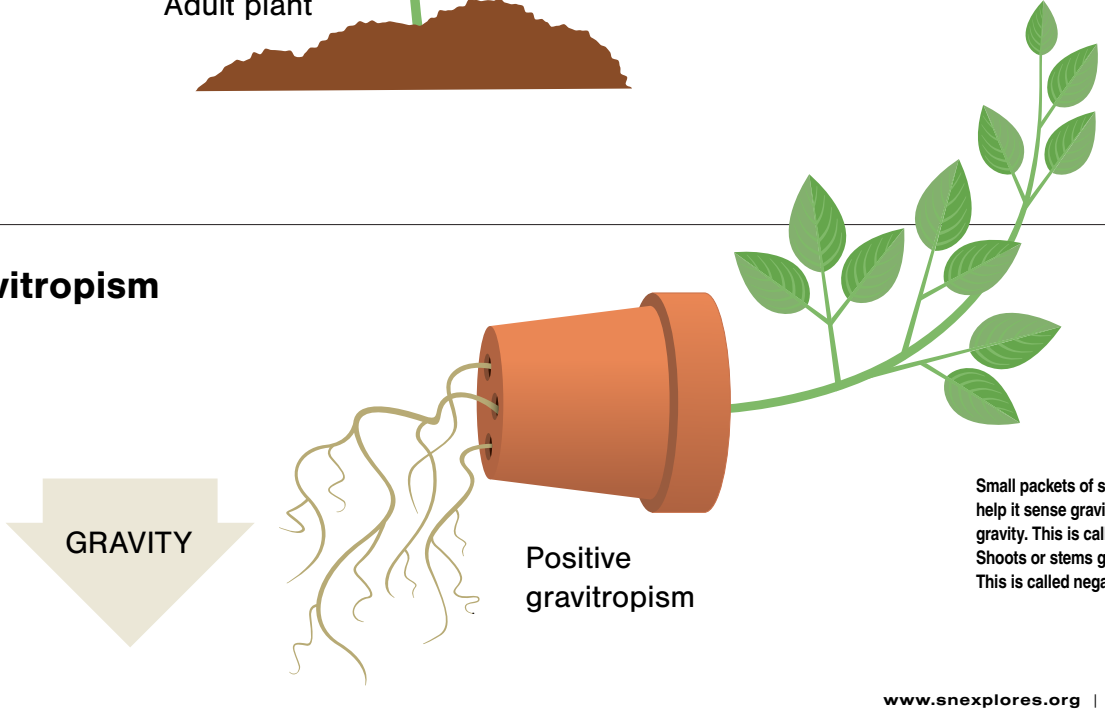


A kernel of corn is actually a seed. Inside the protective seed coat is the endosperm, which feeds the embryo. Add water, sunlight and the right temperature and the seed will start to grow a shoot pointing up and roots digging down. The radicle and hypocotyl create the roots. The epicotyl and cotyledon make the stems and leaves.

XPIXEL/SHUTTERSTOCK



Gravitropism



Small packets of starch in a plant's cells help it sense gravity. Roots grow toward gravity. This is called positive gravitropism. Shoots or stems grow away from gravity. This is called negative gravitropism.

ILLUSTRATION BY STEVE MCCRACKEN

ANIMALS

Fungus-resistant frogs kickstart new populations

Frogs immune to a deadly disease could help save their disappearing species

A deadly fungus has been wiping out amphibians around the globe. But some frogs that have developed resistance to the disease are helping their species bounce back.

Mountain yellow-legged frogs used to live in lakes all over California's Sierra Nevada Mountains. Their numbers started dropping in the past century when people brought into their habitat fish that eat frogs and tadpoles. Then in the 1970s, the deadly chytrid fungus arrived.

These frogs went from being super abundant to being one of the rarest amphibians in the United States, says Roland Knapp. He's a biologist at the Sierra Nevada Aquatic Research Laboratory in Mammoth Lakes, Calif. "By the early 2000s, the mountain yellow-legged frog was headed for extinction," Knapp says. They're now missing from more than 90 percent of the places where they used to live — their historic range.

In some spots, though, a few frogs survived. Their immune systems developed a way to fight off the fungus. Those rare resistant frogs passed on their ability to survive to their young, "which is amazing," Knapp says. Some populations even thrived.

Knapp realized that these resistant frogs might be able to kick-start new populations. In 2006, he and his colleagues started reintroducing frogs to habitats where their species had once lived.

Since then, they have done more than 100 reintroductions. After bringing frogs to their new homes, the researchers keep tabs on them, returning later to catch, identify and weigh them.

It took a long time before Knapp's team could tell if its efforts were paying off. The reintroduced frogs needed not only to survive but also to reproduce. And it takes six years for these frogs to mature to adults from eggs.

"After about 10 years from the first reintroduction, I finally convinced myself that this is working," Knapp says. That was "the best day of my life," he says. His team reported their results for 12 sites in *Nature Communications*.

Now that they know recovery is possible, the scientists want to reintroduce frogs to even more sites. They hope to boost mountain yellow-legged frog numbers across the species' historic range — the entire Sierra Nevada Mountains.

"We can all decide in our own way how we want to make the world a better place," Knapp says. "For me, that meant bringing frogs back to a place where they used to be so abundant."
— *Carolyn Wilke*

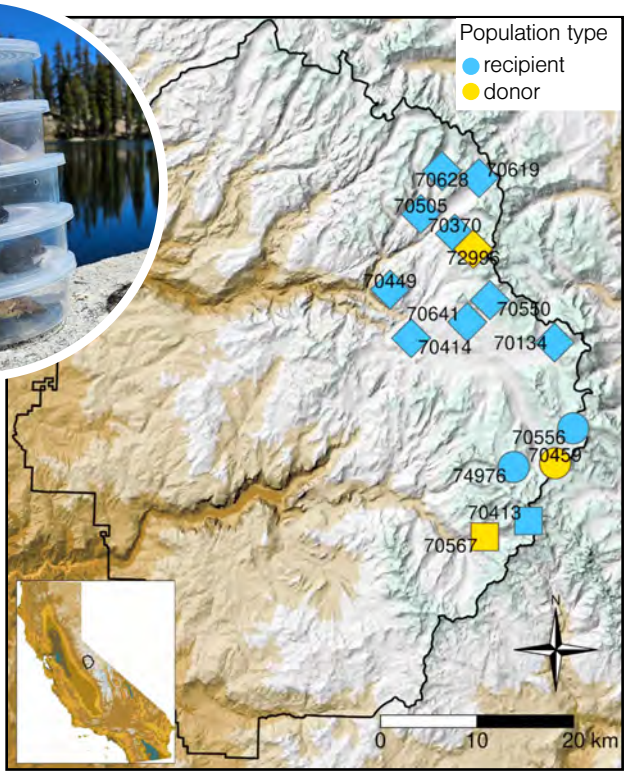
Predatory fish and a deadly fungus have greatly reduced the number of mountain yellow-legged frogs (one pictured) across California's Sierra Nevada Mountains.

R. KNAPP

HABITAT HOPPING

FIGURE A

Frogs traveled to their new homes in plastic containers with holes that let air in.



Mountain yellow-legged frogs include two species. One of those is the Sierra Nevada yellow-legged frog (*Rana sierrae*). In this study, Knapp's team introduced Sierra Nevada yellow-legged frogs 24 times to a total of 12 sites. These reintroductions, shown in Figure A, took place from 2006 to 2020. The scientists took frogs from "donor sites" (yellow markers). They moved these frogs to "recipient sites" where frogs were missing (blue markers). The shape of the markers (square, circle, diamond) shows which donor sites the frog transplants came from.

DATA DIVE

1. Look at Figure A. What's the farthest distance any frogs were moved? What's the shortest distance frogs were moved?

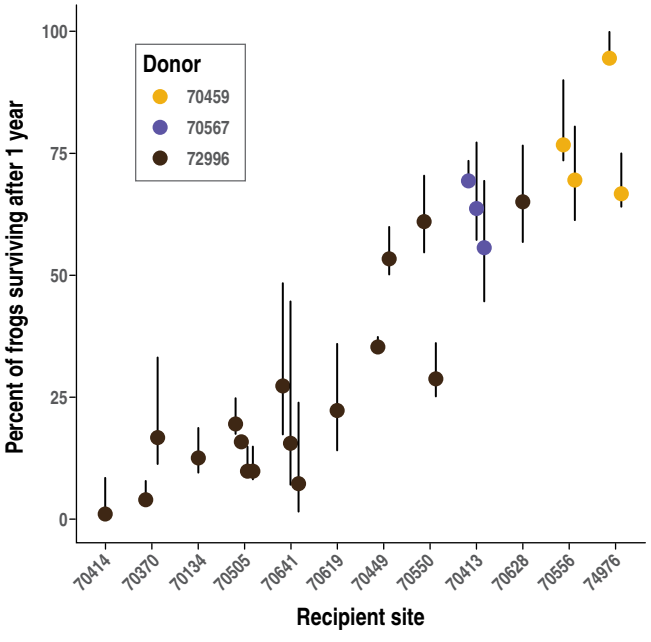
2. Which donor site is connected with the most recipient sites?

3. Look at Figure B. How many sites have a one-year frog survival above 50 percent?

4. Which donor sites are connected with the most successful recipient sites?

5. What aspects of sites do you think may influence whether frog reintroductions are successful?

FIGURE B



Each site has an identification number. Figure B shows the researchers' estimates of how well transplanted frogs survived one year after they were introduced (different donor sites are shown in different colors). Some sites have multiple data points because they had multiple frog relocations.

KNAPP ET AL/NATURE COMMUNICATIONS 2024

ANSWER

Nebula's mysterious glow fueled by stream of planetary debris

Beaming X-ray radiation could hold clues about the demise of a Jupiter-sized world

This illustration is a false-color image of the Helix Nebula, which is exploding in X-rays. In this image, ultraviolet radiation (blue) from a white dwarf at the center (not visible) heats a halo of dust and gas (yellow).

JPL-CALTECH/NASA

The Helix Nebula is like a colorful explosion frozen in time. This planetary nebula has a halo of gas cast off from a star losing nuclear fuel. At its center lies a white dwarf — the leftover heart of that once-mighty star. The white dwarf is not a quiet object. In fact, it appears to be constantly erupting X-rays.

The mystery of this never-ending X-ray explosion coming from a dead star may have finally been solved. The steady radiation may come from scorching-hot wreckage left behind by a giant planet's annihilation.

This discovery stems from X-ray observations of the Helix Nebula starting in 1980. It's located 650 light-years from Earth. The stream of X-ray radiation stayed constant over at least 10 years. Now, scientists suggest a convincing explanation. The ruins of a Jupiter-sized world are streaming toward the nebula's white dwarf. The collision makes the frazzled star glow in X-rays. Researchers reported their results in the *Monthly Notices of the Royal Astronomical Society*.

These X-rays could offer researchers a new way to explore the final chapters of planets. It could even help scientists study the core of these destroyed worlds.

— *Robin George Andrews*

INSIDE THE MIND OF A YOUNG SCIENTIST

A Regeneron Science Talent Search winner 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? Ava Cummings, second-place winner at the 2025 Regeneron Science Talent Search, shares her experience.

Q How did you share your findings with your community?

A Ava studied how well an Indigenous herb could treat STAC3 disorder. This inherited condition impairs muscle development and strength. Ava belongs to the Lumbee Tribe of North Carolina. STAC3 disorder was first identified in her tribe.

Ava attended a meeting of the American Indian Science and Engineering Society. There, she got to meet many Indigenous professionals and spread awareness about STAC3. Some people she met had their own experiences with STAC3. Some were studying other population-specific diseases. "Being able to make those connections and relationships was really fun," she says.

Q What's next for you?

A "I would like to continue researching STAC3," Ava says. But she wants to study Indigenous medicine for other diseases, too. "One, for example, is called GA1, Glutaric Acidemia Type 1," Ava says. "That's a liver disease that's also specific to my tribe."

Q Advice for research newbies?

A Start "with baby steps," Ava says. "I was very intimidated by seeing past projects that people had worked on. I would read their project titles, and I'm like, 'I can't pronounce or even begin to think what any of these words mean.'" But she's gotten to see her own project grow over the past year from a small seed of curiosity. "You're not gonna end up with this big discovery, big project overnight," she says.

Regeneron Science Talent Search Second Place Winner

Ava Cummings

Ava, 18, used the herb *Urtica dioica*, or common nettle, to treat fruit flies with STAC3 symptoms. Her findings shed light on ways Indigenous medicine may complement or even outperform modern drugs. Ava attended the North Carolina School of Science and Mathematics in Durham.

Learn more about the Regeneron Science Talent Search

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