

Harlequin Frogs Make a Comeback | Can Science Banish Nightmares?

ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE ■ DECEMBER 3, 2022

BACK TO THE MOON

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COVER The launch of NASA's Artemis I (shown in an artist's illustration) was a big step toward returning people to the moon. *Liam Yanulis/NASA*



FROM TOP: AL POWERS/ZERO-G; JOSE A. BERNAT BACETE/MOMENT/GETTY IMAGES PLUS; K. JAYNES



Farewell to one of the greats of *Science News*

Science News was founded with a mission to combat disinformation by giving people accurate information about science. Kendrick Frazier dedicated his life to that cause. I was saddened to learn of his sudden passing in November, at age 80. He was one of *Science News*' proudest supporters, first as a reader, then starting in 1969 as a reporter covering mostly earth sciences and then as editor in chief.

After Frazier left *Science News*, he spent decades as editor of the *Skeptical Inquirer*, but he never really left the *Science News* family. "Being at *Science News* was my dream, since I had been a reader for many, many years as a young person," Frazier told Maria Temming, assistant editor of *Science News Explores*, when she interviewed him while researching the history of *Science News* for our centennial (SN: 3/26/22, p. 16).

He was especially proud of our rigorous (some might say obsessive) standards of accuracy: "It's a quality, reliable, respectable science news source," he told Temming, "and I've always been proud of it, because we always — and you always — put scientific discoveries in perspective."

When I was named editor in chief in 2018, Frazier sent me a kind and encouraging e-mail. He was a close reader of every word we published, and I came to relish our e-mail and phone conversations. We talked about how *Science News* covered politically contentious issues back in the 1970s, about how we were managing the challenges of covering the pandemic and climate change, and about the surge in global misinformation surrounding those issues, such as the falsehood that COVID-19 vaccines cause infertility.

In fact, reporting for *Science News* is what helped spark Frazier's interest in challenging disinformation, Temming says. In 1976, he covered a meeting where astronomer Carl Sagan, psychologist B.F. Skinner, science fiction author Isaac

Asimov and other luminaries pledged to give the public "access to facts by which they can judge the validity of unusual claims." The cover art for Frazier's article (at left) is mind-bending (this was the '70s, after all). Like it? You can buy it on a T-shirt at www.societyforscience.org/store

I will miss my conversations with Frazier, both for his deep insights and his unflinching kindness. I will always remember his delight in our work and in the work of all science journalists. And I will remember his joy in defending science against charlatans and propagandists. It was the joy of a battle well fought.
— Nancy Shute, Editor in Chief



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Science News (ISSN 0036-8423) is published 22 times per year, bi-weekly except the first week only in May and October and the first and last weeks only in July by the Society for Science & the Public, 1719 N Street, NW, Washington, DC 20036.

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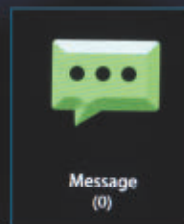
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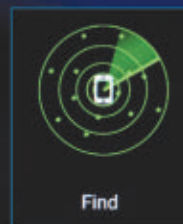
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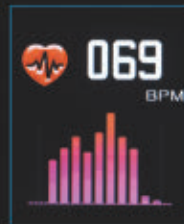
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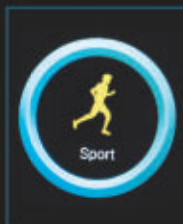
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Excerpt from the December 2, 1972 issue of *Science News*

50 YEARS AGO

The cosmic speed limit

A group at the National Bureau of Standards at Boulder, Colo., now reports an extremely accurate [speed of light] measurement using the wavelength and frequency of a helium-neon laser.... The result gives the speed of light as 299,792.4562 kilometers per second.

UPDATE: That 1972 experiment measured the two-way speed of light, or the average speed of photons that traveled from their source to a reflective surface and back. The result, which still holds up, helped scientists redefine the standard length of the meter (*SN*: 10/22/83, p. 263). But they weren't done putting light through its paces. In the late 1990s and early 2000s, photons set a record for slowest measured speed of light at 17 meters per second and froze in their tracks for one-thousandth of a second (*SN*: 1/27/01, p. 52). For all that success, one major hurdle remains: directly testing the one-way speed of light. The measurement, which many scientists say is impossible to make, could resolve the long-standing question of whether the speed of light is uniform in all directions.



This aye-aye, named Kali, was caught by a low-light camera sticking her extra-long, skinny middle finger up her nose and then licking off the snot — making her kind the 12th known species of primate to eat their own boogers.

HOW BIZARRE

Aye-eyes take nose picking to the extreme

Aye-eyes are champion nose pickers.

A new video offers the first evidence that these nocturnal lemurs of Madagascar stick their fingers up their noses and lick off the mucus. They don't use just any finger for the job, either. The primates go spelunking for snot with the ultralong, witchy middle

finger they typically use to find and fish grubs out of tree bark.

A reconstruction of the inside of an aye-aye's head based on CT scans shows that this spindly digit probably pokes all the way through the animal's nasal passages to reach the throat, researchers report October 26 in the *Journal of Zoology*.

"My first take was that it's a cool — and a bit creepy — video," says Michael Haslam, a primate archaeologist based in Orkney,

TEASER

Mixing gold ions into whiskey can reveal its flavor

A new kind of "gold standard" could soon permeate the whiskey industry.

Whiskey distillers typically age spirits in charred, wooden casks for years, allowing the liquor to gradually absorb flavorful chemicals released from the wood. Now, scientists have shown that swirling gold ions into a whiskey can reveal how much flavor the liquor has — a quality called agedness. The findings, reported in the Oct. 28 *ACS Applied Nano Materials*, could provide master blenders with a quick, inexpensive test for agedness.

"A tiny amount of gold gives you this really bright, strong, red or blue or purple color," says chemist William Peveler of the University of Glasgow in Scotland. The stronger the color and the quicker it arises, the more aged the whiskey, he says.

Peveler's team was inspired by past research showing that various chemicals, from neurotransmitters to poor-tasting compounds in maple syrup, can trigger gold ions in a solution to coalesce into ultratiny gold nuggets, or nanoparticles. The team mixed solutions containing less than a penny's worth of gold ions into different whiskey blends and a vodka. No nuggets formed in the vodka. But the ions reacted with whiskey congeners, flavorful chemicals absorbed from wood casks, to form nuggets in minutes. The nuggets' sizes and shapes varied among whiskeys, causing the spirits to flourish with different colors. Next, the team plans to investigate how the nuggets grow alongside alcohols and sugars to develop an even more robust test for agedness. — *Nikk Ogasa*



Whiskey distillers could use gold ions to determine whether a cask is ready to be bottled or blended.

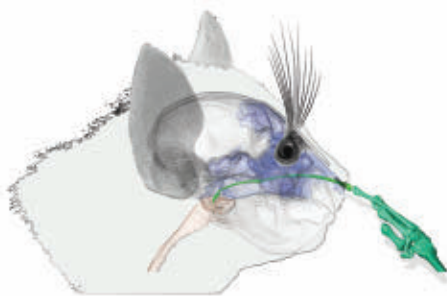
FROM TOP: © A.-C. FABRE; JOSE A. BERNAT BACETE/MOMENT/GETTY IMAGES PLUS

Scotland, who was not involved in the work. But the researchers “have gone beyond that initial reaction of ‘What on Earth?’ to actually explore what’s happening inside the animal,” Haslam says.

The footage stars Kali, a female aye-aye (*Daubentonia madagascariensis*) at the Duke Lemur Center in Durham, N.C. “The aye-aye stopped eating and started to pick its nose,” says evolutionary biologist Anne-Claire Fabre, who filmed the video. “I was wondering where the finger was going.” An aye-aye is about as big as a house cat, but its clawed middle finger is some 8 centimeters long. And Kali was plunging almost the entire digit up her snout then pulling it out to sample her own snot with dainty licks.

Fabre, of the Natural History Museum Bern in Switzerland, asked colleagues if they had ever seen an aye-aye pick its nose. “The ones that were working a lot with aye-ayes would tell me, ‘Oh, yeah, it’s happening really often,’” she says.

Fabre and colleagues were curious



A reconstruction of an aye-aye’s head, based on CT scans, reveals that when the primate picks its nose, the tip of the long middle digit probably reaches the back of the throat.

about how many other primate species have been caught with their fingers in their nostrils. The team searched for past studies and other videos documenting the behavior.

Unfortunately, most of the studies were jokes, Fabre says. “I was really surprised, because there is a lot of literature on other types of pretty gross behaviors,” such as poo-eating among animals (SN: 8/28/21, p. 18). But between

all the bogus articles, the team did find some real reports of primate nose picking, including research done by Jane Goodall in the 1970s.

Aye-ayes are now the 12th known species of primate, including humans, to pick their noses and snack on the snot, the team found. Others include gorillas, chimpanzees, bonobos, orangutans and macaques. Nose pickers tend to be tool-using primates with great dexterity.

The work “raises questions about just how much of this behavior is happening out there, unseen or unreported,” Haslam says. He remembers once seeing a capuchin monkey using a twig or stem to pick its nose.

It’s unclear whether the habit has some advantage. Perhaps eating germ-laden boogers boosts the immune system. For now, untangling the evolutionary origin and potential perks of nose picking will require a more complete census of what species mine and munch on their own mucus. — *Maria Temming*

SCIENCE STATS

Deer-vehicle collisions spike when daylight saving ends

People pay “deerly” for the switch from Daylight Saving Time.

The change to standard time in the United States in autumn corresponds with an average 16 percent increase in deer-vehicle collisions the following week, scientists report November 2 in *Current Biology*. Making Daylight Saving Time permanent could save nearly 37,000 deer — and 33 human lives, the team estimates.

In a typical year, there are more than 2 million deer-vehicle collisions — about 7 percent of total vehicle crashes. To see how much the biannual time change impacts those numbers, wildlife biologist Laura Prugh and colleagues compiled data from 23 states that tracked whether a crash involved an animal and around what time the crash occurred. The team compared those numbers to traffic volumes for each state between 2013 and 2019, focusing on the week before and after the switches to Daylight Saving Time in spring and standard time come fall.

Springing forward had little effect, but almost 10 percent of yearly deer collisions on average took place around the autumn fallback — when the bulk of human traffic shifted to after dark. The problem was especially acute on the East Coast. “You see [a] really steep spike in the fall,” says Prugh, of the University of Washington in Seattle. “In the Western



states, you also see an increase, but it’s not nearly as sharp.” On the East Coast, the autumn switch falls in the middle of mating season for white-tailed deer. Not only are more drivers active after dark, more deer are too. “The timing could not be worse,” Prugh says.

Eliminating the clock change wouldn’t completely wipe out the spike in crashes — mating season plays a big role, regardless of what time sunset happens. But the scientists estimate that keeping Daylight Saving Time year-round would decrease total deer-human collisions by about 2 percent — saving dozens of people, thousands of human injuries and tens of thousands of deer. — *Bethany Brookshire*



LIFE & EVOLUTION

These frogs aren't extinct after all

Dozens of harlequin species have escaped death by fungus

BY FREDA KREIER

Across Central and South America, one group of bejeweled frogs is making a comeback.

Harlequin frogs—a genus with nearly 100 species—were one of the groups of amphibians hit hardest by a skin-eating chytrid fungus that rapidly spread around the globe in the 1980s (SN: 4/27/19, p. 5). The group is so susceptible to the disease that with the added pressures of climate change and habitat loss, around 70 percent of known harlequin frog species are now listed as extinct or critically endangered.

But in recent years, roughly one-third of harlequin species presumed to have gone extinct since the 1950s have been rediscovered, researchers report in the December *Biological Conservation*.

The news is a rare “glimmer of hope” in an otherwise bleak time for amphibians around the globe, says conservation biologist Kyle Jaynes of Michigan State University's W.K. Kellogg Biological Station in Hickory Corners.

For Jaynes, the path to uncovering how many harlequin frogs have returned from the brink of extinction started when he heard about the Jambato harlequin frog (*Atelopus ignescens*). This black and orange frog was once so widespread in the Ecuadorian Andes that its common name comes from the word *jampatu*, which means “frog” in Kichwa, an Indigenous language of the area.

Then came the fungus. From 1988 to 1989, the frogs “just completely disappeared,” Jaynes says. For years, people searched for traces of them. Scientists ran extensive surveys, and pastors offered rewards to their congregants for anyone that could find a frog.

Then in 2016, a boy discovered a small population of Jambato frogs in a mountain valley. For a species that had been missing for decades, “it seemed like a miracle,” says Luis Coloma, a researcher and conservationist at the Centro Jambatu de Investigación y Conservación de Anfibios in Quito, Ecuador.

Coloma runs a breeding program for Jambato and other Ecuadorian frogs threatened with extinction. In 2019, Jaynes was part of a group of researchers visiting Coloma's lab to see if they could work out how these frogs had cheated death. After the rediscovery of the Jambato frogs, the team started hearing about other missing harlequin species

Ecuador's iconic Jambato harlequin frog was thought to have gone extinct in the late 1980s. In 2016, it became one of many members of its genus to be rediscovered.

being spotted for the first time in years.

Those stories led Jaynes, Coloma and their colleagues to comb through reports to see just how many harlequin frogs had reappeared. Of the more than 80 species to have gone missing since 1950, as many as 32 species have been spotted in the last two decades—a much higher number than the team had expected. “I think we were all shocked,” Jaynes says.

The news comes with caveats. For one thing, it seems like most species avoided disappearing by a hair, and their numbers are still dangerously low. So extinction is still very much on the table. “We've got a second chance here,” Jaynes says. “But there is still a lot we have to do to conserve these species.”

Ensuring the continuation of the rediscovered species will depend in part on understanding how they've managed to survive. Some scientists have speculated that amphibians at higher elevations might be more susceptible to the fungus since it prefers lower temperatures.

But a cursory analysis by Jaynes and colleagues reveals that harlequin frogs have been rediscovered at all elevations across their range. That indicates something other than temperature may be at play. Jaynes suspects there could be a biological basis for the frogs' survival, such as having developed resistance to the fungus.

Studies like this one can serve as a “launching pad” for understanding how amphibians might survive the dual threats of disease and climate change, says Valerie McKenzie, a disease ecologist at the University of Colorado Boulder who was not involved with the study.

In the meantime, the fact that people are starting to notice the reemergence of species that were once thought to be gone forever “gives me a lot of hope that other species that are harder to observe—because they're nocturnal or live high in the canopy—are also recovering,” McKenzie says. “It motivates me to think we should go look for them.” ■

A long-lost star catalog has been found

Bits of the ancient Greek map had been erased and overwritten

BY LISA GROSSMAN

Fragments of a star catalog from the second century B.C. have turned up in a manuscript that had been erased and written over centuries later. A new analysis of the religious manuscript shows that the hidden text is probably from the ancient Greek astronomer Hipparchus, whose map of the stars — thought to be the first attempt to map the visible sky — has long been considered lost.

“I think this lays to rest doubts about the existence of Hipparchus’ catalog” and confirms that he was “trying to measure coordinates for all of the visible stars,” says Victor Gysembergh, a historian of ancient science at CNRS in Paris. He and colleagues reported the discovery in the November *Journal for the History of Astronomy*.

The manuscript that concealed the fragments was a palimpsest, or a parchment that had been erased and reused, called the *Codex Climaci Rescriptus*. The codex probably comes from Saint Catherine’s Monastery of Mount Sinai in Egypt. Most of it is currently housed at the Museum of the Bible in Washington, D.C.

The visible writing is a Christian text called the Ladder of Paradise. But shadows of earlier symbols are visible behind it. In 2017, researchers with the Early Manuscripts Electronic Library in Rolling Hills Estates, Calif., and the Rochester Institute of Technology in New York took digital pictures of the codex in many wavelengths of light, from many different angles. This technique is called multispectral imaging and is used to analyze palimpsests and other damaged documents. Light that reflects off ink remnants, or that makes the ink fluoresce, highlights the hidden text. Digitizing the pages then allows researchers all over the world to study the documents without leaving their computers.

Biblical scholar Peter Williams of the University of Cambridge was studying the digitized codex during a COVID-19

lockdown. His team had previously found ancient poetry about astronomy beneath the main text. This time, he also found something that looked like astronomical measurements.

Williams reached out to Gysembergh and historian Emanuel Zingg of Sorbonne University in Paris for help. Gysembergh immediately thought of Hipparchus.

Hipparchus was a Greek astronomer and mathematician who lived between about 190 and 120 B.C. Indirect evidence suggests that he made the first star catalog that used two coordinates to uniquely define a position in the sky, rather than describing constellations’ positions relative to each other.

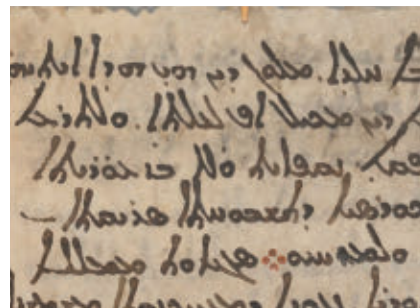
“Most scholars believe there was such a catalog,” says Mathieu Ossendrijver, a historian of astronomy at Free University Berlin who was not involved in the work. But the best evidence for it came from poor translations or references in later catalogs, like that of astronomer Claudius Ptolemy in Alexandria, Egypt, who lived a few centuries after Hipparchus.

To test the idea that the fragment was part of Hipparchus’ catalog, the team first painstakingly translated the revealed passage. “A lot of it was, ‘Can you read this? I can’t,’” Gysembergh says. “We would struggle over every letter, every numeral.”

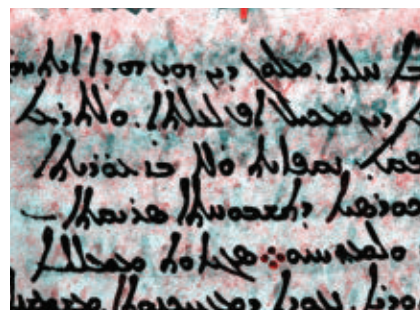
The passage turned out to be a description of the constellation Corona Borealis, the northern crown, giving numerical coordinates for several of its stars. The coordinates were written in an unusual notation that is thought to have been used by Hipparchus and no one else.

Next, the team used planetarium software to calculate where those stars would have been in the sky in 129 B.C., when Hipparchus was alive and working. Those calculations matched the ancient manuscript’s notations to within one degree.

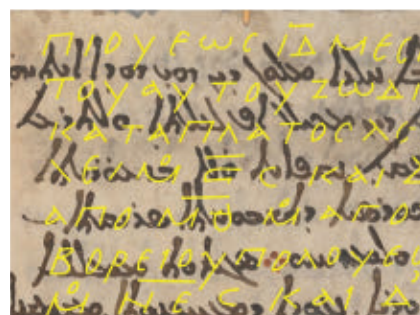
“It’s quite clear that it is actually a well-preserved, well-copied, not much distorted part of the original catalog of Hipparchus,” Ossendrijver says. “It’s



In a religious manuscript called the *Codex Climaci Rescriptus*, shadows of erased text are visible in ordinary light.



When exposed to different wavelengths of light during multispectral analysis, the undertext (red) became more visible.



The analysis revealed Greek text (yellow) describing the constellation Corona Borealis.

really an important discovery.”

Astronomers in ancient Babylonia may have had their own star catalog that was written even earlier, Ossendrijver says. Hipparchus may have picked up the idea of making a catalog — and perhaps even some concrete data — from Babylonians, he suggests.

Gysembergh is hopeful that more of the Hipparchus catalog could turn up in other parts of the *Codex Climaci Rescriptus*, or in other texts that haven’t been analyzed with multispectral imaging yet. “There’s so much more to find,” he says. “We’ve hardly scraped the surface.” ■



Data about the health of San Francisco's Golden Gate Bridge collected from cell phones moving across it rivaled that of dedicated instruments.

MATH & TECHNOLOGY

Cell phones track bridge integrity

Crowdsourcing phone data could help keep bridges safe

BY JAMES R. RIORDON

Your cell phone could reveal the health status of bridges just by being in your pocket as you go about your daily travels.

Accelerometers and GPS sensors that are standard components in smartphones collect information that can show how bridges flex and vibrate as vehicles travel across them, researchers report November 3 in *Communications Engineering*.

Apps that gather the measurements could help keep travelers safe by alerting engineers that a bridge needs repair. The tools could also warn of or help prevent catastrophic failures, like the tragic footbridge collapse in the western Indian state of Gujarat on October 30, or the bridge span that crumbled in Pittsburgh in January.

"This is really applicable to any type of bridge," says civil engineer Thomas Matarazzo of the U.S. Military Academy at West Point in New York. All you need, he says, is a way to get a smartphone on there—whether by car, in the pocket of a pedestrian or mounted to a scooter—and some way of monitoring the device (SN: 12/9/17, p. 14).

Bridge failures often come down to uncertainties about structural properties,

Matarazzo says. "The only way to reduce those uncertainties is to monitor more frequently." Crowdsourcing data from cell phones may be the best, and possibly only, way to get lots of data on bridges around the globe.

More than 600,000 bridges exist in the United States alone. Dedicated sensors that check for structural problems are expensive, Matarazzo says, so most bridges are inspected by eye, typically every other year.

Keeping up on bridge conditions using simple smartphone apps could make maintenance more efficient than is possible with human inspectors alone—and much cheaper than is possible with specialized sensors. The resulting improvement in care could extend the lifetimes of older bridges by a few years, Matarazzo and colleagues estimate. New bridges could last nearly 15 years longer than if they weren't monitored in this way before needing to be replaced.

To test how well cell phones could monitor bridges, Matarazzo drove over the Golden Gate Bridge in San Francisco 102 times with cell phones in his car. His team also collected data from Uber drivers during 72 trips over the suspension bridge. To check the technique on bridges more typical of the overpasses that are common on roadways, the researchers arranged for drivers to record data during 280 passes over a nearly 30-meter-long concrete bridge in Ciampino, Italy.

For both bridges, the cell phone sensors detected vibrations in the structures that were within a few percent of the

measurements that dedicated instruments attached to the bridges could provide.

A single pass with a cell phone gathers as much information about a bridge as a hundred or more stationary sensors, Matarazzo says. That's because phones can take data continuously as they cross, rather than offering data from specific locations along a bridge.

If the researchers manage to get transportation companies, government vehicle operators or the public to collaborate, the team could rack up much more information, leading to extremely precise measurements. Because most phones already have accelerometers and GPS, information could be collected essentially for free.

Cell phones could help monitor bridges that lack installed sensors, says Huili Wang, a civil engineer at the Dalian University of Technology in China. But Wang has doubts about the accuracy that smartphones can provide. Still, "it is a better approach for a rough estimate without [adding] more sensors," he says.

Crowdsourced data probably wouldn't entirely replace dedicated bridge sensors. But cell phones are unbeatable in a few ways, Matarazzo says. "The advantage is in the convenience and the scale.... It's a mobile-sensing system that's already in place."

Bridges are key parts of the transportation infrastructure. It's crucial to look at changes in them that can occur in days and weeks, Matarazzo says, rather than checking on bridges every couple years. "This technology enables us to do that." ■

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This is a lunar rover.

Students from Michigan Technological University want to shine a light on the darkest places of the moon. Their design, a rover called Tethered permanently shadowed Region EXplorer (T-REX), deploys a lightweight, superconducting cable to keep other lunar rovers powered and provide wireless communication as they operate in the extreme environments of the moon's frigid, lightless craters.

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GENES & CELLS

Asthma drug helps tame cat allergies

Pairing an antibody with standard shots brings lasting relief

BY TINA HESMAN SAEY

Adding lab-made antibodies to allergy shots may better groom the immune system against cat allergies than standard shots alone, a new study finds.

Allergy shots, a type of immunotherapy, have been used for over a century to reduce allergy symptoms. The shots contain tiny amounts of the things people are allergic to. People get shots weekly to monthly and gradually build tolerance.

Scientists don't know exactly how the shots work, says allergist Lisa Wheatley of the National Institute of Allergy and Infectious Diseases. Some people are essentially cured after a few years of treatment; others need shots indefinitely.

Wheatley and colleagues wanted to see if they could improve allergy therapy by reducing the treatment period while still giving patients long-lasting relief. When allergies strike, some immune cells produce alarm chemicals that trigger inflammation and other symptoms. "If we could dampen the signaling that says 'danger,' we could maybe improve immunotherapy," Wheatley says.

Her team used a monoclonal antibody called tezepelumab to block one of those alarm chemicals, known as thymic stromal lymphopoietin, or TSLP. The antibody has been used as an asthma treatment, so researchers know it's generally safe.

The team gave 121 cat allergy sufferers either allergy shots, tezepelumab, a combination of the two or a placebo. By itself, tezepelumab was no better than a placebo.

But after a year of treatment, people who got the combo therapy had a greater reduction in allergy symptoms to cat dander than people who got just allergy shots, the team reports October 9 in the *Journal of Allergy and Clinical Immunology*.

In people who got the combination, levels of allergy-triggering antibodies called IgE fell and kept falling even a year after treatment ended. In people on the standard shots, IgE levels started to claw their way back to baseline once treatment stopped, Wheatley says.

One reason the therapy may work is that it alters inflammation-triggering gene activity in some immune cells, the team found. Mast cells made less tryptase — one of the major chemicals released in an allergic reaction — in people who got the combination therapy.

The results are encouraging, but it's not clear that tezepelumab would work as well for other allergies, says Edward Zoratti, an allergist and immunologist at Henry Ford Hospital in Detroit. "Did they just get lucky and choose the right allergen?"

Cat allergies develop against a single sticky protein called Fel d1 present in cat saliva and dander (SN: 2/15/20, p. 16). Cockroach allergies, in contrast, can be produced by a variety of proteins.

But the study is important for understanding how allergy therapies work, he says. "It's one step in a long chain that will probably lead us to a really useful therapy in the future." ■

For some people, cats can cause sneezing, itching and other miserable symptoms. Adding an antibody to allergy shots may better calm those reactions than shots alone.



BODY & BRAIN

Invasive mosquito spreads malaria

In Africa, an intruding insect is a particular problem for cities

BY JAKE BUEHLER

In the first half of 2022, malaria cases in Dire Dawa, Ethiopia, surged, with more than 2,400 people sickened. The spike in infections was the work of an invasive mosquito called *Anopheles stephensi*.

That finding, presented November 1 at the annual American Society of Tropical Medicine and Hygiene meeting in Seattle, shows that the invasive species can drive malaria outbreaks. Because this species can thrive in urban environments, it brings the threat of malaria to potentially many millions of more people across Africa.

In Africa, *An. gambiae* is the main malaria vector. *An. stephensi* — which spreads malaria in its native Pakistan, India and the Persian Gulf — was first reported in Africa in 2012 in Djibouti. Since then, it has turned up elsewhere on the continent, including in Ethiopia, Somalia and Nigeria.

In the eight years since the mosquito's arrival, annual cases of malaria in Djibouti have increased 40-fold to over 70,000 cases per year, says Fitsum Girma Tadesse, a molecular biologist at the Armauer Hansen Research Institute in Addis Ababa, Ethiopia. But no one had directly linked *An. stephensi* to the increase.

So when malaria cases suddenly rose in Dire Dawa — from 27 cases to 260 in just three weeks in early 2022 — Tadesse and his team jumped in to investigate.

The researchers tracked 80 patients in the city who had sought care for malaria at a local or university clinic, plus 210 patients who had sought treatment for other reasons. The team also screened the patients' household members for malaria and scanned for the presence of mosquitoes within a 100-meter radius of patients' households or university dormitories.

Households and dorms close to aquatic habitats harboring *An. stephensi* larvae were more than three times as likely as those not close by to have a family or dorm

member test positive for malaria. And 97 percent of the adult mosquitoes caught by the team were *An. stephensi*, the only type of mosquito found carrying malaria.

An. stephensi “prefers to breed in water storage containers that are typically common in rapidly expanding urban settings,” Tadesse says. The native *An. gambiae* tends to use natural water sources like small pools, which are more common in rural areas. With the expansion of *An. stephensi* alongside urbanization in Africa, there’s concern that the mosquito could exploit many new sources of water stores.

“This expands the malaria problem from a predominantly rural problem to an urban problem,” says Teun Bousema, an epidemiologist at Radboud University in Nijmegen, Netherlands.

A 2020 study estimated that if the invasive mosquito were to spread widely in Africa, an additional 126 million people in cities could be at risk of malaria.

An. stephensi “has a number of characteristics that make it difficult to control,” says Tanya Russell, an entomologist at James Cook University in Cairns, Australia. Not only can the insects lay their eggs in nearly any available water source, but the eggs can also survive being dry for long periods of time. “This is very uncharacteristic for malaria vectors.”

Using insecticide-treated bed nets and spraying a residual insecticide indoors are the primary control approaches for malaria-carrying mosquitoes, Russell says. But since *An. stephensi* also bites outdoors, its spread may blunt the tools’ efficacy.



In Africa, the invasive *Anopheles stephensi* mosquito may bring malaria to more cities.

The next steps, Tadesse says, are interventions to reduce malaria transmission, including targeting mosquito larvae with chemicals and encouraging communities to cover and secure water containers.

“The window of opportunity to do something about this species is closing,” Bousema adds. “So I really think this calls for very urgent action.” ■

BODY & BRAIN

Learning trick puts nightmares to bed

Memory enhancer boosts treatment for a scary sleep disorder

BY JACKIE ROCHELEAU

For people haunted by recurring nightmares, untroubled sleep would be a dream come true. Now, neuroscientists have demonstrated a technique that, for some, may chase the bad dreams away.

Enhancing the standard treatment for nightmare disorder with a memory-boosting technique cut down average weekly nightmares from three to nearly zero for people in a small study, researchers report October 27 in *Current Biology*.

“The fact that they could actually make a big difference in the frequency of those nightmares is huge,” says neuroscientist Gina Poe of UCLA.

People with nightmare disorder have frequent nightmares that disturb sleep and even affect well-being in waking life. The go-to treatment is imagery rehearsal therapy, or IRT. Patients reimagine nightmares with a positive spin, mentally rehearsing the story line while awake. It helps most patients but fails for nearly a third.

To boost IRT’s power, neuroscientist Sophie Schwartz of the University of Geneva and colleagues leveraged a technique called targeted memory reactivation,

or TMR. A person focuses on learning something while a sound plays, and that same cue plays during sleep. During sleep, which is important for memory storage, experiencing the cue may reactivate and strengthen the associated memory.

The researchers gave 36 people with nightmare disorder training in IRT, randomly assigning half of them to rehearse their revised nightmares in silence. The other half rehearsed while a short piano chord, the TMR cue, played every 10 seconds for five minutes.

For two weeks, participants practiced IRT daily and kept a dream diary. While they slept, a headband recorded electrical activity in the brain and tracked sleep stages. The piano chord served as a dream soundtrack, with the headband sounding off every 10 seconds during rapid eye movement, the sleep stage associated with dreaming. The headband played the sound for all participants.

TMR nearly vanquished the nightmares, bringing the weekly average down from three to 0.2 for those trained on the chord, and even encouraged happier dreams. The group that received only IRT improved too,

but still averaged one weekly nightmare after starting with an average of three.

The TMR-IRT combo also had more staying power three months after treatment ended, with that group’s average rising only slightly from about 0.2 to 0.3 nightmares a week, while the IRT-only group’s jumped to 1.5.

Larger studies are needed to test how generalizable this treatment combination is. This study included only young adults, ages 20 to 35, who had nightmare disorder and no other psychiatric conditions. The study also didn’t compare IRT and TMR with no treatment, though previous studies have shown how effective IRT can be.

If a TMR-IRT combo proves to be effective, it still has a way to go before it’s widely accessible. Commercially available sleep trackers in watches and rings have yet to distinguish between sleep stages as accurately as brain-monitoring tools.

Even with these caveats, the results are encouraging, Poe says. She suggests that future studies test whether the TMR-IRT combination can help people with post-traumatic stress disorder, in which nightmares rehash traumatic events.

Schwartz wants to try. “I’m not sure we’ll succeed with these particular patients,” she says. “But if we do, this would be a really important addition to the methods we have for treating PTSD.” ■

ATOM & COSMOS

Magma may flow beneath Mars

An analysis of Marsquakes hints at volcanic activity

BY KATHERINE KORNEI

Mars might be not quite dead, geologically speaking.

Researchers have analyzed a slew of recent temblors on the Red Planet and shown that these Marsquakes are probably caused by magma moving deep under the Martian surface. That's evidence that Mars is still volcanically active, the team reports October 27 in *Nature Astronomy*.

Since touching down on Mars in 2018, NASA's InSight lander has detected more than 1,300 Marsquakes. Its seismometer records seismic waves, which reveal information about a temblor's size and location.

Previous studies determined that several Marsquakes originated from Cerberus Fossae, a fault-riddled region that is more than 1,000 kilometers from InSight. But



A relatively young fracture cuts through hills and craters in Mars' heavily faulted Cerberus Fossae region, seen in this 2018 image taken by the Mars Express orbiter.

most of the quakes linked to the region had low-frequency seismic waves, similar to earthquakes, says planetary scientist Anna Mittelholz of Harvard University.

Mittelholz and colleagues have now analyzed a large sample of Marsquakes, including more than 1,000 high-frequency temblors that look nothing like their earthly brethren. To better understand the origin of the high-frequency quakes, whose signals are often relatively weak, the team stacked the quakes' seismic waves. In the combined data, the team saw a peak in the amount of seismic energy coming from the direction of Cerberus Fossae.

The work is impressive, says Hrvoje Tkalčić, a geophysicist at the Australian National University in Canberra. "No study before this one attempted to locate the high-frequency quakes."

Finding different types of Marsquakes concentrated in one region is surprising. Previous research had suggested that Marsquakes might be due to Mars' surface cooling and shrinking over time, which would produce temblors that are evenly spread over the planet, Mittelholz says.

The researchers also compared Mars' seismic waves with those from different regions on our own planet. Data from the low-frequency Marsquakes in Cerberus Fossae were most consistent with data from Earth's volcanic regions. That suggests magma moving below Mars' surface produced those quakes. And because high-frequency quakes emanate from the same region, magma might be responsible for those too. Rather than being a geologically dead planet, as some have suggested, Mars might be a surprisingly dynamic place. ■

LIFE & EVOLUTION

Insect swarms might electrify the sky

Locusts could generate as much static electricity as storm clouds

BY DARREN INCORVAIA

You might feel a spark when you talk to your crush, but romance isn't required for living things to make electricity. A study published October 24 in *iScience* suggests that the electricity naturally produced by swarming insects like honeybees and locusts is an unappreciated contributor to the atmosphere's overall electric charge.

"Particles in the atmosphere easily charge up," says physicist Joseph Dwyer of the University of New Hampshire in Durham. "Insects are little particles moving around the atmosphere."

But the role that insect-induced static electricity plays in the atmosphere's electric field — which influences how water droplets form, dust particles move and lightning brews — hasn't been considered before, says Dwyer,

who wasn't involved in the study.

Scientists have long known about the minuscule electric charge carried by living things, such as insects. However, the idea that an electric bug-aloo could alter the charge in the air on a large scale came to researchers through sheer chance.

"We were actually interested in understanding how atmospheric electricity influences biology," says biologist Ellard Hunting of the University of Bristol in England. But when a swarm of honeybees passed over a sensor meant to pick up background atmospheric electricity at the team's field station in England, Hunting and colleagues began to suspect that the influence could flow the other way too.

The team measured the change in the strength of electric charge when other honeybee swarms passed over the

sensor, revealing an average increase of 100 volts per meter. The denser the insect swarm, the greater the charge produced. This inspired the team to think about even larger insect swarms, like the hordes of locusts that plagued Las Vegas in 2019 (*SN Online*: 3/30/21).

The researchers measured the charges of individual desert locusts (*Schistocerca gregaria*) as the insects flew in a wind tunnel. Using a computer simulation to scale up the measurements for an entire locust swarm, the team estimates clouds of locusts could produce as much electricity on a per-meter basis as storm clouds.

The results are "an interesting first look" into the phenomenon, Dwyer says. It's unlikely that electrically charged flying animals will ever reach the density required to produce lightning like storm clouds do, he notes. But the animals could interfere with sensors that help us watch for looming strikes that could hurt people or damage property, he says. ■

Ancient city took root in a marsh

The Mesopotamian metropolis spanned four islands in Iraq

BY BRUCE BOWER

A ground-penetrating eye in the sky has helped to rehydrate an ancient southern Mesopotamian city, tagging it as a “Venice of the Fertile Crescent.” Identifying the watery nature of this early metropolis has implications for understanding how urban life flourished nearly 5,000 years ago between the Tigris and Euphrates rivers, where modern-day Iraq lies.

Remote sensing data, mostly gathered by a drone, show that a vast urban settlement called Lagash largely consisted of four marsh islands connected by waterways, says anthropological archaeologist Emily Hammer of the University of Pennsylvania. The finding adds crucial details to an emerging view that southern Mesopotamian cities did not, as traditionally thought, expand outward from temple and administrative districts into irrigated farmlands that were encircled by a city wall, Hammer reports in the December

Journal of Anthropological Archaeology.

“There could have been multiple evolving ways for Lagash to be a city of marsh islands as human occupation and environmental change reshaped the landscape,” Hammer says.

Because Lagash had no geographical or ritual center, each city sector developed distinctive economic practices on an individual marsh island, much like the later Italian city of Venice, she suspects. For instance, canals crisscrossed one marsh island, where fishing and reed collection for construction may have predominated.

Two other islands display evidence of having been bordered by gated walls that enclosed carefully laid out streets and areas with large kilns, suggesting these sectors were built in stages and may have been settled first. Crop growing and pottery making may have occurred there.

Drone photos of what were probably harbors on each marsh island suggest that boat travel connected city sectors. Remains of what may have been footbridges appear in and adjacent to waterways between islands, a possibility that further excavations can explore.

Lagash, which formed the core of one of the world’s earliest states, was founded between about 4,900 and 4,600 years ago.

Residents abandoned the site, now known as Tell al-Hiba, around 3,600 years ago.

Previous analyses of ancient wetlands expansions in southern Iraq indicated that southern Mesopotamian cities like Lagash were built on raised mounds in marshes. Based on satellite images, archaeologist Elizabeth Stone of Stony Brook University in New York recently proposed that Lagash consisted of about 33 marsh islands.

Drone photos provide a more detailed look than satellite images, Hammer says. Guided by initial remote sensing data gathered from ground level, a drone took high-resolution photos of much of the site’s surface and detected remnants of buildings, walls, streets, waterways and other buried city features over six weeks.

Hammer used the data to narrow down densely inhabited parts of the ancient city to three islands. It’s possible that the islands were part of delta channels extending toward the Persian Gulf. A fourth, smaller island featured a large temple.

The study “confirms the idea of settled islands interconnected by watercourses,” says Augusta McMahon, an archaeologist at the University of Chicago and a field director of ongoing excavations at Lagash.

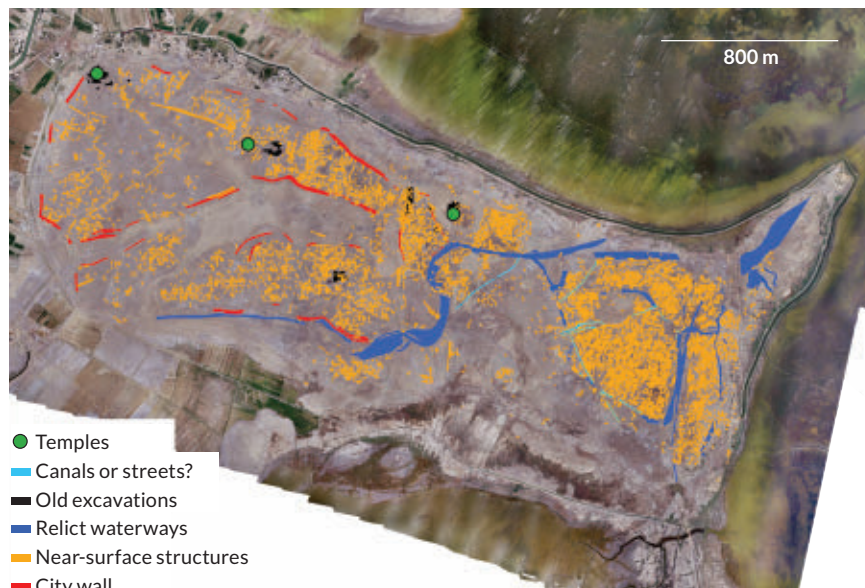
Drone evidence of contrasting neighborhoods on different marsh islands, some looking planned and others more haphazardly arranged, reflect waves of immigration into Lagash between around 4,600 and 4,350 years ago, McMahon says. New arrivals included people from nearby and distant villages, mobile herders looking to settle down and enslaved laborers.

Clusters of buildings across much of Lagash suggest tens of thousands of people lived there at its peak, Hammer says. At that time, the city covered 4 to 6 square kilometers.


Lagash and other southern Mesopotamian cities probably exploited water transport and trade among settlements, enabling unprecedented growth, says archaeologist Guillermo Algaze of the University of California, San Diego.

But unlike its contemporaries, some of which merged with each other, Lagash is frozen in time. That gives scientists a chance to see what the other ancient cities were initially like, Hammer says. ■

Hidden city Remote sensing data offer a new view of the ancient Mesopotamian city of Lagash, in what’s now Iraq. Drone photos reveal buried structures (yellow) clustered in four sectors that had probably been marsh islands. Walls (red) surrounded two large sectors. Now-dry waterways (dark blue) connected sectors and crisscrossed one sector (far right).



Boots ON THE MOON



With the November 16 launch of Artemis I, the countdown begins for getting humans back on the moon, as in this NASA illustration. December marks the 50th anniversary of Apollo 17, the last crewed mission to the lunar surface.

The launch of Artemis I is a giant step toward sending humans back to the moon and beyond

By Liz Kruesi

Fifty years ago, three NASA astronauts splashed down in the Pacific Ocean, concluding the final Apollo mission. Less than a dozen years after President John F. Kennedy challenged the United States to commit itself to “landing a man on the moon and returning him safely back to the Earth,” that historic program had achieved its goals and ended.

Now, we’re going back. But this time will be different.

A pivotal moment for the return of crewed missions to the moon occurred at 1:47 a.m. EST on November 16, with the successful launch of Artemis I. NASA’s high-powered Space Launch System rocket roared and crackled as it lifted off the Florida coast on its maiden voyage. The rocket pushed the Orion capsule toward the moon, on a flight testing the technology that will eventually bring astronauts, both men and women, back to the lunar surface.

“It was just a spectacular launch,” says geologist Jose Hurtado of the University of Texas at El Paso, who works with NASA on mission simulations and programs to train astronauts in geology. “It really hits home to me what I love about space exploration, especially human exploration. It’s just an aspirational and inspirational spectacle, and I hope that everybody that was watching it got some of that inspiration.”

Now, the United States and China are leading the way to return humans to the moon. The two countries’ programs are massive and complex undertakings with potentially big payoffs. Both aim to boost scientific understanding about the moon and the early Earth, develop new technologies for space exploration and use on Earth, as well as set the stage for longer-term human space exploration.

Better than rovers

Apollo was “a technological program to serve political ends,” says space historian Teasel Muir-Harmony. It was rooted in the political tension and conflict between the United States and the

Soviet Union. The program “was about winning the hearts and minds of the world public. It was a demonstration of world leadership...of the strength of democracy and then also of capitalism,” says Muir-Harmony, curator of the Apollo Spacecraft Collection at the Smithsonian National Air and Space Museum in Washington, D.C.

Apollo 11 astronauts Neil Armstrong and Buzz Aldrin took the first-ever steps on the moon on July 20, 1969. Over the next few years, 10 more American men hopped, skipped and even drove across the pewter-colored, lifeless terrain of our planet’s only natural companion. Apollo 17 was the final mission in that series of landings, ending on December 14, 1972 (SN: 12/23/72, p. 404). Once Apollo 17 astronauts Eugene Cernan and Harrison Schmitt left their footprints embossed in the lunar dust and joined Ronald Evans in the command module, humans stopped walking on the moon.

In the decades since Apollo 17, about two dozen spacecraft from various countries have visited the moon. Some have orbited, others have slammed into the surface so researchers could study the material in the debris of those collisions, and some have landed and brought lunar samples back to Earth (SN: 1/16/21, p. 7).

While these uncrewed spacecraft have made some big strides in lunar exploration, humans could do better. “Nothing can replace the value of having a human brain and human eyes there on the scene,” Hurtado says.

One moment during Apollo 17 makes his point. Schmitt, the only geologist to visit the moon, noticed a patch of lunar soil with a particular rusty hue. He walked over, contemplated the surroundings and realized it was evidence of a volcanic eruption. He and Cernan scooped up some of this orange soil for later Earth-based analyses, which revealed that the orange glass blobs in the soil did in fact form during a “fire fountain” explosion some 3.7 billion years ago.

That discovery supported the idea that the moon had hosted volcanoes in its youth, and additional analysis of the orange soil’s chemical composition hinted that the moon formed at around the same time as Earth. Scientists wouldn’t have had access to the orange soil if it wasn’t for Schmitt’s quick grasp that what he saw was important. “Probably the ultimate field tool is the well-trained human,” Hurtado says.

In his 2005 book, *Roving Mars*, planetary scientist Steven Squyres wrote: “The unfortunate truth

“Nothing can replace the value of having a human brain and human eyes there on the scene.”

JOSE HURTADO

is that most things our rovers can do in a perfect [Martian day], a human explorer on the scene could do in less than a minute.” Squyres, of Cornell University, led the Spirit and Opportunity rover missions to Mars (SN: 8/13/22, p. 20).

A long-awaited lunar return

Once Apollo ended, NASA shifted its focus to space stations to prepare for longer-term human spaceflight. Skylab launched in May 1973, hosting four crews of astronauts that year and the next. A few years later, the temporary station broke apart in the atmosphere, as planned. NASA’s next space station, the International Space Station, or ISS, was a larger, collaborative project that’s been hosting astronauts since November 2000. It’s still orbiting roughly 400 kilometers above Earth.

U.S. leaders have occasionally tried to shift NASA’s gaze from low Earth orbit, where the ISS flies, to a more distant frontier. Many presidents have proposed investments in different technologies for different exploration goals and with different price tags. But by 2019, the plan was set: NASA would land humans on the moon’s south pole in 2024, though the timeline has since slipped.

“The first woman and the next man on the moon will both be American astronauts, launched by American rockets from American soil,” said Vice President Mike Pence in early 2019. Shortly after,

NASA named this effort the Artemis program — after Apollo’s mythological twin sister.

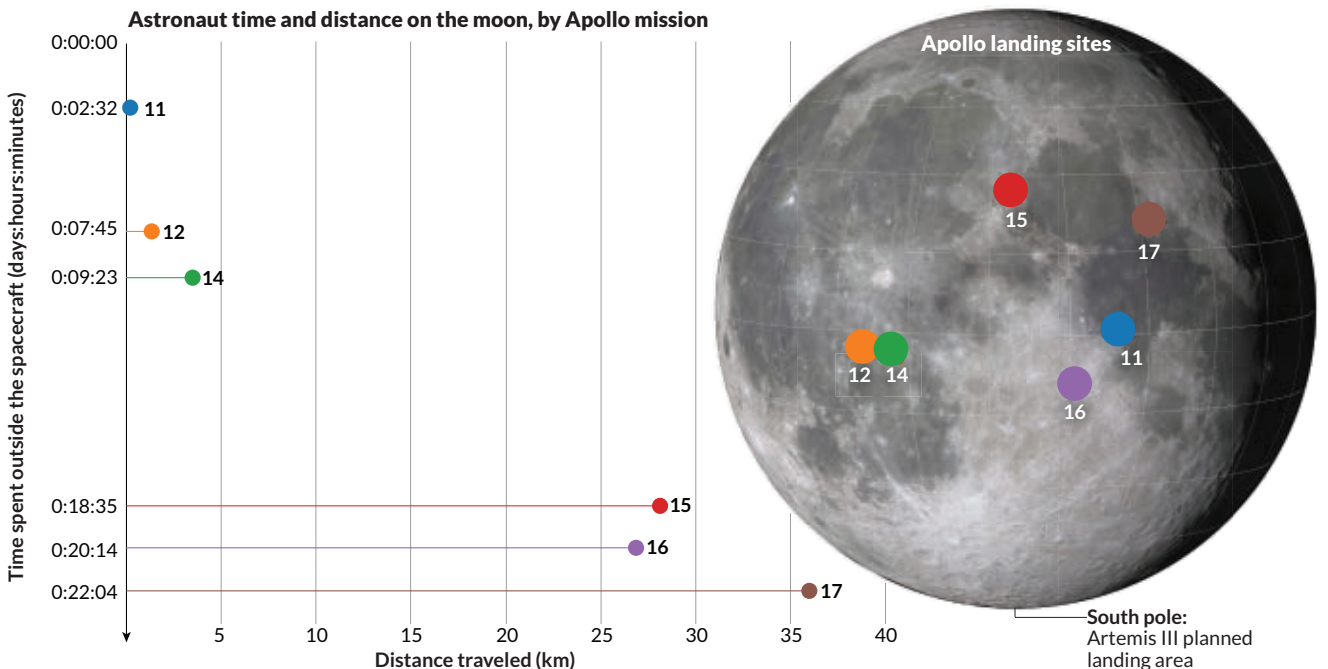
The Artemis program is part of NASA’s Moon to Mars program, which aims to send humans farther into space than ever before. The moon is up first, with astronauts stepping on its surface as early as 2025. What the space agency and its partners learn during a few years of lunar exploration will help guide the phases beyond the moon, including sending astronauts to the Red Planet.

“The goal with Artemis is to build off everything we’ve done to this point and really start to establish a presence for humanity beyond low Earth orbit,” says planetary geologist Jacob Bleacher of NASA’s Human Exploration and Operations Mission Directorate in Washington, D.C.

The first big test for Moon to Mars is to show that NASA’s rocket, the Space Launch System, or SLS, in development for over a decade at a cost of more than \$20 billion, can successfully launch a crew capsule, without the crew, beyond low Earth orbit.

But that effort has had a rocky start with the Artemis I launch scrubbed twice for fuel leaks and delayed by two hurricanes. Now that it’s on its way, Artemis I will test the SLS rocket and the Orion advanced crew capsule on a trip beyond the moon and back, ending with a December 11 splashdown of the capsule in the Pacific Ocean. One more test flight, Artemis II, will follow a similar trajectory as

More to see Over the 3.5-year span of the Apollo missions, a dozen astronauts spent a total of 80.5 hours exploring the surface near the moon’s equator. “They explored only the tiniest fraction of the moon,” says planetary scientist David Kring of the Lunar and Planetary Institute in Houston. Artemis crews will be checking out a new area: the south pole.



GODDARD SPACE FLIGHT CENTER SCIENTIFIC VISUALIZATION STUDIO/NASA

the first mission, but with astronauts on board, launching no earlier than 2024.

Artemis III, slated for 2025, is expected to return boots to the moon and make history by landing the first woman on the lunar surface (see Page 20). On that flight, the SLS rocket will launch the Orion crew capsule toward the moon. When it arrives at lunar orbit, the capsule will dock with the human landing system, currently in development by the company SpaceX. Two astronauts will board the SpaceX vehicle, which will bring them to the moon for a 6.5-day stay. That landing system will also bring the astronauts back to Orion, still in lunar orbit, which will then return them to Earth.

If all goes well, NASA plans to run Artemis missions roughly once a year. “We hope to, through those missions that follow Artemis III, build up some infrastructure,” Bleacher says. That infrastructure will include hardware for developing and distributing power on the moon, rovers for the astronauts to traverse long distances and eventually living and working quarters on the surface. The aim is to increase the astronauts’ length of stay from days to perhaps months.

To help support these lunar astronauts, NASA is leading the creation of a new space station. Called the Gateway, it will orbit the moon when complete, maybe by the 2030s. Like the International Space Station, which is scheduled to safely break apart in early 2031, Gateway will be an international and commercial research station. It will also serve as a way station for trips to Mars and beyond.

The moon goddess

NASA astronauts likely won’t be the only people exploring the lunar surface. China aims to land its own astronauts at the moon’s south pole by the next decade. Begun in 2004, China’s lunar exploration program, Chang’e — named after the Chinese goddess of the moon — has seen fast progress. It “is very systematic, very well done, and they’ve been successful every step of the way,” says planetary geologist James Head of Brown University in Providence, R.I.

In 2018, China put a relay communication satellite in orbit around the moon. In 2019, China landed a rover on the lunar farside, providing the first up-close view of the side of the moon hidden from Earth. That rover is still operating. In November 2020, China sent another rover, which brought samples from the moon’s nearside to Earth the following month. Next up, although China doesn’t share its specific schedule plans, is Chang’e 6, which will collect and return material from the



moon’s farside. In 2026, China intends to launch its Chang’e 7 robotic mission to the south pole to search for water ice. “There’s no question,” Head says, “that [China] will be sending humans to the moon toward the end of the decade.”

China’s human-occupied space station, called Tiangong, is now complete and in low Earth orbit. And Mars exploration is on the menu as well. China landed a rover safely there in 2021 and is gearing up for a sample-return mission in the same time frame as a NASA–European Space Agency sample-return mission to Mars.

Science is an international endeavor, but NASA and China’s space agency are unable to collaborate due to the Wolf Amendment (SN: 11/24/18, p. 14). Tacked onto a U.S. appropriations bill in 2011, the amendment prohibits NASA and the White House Office of Science and Technology Policy from collaborating, designing and planning projects with China, unless authorization is granted by the U.S. Congress.

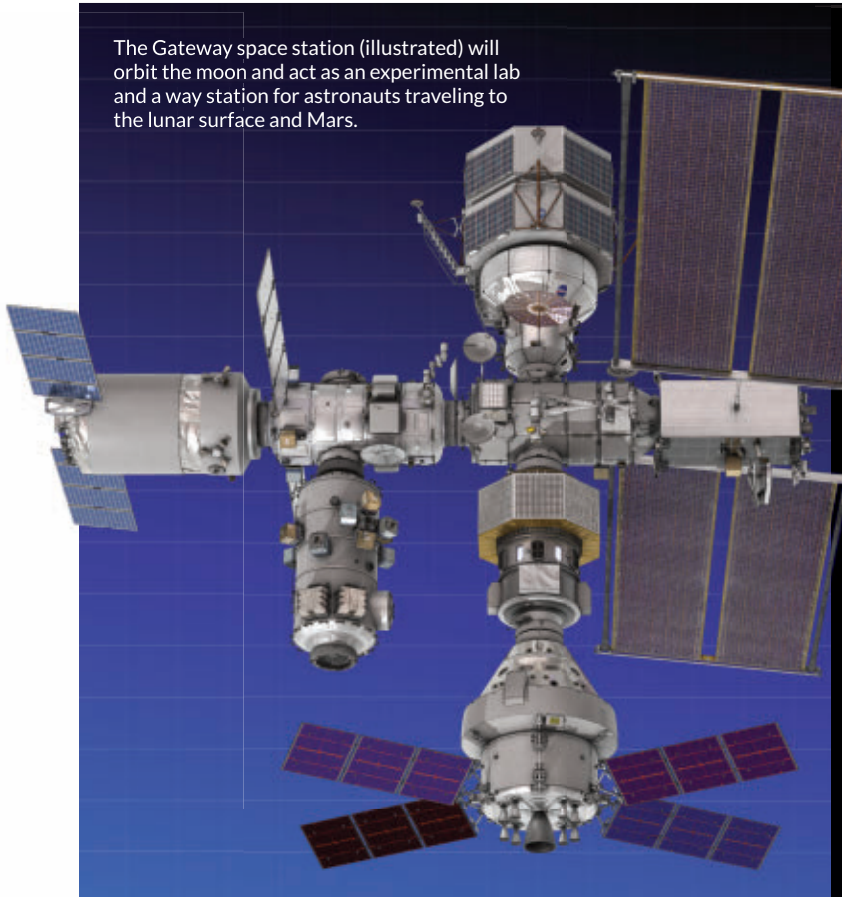
Some lunar scientists, however, hope there can be collaboration between the two nations, such as sharing returned samples. “There are a lot of different places to go in space, and there’s no sense duplicating everything,” Head says.

While human space exploration began as a competition, international collaboration is now the norm. Astronauts from 20 countries have visited the International Space Station over its 22-year history, living together for months and working toward shared interests.

“The International Space Station is a frigging United Nations in orbit in a tin can,” Head says. Private firms also have become increasingly involved in the ISS. And for the Moon to Mars program, international space agencies and private companies are participating, designing and fabricating crucial components (see Page 18).

China’s Tiangong space station (illustrated) completed its final construction phase, in low Earth orbit, in early November.

The Gateway space station (illustrated) will orbit the moon and act as an experimental lab and a way station for astronauts traveling to the lunar surface and Mars.



To the south pole

When humans step on the moon again, they'll investigate a never-before-explored locale, the moon's south pole. It's a region rich with impact craters, uplifted ancient material and water ice. Both the United States and China are targeting this area to answer new research questions and to access resources humans would need for an extended stay.

This cratered terrain reveals when rocky material tore through the solar system in the first billion years of its history, slamming into the nascent planets. Earth no longer tells that history, but the moon, without liquid water or a robust atmosphere to smooth away the evidence, retains a surface record of meteorite impacts over billions of years. "Because that record is so perfectly preserved on the lunar surface, it is the single best place in the entire solar system to understand the origin and early evolution of planets," says planetary scientist David Kring of the Lunar and Planetary Institute in Houston.

And while those are important mysteries, the south pole's deep craters also hold something thrilling—water ice. There's a lot to learn about that ice, says lunar exploration scientist Clive Neal of the University of Notre Dame in Indiana. How much is there? Can it be extracted? How to refine it for human use? The Artemis explorers can address those questions, which would enable even longer-term exploration.

That's the goal this time around: to stay longer for both science exploration and to learn how humans can have a lasting presence on another celestial body. This work "would extend the bounds of human experience in a way that has never happened before," the Smithsonian's Muir-Harmony says.

That's a tall order, considering how NASA's schedules keep slipping and the cost estimates for each piece of Moon to Mars keep ballooning. A 2021 audit estimates that by the end of 2025, the cost for the Artemis program will reach \$93 billion, some \$25 billion over NASA estimates.

These next few years of Artemis flights will show what NASA can do. And China's upcoming missions will show what that nation's lunar exploration can achieve. The world will be watching both. ■

Explore more

- NASA. "Moon to Mars Objectives." September 2022. [go.nasa.gov/3BUKHGL](https://www.nasa.gov/3BUKHGL)

It takes a village

Here are some of the primary private partners and international space agencies helping to build NASA's Orion crew capsule, the powerful Space Launch System rocket and the Gateway space station:

Aerojet Rocketdyne

Engines for the Space Launch System, or SLS, heavy-lift rocket

Boeing

SLS core stage, the rocket's largest piece, which holds the propellants, engines and "brains"

Canada Space Agency

Robotic arm to attach to and access Gateway's exterior

European Space Agency

Orion spacecraft's service module, which provides electricity, air, water and other necessities to the crew; Gateway's refueling module and international habitation module

Japan Aerospace Exploration Agency

Essentials for Gateway's habitation module, including life support systems and batteries

Lockheed Martin

Orion spacecraft and crew capsules

Maxar Technologies

Gateway's solar electric power and thruster system

Northrop Grumman

SLS boosters and Gateway main module

SpaceX

Artemis III's human landing system; launching the first two parts of Gateway



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Who gets to go to space?

Crews to the moon and beyond will look very different from past astronauts **By Lisa Grossman**

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When astronaut Eugene Cernan stepped from the moon's surface into his spacecraft in December 1972, he was aware it was the end of an era. His mission, Apollo 17, was the last of the Apollos.

"Take your final look at the valley of Taurus-Littrow, except from orbit," Cernan said of the view before the craft lifted off. "We're on our way, Houston!"

And with that, the last person to walk on the moon returned to Earth. No other boots have touched lunar soil in the 50 years since then.

Now, NASA is preparing to go back, and China is on its way too (see Page 14). On November 16, the U.S. Artemis I mission launched to bring the first crew-ready space capsule to the vicinity of the moon since Cernan and his two crewmates left half a century ago.

That spacecraft isn't carrying any astronauts; the mission was designed to check technology and other systems that will eventually take people to the moon, on Artemis III, no sooner than 2025. This time, NASA says, the intention is to stay longer, to learn how to live on the moon and eventually send people to Mars.

The obvious next question is, who gets to go?

Thanks to social, political and scientific changes over the last 50 years, today's astronauts are not like the astronauts of the past. They are more diverse in sex, race and field of expertise. The next set of people to walk on the moon will face different challenges and require different skills, temperaments and support systems than the Apollo crews.

And some groups are thinking about how to include people with disabilities in the spacefaring future. Preparing for a more permanent human presence in space will require rethinking the right stuff. Future lunar crews may reflect our lives on Earth more faithfully, making space for everyone.

Becoming an astronaut

NASA has declared that upcoming missions to the moon will include a woman and a person of color, setting two firsts for lunar astronauts.

The next visitors to the moon haven't been selected yet. But there are only about 50 people to choose from. The 43 active astronauts and 10 astronaut candidates, who are still in training, come from a variety of backgrounds. The list includes medical doctors, military pilots, geologists, microbiologists, engineers and others. Of NASA's active astronauts, about 37 percent are women.

"The astronaut corps is, of course, NASA's most

visible workforce," says Lori Garver, who was NASA's deputy administrator from 2009 to 2013. "Because of that, NASA has, I think, a responsibility to have an astronaut corps that reflects the nation."

Modern astronauts are already different from those of Apollo. For its first class of astronauts in 1959, NASA recruited military fighter pilots shorter than 5 feet, 11 inches (because of the tight space in the Mercury space capsule). At the time, all military test pilots were white men, so all astronauts were too.

NASA recruited its first class of "scientist-astronauts" in 1964. The move drew criticism from pilots. In an interview, Cernan — who shared his spot on Apollo 17 with the only geologist to walk on the moon, Harrison Schmitt — called science "a parasite" on the moon program. "Science is not the reason we learned to fly," he griped. Cernan later referred to Schmitt as "Dr. Rock" and worried that he wouldn't be able to get out of a tough spot on his own.

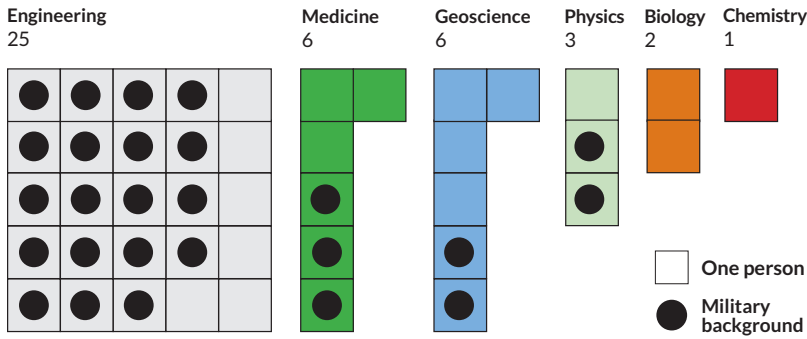
But according to NASA's mission report, Apollo 17 was "the most productive and trouble-free manned mission." It "demonstrated the practicality of training scientists to become qualified astronauts."



The first groups of U.S. astronauts were white men. Apollo 17's crew (left) were Harrison Schmitt, Eugene Cernan and Ronald Evans. The most recent class of NASA astronaut candidates (below) is more diverse.



Current NASA astronauts' military and science backgrounds



Science expertise

While the earliest U.S. astronauts were mostly military pilots, a science background is considered a necessity for today's 43 active astronauts. Many are in the military, but also have degrees in medicine, geoscience or physics.

Today, 42 percent of NASA's active astronauts have a research science or medicine background, in fields ranging from oceanography to physics.

Counterintuitively, though, NASA's definition of "astronaut" doesn't require going to space. Once you've made it through the strenuous and selective application and training process, you're a member of the astronaut corps, whether you leave Earth or not.

The first step in applying to be an astronaut is "unnervingly underwhelming," says geobiologist Zena Cardman, who joined the astronaut corps in 2017 but has not yet been to space. "You submit a very short resume to USAJobs.gov, and then you wait for a long time," she says. (Full disclosure: I applied to the astronaut program myself in 2012. I kept the rejection postcard for years.)

The minimum requirements for applying are being a U.S. citizen, having a master's degree in engineering, biological science, physical science

or math, and two years of professional experience, including teaching or graduate school. Pilots can substitute the two years of experience with 1,000 hours of jet-flying experience. Candidates who make it through that first round travel to Houston for a two-round interview process.

"What we're looking for in these first few Artemis missions...first and foremost, is technical expertise," astronaut Reid Wiseman, chief of NASA's Astronaut Office, said in a news briefing on August 5. A lot of those desired skills revolve around acquiring resources to support long stays.

Artemis III plans to send people to the lunar south pole, which could be a reasonable place to put a long-term base. It has regions that will be in sunlight for the entire 6.5-day mission. The light will help generate energy from solar power. And it has regions in permanent shadow that host pockets of water ice, which could be used for water and fuel for human settlements.

The possibility of finding and using resources on the moon is part of why science backgrounds, especially in geology, are now more important for astronauts. But in the astronaut corps, everyone does everything, Cardman says. Her background is in geology and microbiology. She's done fieldwork in Antarctica, the Arctic, underground caves and on ocean research vessels. Space "seemed like the ultimate fieldwork endeavor," she says.

To round out her skills, she's getting trained in engineering and aviation, and her test pilot colleagues are learning geoscience. "We will have roles, but we won't be siloed," she says.

Beyond technical skill, the next most important characteristic NASA looks for is: "Are you a team player?" Wiseman says. Working together was important on the Apollo missions. But those missions lasted 12 days at most, with three days tops on the lunar surface. Astronauts on a weeks-long Artemis mission to the moon or a years-long mission to Mars will need to survive in stressful, challenging, isolated environments (SN: 11/29/14, p. 22). Getting along becomes crucial to staying alive.

That explains why the interview process includes teamwork exercises and group dynamic activities to simulate the kinds of situations astronauts would find themselves in, Cardman says.

The interview also involves medical screening. The details are not public, but "they really go quite in depth," Cardman says. There's no official requirement for any particular body type or standards for physical fitness, like running a mile in a certain time or doing a certain number of pull-ups. "It's more functional," she says. As long as you



In a prototype space suit — the actual Artemis suit is not yet designed — NASA astronauts Zena Cardman and Drew Feustel train on a barren landscape in Arizona.

FROM TOP: T. TIBBITTS; BILL STAFFORD/NASA

can meet the mental and physical demands of a spacewalk, it doesn't matter how you get in shape. Cardman's exercise of choice is powerlifting.

Ultimately, there are thousands more applicants than there are openings for astronaut jobs. "The final selection is somewhat subjective," Garver says. "So I think it's absolutely appropriate that you look at the demographic along with the qualifications."

Take it to the limit

There's one other medical requirement for the next people to walk on the moon: They can't have already spent too much time in space.

Over time, exposure to the harmful charged particles that zip around space can increase a person's risk of developing cancer. For astronauts' safety, NASA limits the amount of radiation an astronaut can absorb over their career. (SN: 7/4/20 & 7/18/20, p. 18).

From 1995 until 2021, those bounds were dependent on an astronaut's age and sex. The limit was the amount of radiation that correlates with a 3 percent risk of dying from cancer caused by radiation exposure. But because women were considered to have higher risks of dying from radiation-related cancers, that limit grounded female astronauts earlier than males. Effectively, women were allowed about 150 millisieverts of radiation in their careers, while men were allowed closer to 800 millisieverts, says emergency medicine physician and aerospace engineer Erik Antonsen of Baylor College of Medicine in Houston.

"It was a consequence of the way we were calculating risk that women were being limited much earlier in their career and could not fly as much as men," Antonsen says. "We had to dive deep into that stuff, come back up for air and say, hey man, there's not justification for this stuff. And it's causing discrimination against females." Antonsen notes that no openly transgender astronauts have flown, but he can't think of any medical issues that would hold them back.

In 2021, the National Academies of Sciences, Engineering and Medicine released a report urging NASA to change the limit to 600 millisieverts of radiation over a career for everyone, regardless of sex or age. That amounts to about 400 days in orbit around the moon or 680 days on the lunar surface, some of the time in a habitat, for an astronaut with no other spaceflight exposures.

NASA, the German Aerospace Center and the Israel Space Agency are flying a pair of dummies on Artemis I to test a radiation protection vest for female astronauts, which might help reduce



To show that disabled people can be an asset on spaceflights, AstroAccess took the crew above on a zero gravity flight. Linguist Sheri Wells-Jensen (back row, second from left), who is blind, was surprised that her usual instincts worked differently in zero g.

radiation risks further if worn on future missions.

That could all be good news for Cardman. She and her cohort, who are beginning to fly missions to the International Space Station, are likely candidates for Artemis III. Cardman herself could be the first woman on the moon.

She's modest about it. "I would be thrilled to go to the moon, of course," she says. "Depending on the timeline, who knows. But it's pretty exciting to know I work with the people who will be the first ones setting foot on the moon in half a century."

The new right stuff

Even though there are no official astronaut health standards, NASA does end up selecting "the healthiest damn people to fly," Antonsen says.

Commercial spaceflight is expanding the pool of people who get to go to space. Companies like SpaceX, which is building the moon lander for Artemis III, and Blue Origin are already sending paying customers on space joyrides. These companies have different goals, incentives and risk tolerances than NASA does.

"The beautiful thing about this is, the goal is eventually to send just people," Antonsen says. "It's changing. And it should change."

SpaceX would not comment on how it chooses who they send to space. But Antonsen speculates that some companies' only criteria for their customers will be "making sure they can walk up the stairs to get to the vehicle."

And even that might not be the final barrier for long. Some organizations are investigating how disabled people can live and work in space.



Mona Minkara, a bioengineer at Northeastern University in Boston who is blind, floats in midair during a zero-g flight with AstroAccess.



NASA engineers wear spacewalk backpacks with head lamps to practice sample collection in New Mexico. At the lunar south pole, some regions will be in permanent shadow.

“Disability inclusion affects how we design our spacecraft,” says AJ Link, communications director of the nonprofit advocacy group AstroAccess. “If we can make space accessible, we can make any space accessible.”

By organizing flights for disabled people on zero gravity aircraft, AstroAccess aims to show that disabled people have strengths that could be useful in space. In October 2021, 12 people with various disabilities took a parabolic flight, in which the plane took a repeating upward and downward trajectory to give the passengers inside a few minutes of weightlessness.

“My personal, emotional conclusion was, it was wicked fun,” says Sheri Wells-Jensen, a linguist at Bowling Green State University in Ohio. Wells-Jensen, who is blind, was one of the people on that flight. She plans to try it again this month, on the anniversary of Apollo 17’s departure from the moon, despite describing herself as a “big chicken.”

“I’m not a thrill seeker. I don’t even like roller coasters,” she says. But in zero g, she was “surprised by how not terrified” she was.

She was also surprised at how useless her normal instincts were. In simulated lunar gravity, a tiny hop sent her flying to conk her head on the ceiling. The plane was so noisy that her normal ways of orienting by sound didn’t work. She felt like there was no up or down. “I’m damn well oriented on Earth, but boy, there were several moments there where I had nothing,” she says.

Learning how disabled people behave on spaceflights will help all astronauts in the future,

regardless of disability, Wells-Jensen says.

“Space is a profoundly disabling environment. It’s always trying to kill you,” Wells-Jensen says. What happens if an astronaut loses their vision, whether temporarily or permanently, on the way to Mars? Or if the spacecraft lights go off, or smoke makes it hard to see? Designing a spacecraft to be used by blind people, she says, will help all astronauts navigate those situations.

Similarly, if an astronaut loses use of their legs, knowing how people with amputations or limb deficiencies navigate a spacecraft will give them options. “For able-bodied people who acquire a disability in space, we’re not just going to send them home,” Wells-Jensen says. “How do we make sure they’re safe and can still do their jobs?”

Wells-Jensen hopes that sending disabled people on zero-g flights will raise awareness of how capable they are as well. “A disabled person could take a suborbital flight tomorrow,” she says. “I think at this point, the limiting factor is cultural, rather than technological.”

The European Space Agency is also considering disabled astronauts. It is recruiting people with physical characteristics such as limb deficiencies or short stature that would normally disqualify them. These “parastronauts” would help research the kinds of adaptations needed for disabled people to fly in space.

Both ESA and AstroAccess argue that now is the time to consider accessibility in space, before the spacefaring vehicles of the future are finalized.

“Retrofitting is hard,” Wells-Jensen says. “Building things the way you want them is much easier.”

That could be especially important for private companies like SpaceX that are designing moon vehicles. The Federal Aviation Administration, which oversees commercial space transportation, has a legal moratorium on setting regulations about the safety of participants in private spaceflights until October 2023 to give the industry time to get established and collect data. AstroAccess, for one, wants to help guide those regulations.

“We want to fundamentally change the way humanity goes to space,” Wells-Jensen says. “We can’t become a spacefaring species if only some of us can go.” ■

Explore more

- Michael G. Smith, Michelle Kelley and Mathias Basner. “A brief history of spaceflight from 1961 to 2020: An analysis of missions and astronaut demographics.” *Acta Astronautica*. October 2020.

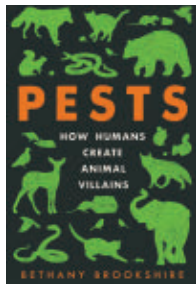
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Pests
Bethany Brookshire
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BOOKSHELF

Why do we hate pests?

We spend so much time making sure wildlife stays away from us, whether that's setting traps, building fences or putting out poisons. Sure, unwanted guests are annoying. But why do we consider some animals "pests"? It's all about perspective, says science journalist Bethany Brookshire. "We can put poison out for rats and protest their use as labo-

ratory animals. We can shoot deer in the fall and show their adorable offspring to our children in the spring," she writes in her new book, *Pests: How Humans Create Animal Villains*.

Brookshire argues that we deem animals "pests" when we fear them (like snakes). Or when they thrive in a niche we unintentionally created for them (think rats in the New York subway). Or when they find a way to live in a habitat now dominated by humans (all those deer in the suburbs). Sometimes we demonize an animal if we feel like it's threatening our ability to control the landscape (like coyotes that attack our livestock, pets and even children).

Through the lens of science, history, culture, religion, personal anecdotes and a big dose of humor, Brookshire breaks down how our perspective shapes our relationships with our animal neighbors. She also goes into the field — trailing rats, hunting pythons, taming feral cats, tracking drugged-up bears — to see firsthand how pests are treated.

Science News spoke with Brookshire, a former staff writer for *Science News for Students* (now *Science News Explores*), about what we can learn from pests and how we can coexist with them. The following conversation has been edited for clarity and brevity. — Deborah Balthazar

What inspired you to write this book?

I wrote a news story that was about mice living with humans. [It was based on a study] showing that we've had house mice since we've had houses. I love the fact that humans have had these other animals taking advantage of the ecosystems that we create basically since we started living settled life. Every location that has humans has their "rat." Sometimes that's a rat, and sometimes it's a pigeon or a cockatoo or a lizard or a horse. It's not about what these animals are doing. Animals live in ecosystems that we create, and we hate animals that live too close.

What surprised you during your research?

The reflexiveness of people's responses [to pests]. People respond emotionally. When you make them pause and think about it, they go, "Oh wow, that doesn't make any sense. I should not be caught trying to kill a raccoon with a sword." But in the moment, you're so wrapped up in the violation of what you see as your personal space.

The other thing is the extent to which our disdain of pests is

wrapped up in social justice. A lot of times we see this hatred and disgust for animals that we see as "low class." High-class people don't have rats. And that's really about social justice, about infrastructure and the ability of people to live in clean houses, store their food properly or even have a house at all.

Also, the way we deal with these animals often has vestiges of colonialism, as in the chapter on elephants. [In Kenya, European colonists] made people grow corn and sugarcane, which elephants love. Colonization created national park systems that assumed that humans had no place in wilderness, shoving out Indigenous pastoralists. Colonization created the market for poached ivory. And colonizing people assumed that Indigenous people did not like elephants or know their benefits. We are living with the consequences. Many modern efforts at elephant protection are spearheaded by Western people, and they assume the biggest issue with elephants is poaching and that Indigenous people don't know what's best for themselves or the elephants. In fact, human-elephant conflict [which includes elephant crop raids] is the far bigger problem, and Indigenous people have a long history of coexisting with elephants.

In the book, you looked at many different cultures and included Indigenous voices.

It's important to realize there's more than one way to look at the world. By learning from other cultures, it helps us understand our biases. It's only when you get outside of your own beliefs that you realize that's not just the way things are.

That shows up when you write about the Karni Mata Temple in India, also known as the Temple of Rats. Temple rats are not treated as pests, but a rat in a house would be.

That's the result of context. And you see that in Western cultures all the time. People love squirrels. Well, they're basically rats with better PR. Then you have people who have pet rats, who would probably scream if a sewer rat ran by.

Are there any animals that you consider a pest?

No. The animal that I've probably come away with the most negative impression of is humans. It's funny because we think we can extinct anything. And I love how these animals have gone: "Oh, poison? That's cute." "Oh, a trap? You're funny." We've tried to use electric fences on elephants [to stop them from eating crops]. And elephants are like, "Guess what? Ivory doesn't conduct electricity." Even if they don't have tusks, elephants just pick up a log [to destroy the fence].

Are you hoping to change people's minds about pests?

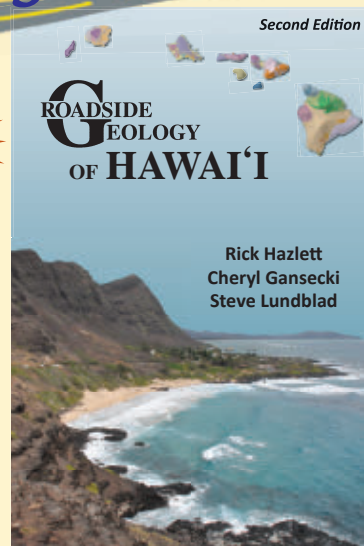
I hope that they will ask why they respond to pests the way they do. Instead of just going, "This animal bothers me," ask why, and does it make sense. I also hope it opens more curiosity about the animals around us. I learned from Indigenous groups just how much knowledge they have of the animals in their ecosystem. I hope more people learn. A world that you know a lot about is just a better world to live in. ■



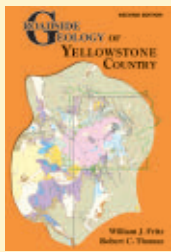
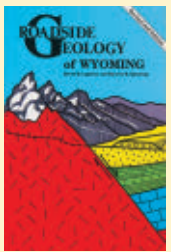
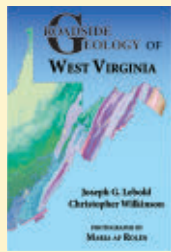
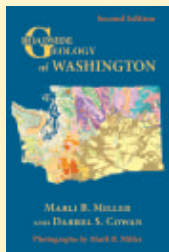
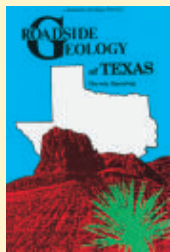
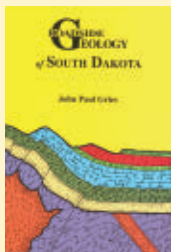
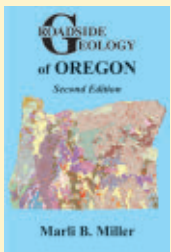
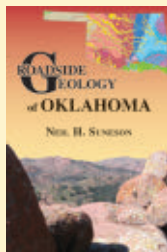
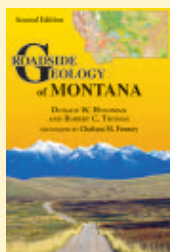
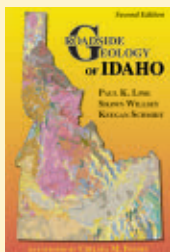
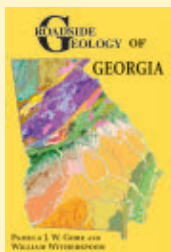
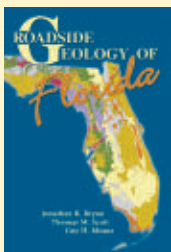
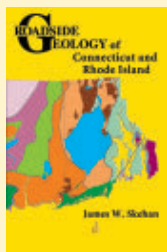
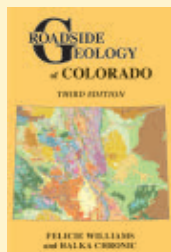
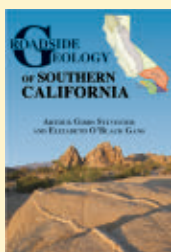
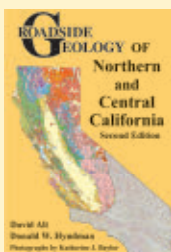
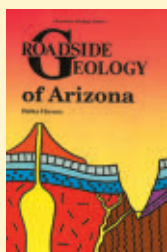
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EMBRACING PERSPECTIVES IN STEM

Technologist shares how her Indigenous heritage shapes her work

"There's really no wrong and right in research, there are just findings," Laura Smith-Velazquez said during her keynote address at the 2022 Middle School Research Teachers Conference, run by the Society for Science, which publishes *Science News*. "There is always going to be a different question. There are always going to be findings that don't quite fit."

Smith-Velazquez (pictured left) is a principal scientist at Charles River Analytics, as well as the Indigenous Peoples Affinity Group lead for the Society of Women Engineers. Charles River Analytics conducts artificial intelligence, robotics and human-machine interface research and development to create custom solutions. In her remarks, she shared the story of her own STEM journey and highlighted the power of elevating different viewpoints in STEM fields and science classrooms.

"What I realized is that, being Cherokee, I already had a system-level thinking," she said. "I already had the understanding that you must ask questions and learn deeply. Now I try and give that to the kids, teaching them to use perspective and look from all different views. A perspective of a different point of view is key to teaching good scientists."

This year's conference, held in person for the first time since 2019, welcomed 75 middle school teachers from 35 states to Washington, D.C., for a weekend of professional development and peer-led workshops sharing best practices.

// You, as teachers, are facilitating and enabling the next generation of explorers."

LAURA SMITH-VELAZQUEZ

Principal scientist, Charles River Analytics
and Indigenous Peoples Affinity Group lead,
Society of Women Engineers

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SOCIAL MEDIA

Conservation wins

Tree-climbing carnivores called fishers (one shown below and above) have returned to Washington state's forests after a 14-year reintroduction effort, **Brianna Randall** reported in "Bringing back the fishers" (SN: 10/8/22 & 10/22/22, p. 20). On Twitter, **@MeadeKrosby**, a climate scientist at the University of Washington, wrote: "Love reading about the success of efforts to bring fishers back to Washington! Taking my kid to watch these gorgeous, elusive critters released into the Cascades after a 70-year absence remains one of the most hopeful moments of my career."



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What's in a name?

An ancient mammal that some researchers dubbed "ManBearPig" had long pregnancies and gave birth to highly developed young that grew up much faster than expected. Such an approach to life could help explain how some mammals took over the world after dinosaurs' demise, **Maria Temming** reported in "ManBearPig lived fast, died young" (SN: 10/8/22 & 10/22/22, p. 12).

Several readers remarked that the creature's nickname bears a resemblance to that of the ManBearPig character from the animated television series *South Park*. Was the show the inspiration for the name?

"In short, yes," says paleontologist **Gregory Funston** of the Royal Ontario Museum in Toronto. **Funston** wondered how to describe the appearance of *Pantolambda bathmodon* to **Temming**. "After some deliberation and comparison to bears (they share a short face), pigs (a rounded torso) and humans (five-fingered hands and feet), I joked that... it was a kind of ManBearPig," he says.

Of course, in reality, *P. bathmodon* would have looked quite different from the *South Park* character, **Funston** says.

In the show, the fictional ManBearPig is a demon — a grotesque chimera of human, bear and pig features. It has beady yellow eyes, a pig's snout, gnarly bear fangs, one contorted human hand and one bear paw with razor-sharp claws. Its upper body is half fur, half human skin. And its lower body is a bizarre amalgamation of human thighs and pig feet.

P. bathmodon, on the other hand, looked more like "a large red panda or binturong, although it isn't closely related to either of these animals," **Funston** says. "The group of mammals that it does belong to [has] no living descendants. And like many other groups of mammals from this time, [*P. bathmodon*'s group] would have appeared somewhat generalized to our eyes, combining familiar aspects of many mammals but without any of the distinct features that we use to separate major mammal groups today."

Celebrating differences

Biological anthropologist **Tina Lasisi**, one of our SN 10: Scientists to Watch, studies the evolution of curly hair in humans, **Aina Abell** reported in "Curly hair starts conversations about human variation" (SN: 10/8/22 & 10/22/22, p. 28).

Reader **Gillian Ingram** found Lasisi's research on human variation fascinating.

"As a civilian watching science, I find the diversity within us amazing... [Lasisi's work has] opened a great sea of possibilities," **Ingram** wrote. "It is good to remember we are all very closely related, but our diversity should be explored and celebrated too."

In the family

Researchers have linked variants of a hair shaft gene called PADI3 to most cases of uncombable hair syndrome, which presents in people as silvery, spangly, spun glass hair that stands on end, **Meghan Rosen** reported in "Why some hair can't be tamed" (SN: 10/8/22 & 10/22/22, p. 5).

Reader **Diane F. Klein** shared a family connection with uncombable hair syndrome.

"My first cousin, born about 1960, had whitish hair when she was a little girl that stood out from her head like a fluff. It was shocking to see. My aunt could not control it," **Klein** wrote. "My brother, born in 1957, also probably had it. His hair was blondish white, and when he was a toddler, it stood out from his head like a wheat field, softly wafting in the wind."



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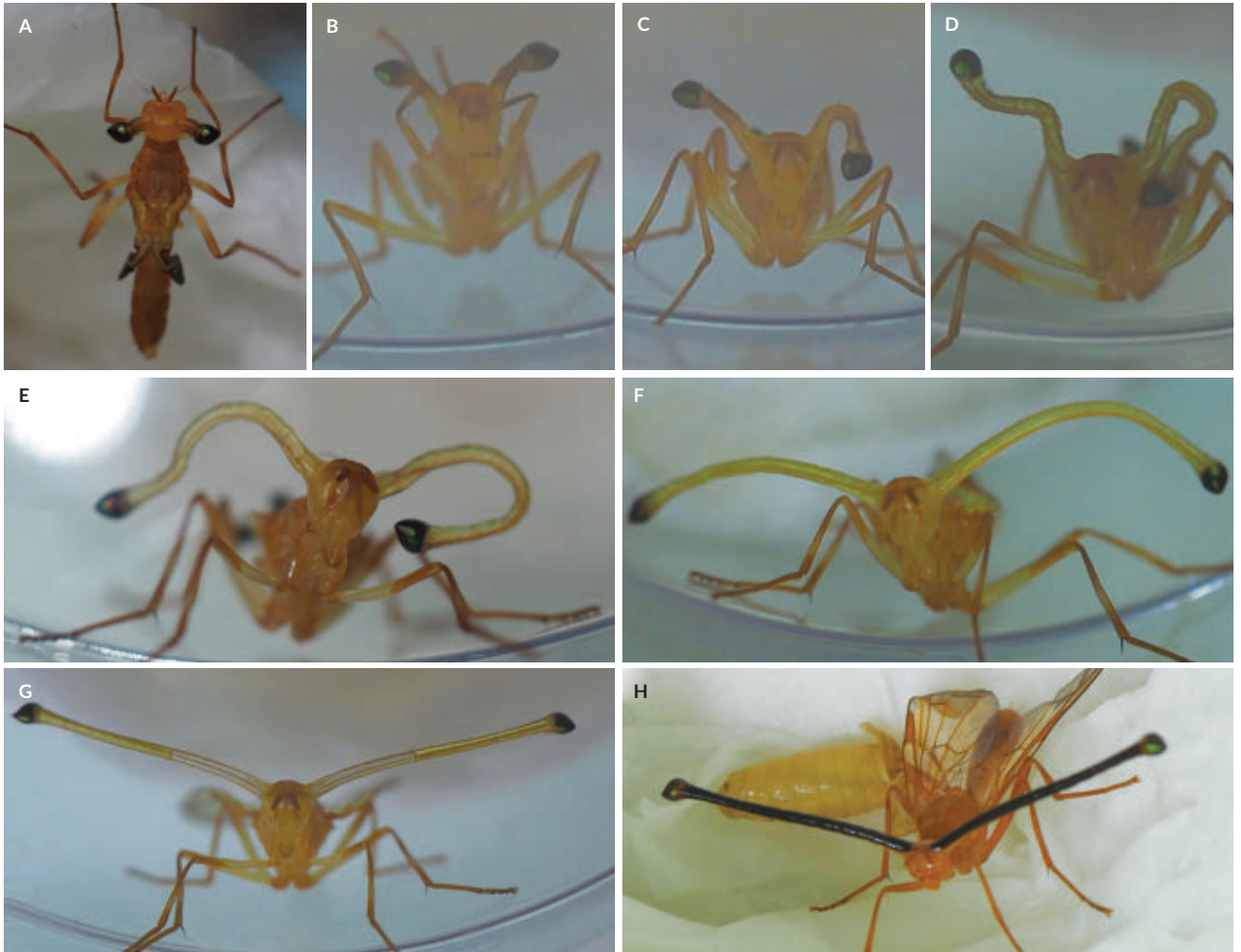
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Meet the flies with pop-out eyes

Body changes at the brink of adulthood can get awkward in humans, but at least our eyes don't pop out of our heads on stalks longer than our legs.

High-rise eyes, however, give macho pizzazz to the adult male *Pelmatops* fruit fly. In one of the stalkier known species, *P. tangliangi*, the whole eyes-up transformation takes less than an hour, a new study reports. Once stretched, the skinny eyestalks darken and harden, keeping the eyes stuck out like selfie sticks for the rest of the fly's life.

The details of *P. tangliangi*'s eye lift come from the first photo sequence (above) of the species's ocular blossoming, published in the September *Annals of the Entomological Society of America*. Just 16 minutes after emerging as an adult from the larval capsule, the male's eyes are close to his head (A). Over the following 40 minutes (B–H), the gangly eyestalks grow and eventually darken, stretching the eyes away from the body.

Biologists have known that eyestalks evolved in eight fly families. Yet *Pelmatops* flies have gotten so little scientific attention that a lot of their basic biology remains a string of question marks.

In the new images, the eyestalks curl and rise irregularly. Yet “they are not flopping around while partly inflated,” says Xiaolin Chen, an entomologist and evolutionary biologist at the Chinese Academy of Sciences in Beijing. “They seem slightly stiff but still flexible enough.”

Females of the species may raise eyestalks too — if Chen and her colleagues have found the right females. What are now named as two species may be just two sexes of *P. tangliangi*: The researchers observed a male mating with a female known by a different species name.

While such headgear can burden a flying insect, long eyestalks may give flies some swagger. *Pelmatops* and other kinds of stalk-eyed flies face off, eyestalk to eyestalk, with others of their species. Though any pushing and shoving, Chen says, is “done with other body parts.”

Extreme eyes may have other benefits too, Chen says. In the wild, she typically finds these flies on stems of *Rubus* berry brambles. The eyes periscope outward and upward, presumably letting the flies spot danger while staying hidden in the greenery. — Susan Milius

HAPPY NEW YEAR

To all our *Science News* readers, may the New Year bring good health, prosperity and joy.

Maya Ajmera

President & CEO, Society for Science
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