ScienceNews Explores
May 2022

WHAT CAN A WHALE DO WHEN IT'S DEAD?
P16

HOW TO FLOAT A BOAT UPSIDE DOWN

PLANETS GONE ROGUE

HOW MANY WANDERING WORLDS AWAIT DISCOVERY?

IS SPIDER-MAN THE CURE FOR ARACHNOPHOBIA?

MEET THE WORLD'S SMALLEST REPTILE

Table of Contents

Contents

Science News Explores | May 2022 | Vol. 1, No. 1

Departments

ScienceNews Explores

A magazine by the Society for Science

SCIENCE NEWS MEDIA GROUP
PUBLISHER **Maya Ajmera**
EDITOR IN CHIEF **Nancy Shute**

SCIENCE NEWS FOR STUDENTS
EDITOR **Janet Raloff**
MANAGING EDITOR AND EDITOR, SCIENCE NEWS EXPLORES **Sarah Zielinski**
ASSISTANT EDITOR **Maria Temming**
ASSISTANT DIGITAL EDITOR **Lillian Steenblik Hwang**

SCIENCE NEWS
EDITOR, SPECIAL PROJECTS **Elizabeth Quill**
NEWS DIRECTOR **Macon Morehouse**
FEATURES EDITOR **Cori Vanchieri**
MANAGING EDITOR, MAGAZINE **Erin Wayman**

CONSULT DESIGN AND MARKETING
Team of Creatives

SOCIETY FOR SCIENCE
PRESIDENT AND CEO **Maya Ajmera**
CHIEF OF STAFF **Rachel Goldman Alper**
CHIEF MARKETING OFFICER **Kathlene Collins**
CHIEF DESIGN OFFICER **Stephen Egts**
CHIEF PROGRAM OFFICER **Michele Glidden**
CHIEF, EVENTS AND OPERATIONS **Cait Goldberg**
CHIEF COMMUNICATIONS OFFICER **Gayle Kansagor**
CHIEF ADVANCEMENT OFFICER **Bruce B. Makous**
CHIEF TECHNOLOGY OFFICER **James C. Moore**
CHIEF FINANCIAL OFFICER **Dan Reznikov**

BOARD OF TRUSTEES
CHAIR **Mary Sue Coleman**
VICE CHAIR **Martin Chalfie**
TREASURER **Hayley Bay Barna**
SECRETARY **Christine Burton**
AT LARGE **Thomas F. Rosenbaum**
MEMBERS **Craig R. Barrett, Adam Bly, Lance R. Collins, Mariette DiChristina, Tessa M. Hill, Charles McCabe, W.E. Moerner, Dianne K. Newman, Roderic Ivan Pettigrew, Afton Vechery, Gideon Yu, Feng Zhang**

Science News Explores
1719 N Street NW, Washington, DC 20036
202-785-2255

SUBSCRIBER SERVICES
E-mail: subscriptions@snexplores.org
Phone: 1-855-478-5081
Web: www.snexplores.org
Mail: *Science News Explores*, P.O. Box 292933, Kettering, OH 45429-0255

Subscriptions include 10 issues per year published monthly except in January and July and cost $19.95 (international rate $44.95 includes extra shipping charges). Periodicals Rate Pending, Permit Acct Number: 3410866. Preferred Periodicals Postage paid at Washington, D.C., and an additional mailing office.

Society for Science is a 501(c)(3) nonprofit membership organization founded in 1921. The Society seeks to provide understanding and appreciation of science and vital role it plays in human advancement: to inform, educate and inspire (learn more at societyforscience.org).

From the Editor

MONKEY BUSINESS IMAGES/SHUTTERSTOCK

For years, people have asked the Society for Science for a science magazine designed expressly for younger readers and their families. We listened, and here it is. Each issue of this magazine will explore new developments across the breadth of STEM (science, technology, engineering and math). Along the way, we will share why research is important for understanding our world — and beyond. And we'll do it in a way that's fun, beautiful and youth-focused.

Every issue of this magazine will carry content from our flagship magazine *Science News* and the online magazine *Science News for Students*. And *Science News Explores* won't dumb the science down to make it accessible. Our broad team of award-winning journalists will just describe the known or suspected mechanisms behind the news in a way that even an 11-year-old could easily understand — while still fully engaging adult readers.

So sit back and learn about the lonely voyages of rogue planets, how whale carcasses keep a diverse host of deep-sea cleanup crews well fed, how multitasking can affect your memory and how close we are to having paper keyboards that we can print out for our home computers. There's so much to explore.

Sarah Zielinski
Editor, *Science News Explores*

ANIMALS

A million species could vanish, and people are to blame

Here are five ways humans are speeding up the rate of extinctions

1. Leaving species fewer places to live on land

2. Overfishing the world's oceans

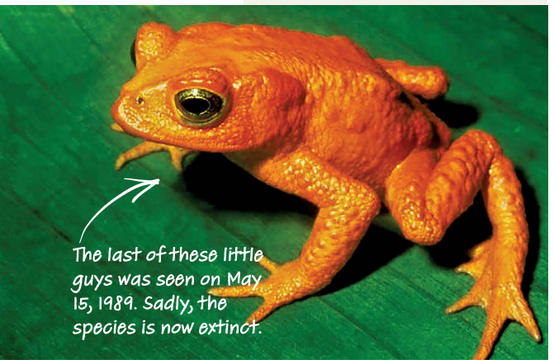
3. Not tackling climate change fast enough

4. Continuing to pollute the environment

5. Paving the way for invading plants and animals

But there's hope that people can slow the loss of species.

FIND OUT MORE AT
www.sciencenewsforstudents.org/extinction



The golden toad *Incilius periglenes* was once abundant in the cloud forests of Central America.

A new chameleon species may be the world's tiniest reptile

This fingertip-size critter in Madagascar may be endangered with extinction

A forest-dwelling chameleon easily hides beneath leaf litter in northern Madagascar. It is so slight it could tumble off the tip of your finger. The tiny critter is nearly 30 millimeters (1.2 inches) from snout to tail. It also might just be the smallest reptile on Earth.

Frank Glaw is a herpetologist at the Bavarian State Collection of Zoology in Munich, Germany. He was part of a team that described the animal in the journal *Scientific Reports*.

No one knows how many of these chameleons exist. Scientists turned up just two, a male and female. The female measured 28.9 millimeters. She was 7.3 millimeters longer than the male.

The researchers dubbed the species *B. nana* for its nano size. The critter's formal name is *Brookesia nana*. It belongs to a genus of at least 12 other small chameleons. All roam mountainous forests of northern Madagascar. By day, *Brookesia* chameleons scour the forest floor. They're feeding on mites and other small invertebrates, Glaw's team suspects. At night, the lizards retreat upward. They likely grip blades of grass or other plants for safety.

Why *B. nana* and its cousins are so small remains a mystery. However, being tiny can have its benefits: There's some evidence that small chameleons are especially good shots, using their ballistic tongues to catch prey.

But the loss of forests and damage to other wild habitat may threaten the future of *B. nana*, the researchers worry. The good news: Madagascar's government recently made the area where these compact chameleons live a protected area. — *Jonathan Lambert*

PAPA LIMA WHISKEY/WIKIMEDIA COMMONS TOP: F. GLAW/ZSM/SNSB

BRAIN

Can't remember? Maybe you multitask too much between screens

You don't even have to be multitasking when you're making those faulty memories

Ever played a game on your phone while watching TV or YouTube? Checked social media during an online class? Texted a friend while playing video games? If so, you're not alone. Many people use multiple screens at once. But such multitasking of screentime can impair our attention and memory — even when we're no longer multitasking. The finding comes from a study conducted in adults, but its conclusions likely hold for kids and teens as well.

Psychologists had suspected that using multiple forms of media at once could lead to problems with attention and memory. But they weren't sure the two were related. Kevin Madore and Anthony Wagner decided to put this idea to a test. Both are psychologists at Stanford University in California.

They and their team recruited 80 young adults, 18 to 26 years old. All came into the lab where they performed a memory task. The first step required them to classify the pleasantness or size of images. After a 10-minute break, they viewed another set of images. Participants had to recall whether each image had been in the first set. For some, they also had to remember the original image's size.

The researchers recorded brain activity in the recruits during the tasks. They also recorded changes in pupil dilation. With close attention, our pupils dilate and contract over and over. But as we zone out, our pupils shrink.

People who reported more media multitasking in their lives were more likely to forget images from the first set of pictures.

The brain and pupil-dilation recordings showed these people also had a harder time paying attention during the task.

The researchers then examined these data during the single second before the participants were asked how they had previously categorized each image. That's when the brain should be paying attention as we try to remember something. Pupils shrank and brain waves increased right before someone incorrectly recalled how they categorized images. People who multitasked less, however, showed no such brain and eye changes. They also performed better on the memory task. The team reported its findings in *Nature*.

It's important to note, the researchers say, that media multitasking and gaps in attention or memory were correlated here. They appeared related. That does not, however, mean one caused the other. We shouldn't confuse the two, they point out.

"We know that multitasking in general has switch costs," Madore says. You may take longer to perform a task, or make more mistakes. Those switch costs don't only happen while multitasking. They can also occur even when we're supposedly focusing on only one task, the new study shows. "Our attention has limits and the power of distraction can be big," Madore adds.

Ashleigh Maxcey agrees. This psychologist works at Vanderbilt University in Nashville, Tenn. "If you want to improve your memory," she says, "it is worth a shot to not media multitask." — *Alison Pearce Stevens*

ILLUSTRATION BY STEVE MCCRACKEN

PHYSICS

Why does this toy boat float upside down?

Buoyancy will keep objects afloat on the underside of a levitating liquid

Going bottom-up is no problem for a boat on the underside of a levitating liquid.

In a container, liquid can be levitated over a layer of gas by shaking the container up and down. The upward jerking motion keeps fluid from dripping into the air below. Now, lab experiments have revealed a curious side-effect of this phenomenon. Objects can float along the bottom of this levitated liquid.

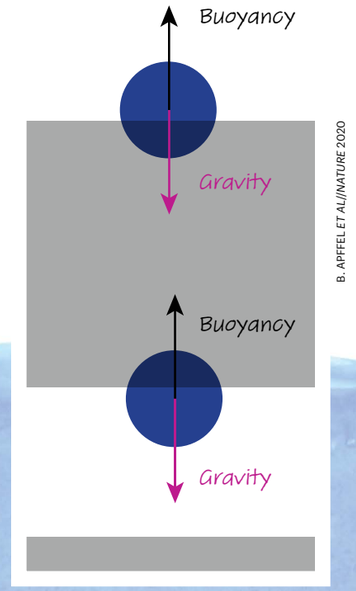
Emmanuel Fort is a physicist at the École Supérieure de Physique et de Chimie Industrielles. It's in Paris, France. Fort was part of a team that levitated silicone oil or glycerol. Then the researchers watched as toy boats bobbed along the top — and bottom — of the hovering liquid.

A toy boat floating atop the liquid experienced buoyancy. This force pulled the boat upward toward the sky. The strength of the force depended on the amount of space the boat took up in the liquid. It's a physical law discovered by Archimedes. The inventor and mathematician lived in ancient Greece. His law explains why dense objects sink and lightweight objects float.

An upside-down boat, it turns out, experiences the same upward pull of buoyancy. As long as the right amount of the boat is submerged in the liquid, the buoyant force will be strong enough to offset the gravity pulling the boat down. As a result, the underside boat floats, too. (Bet Archimedes never saw that coming.)

The team reported its finding in *Nature*.

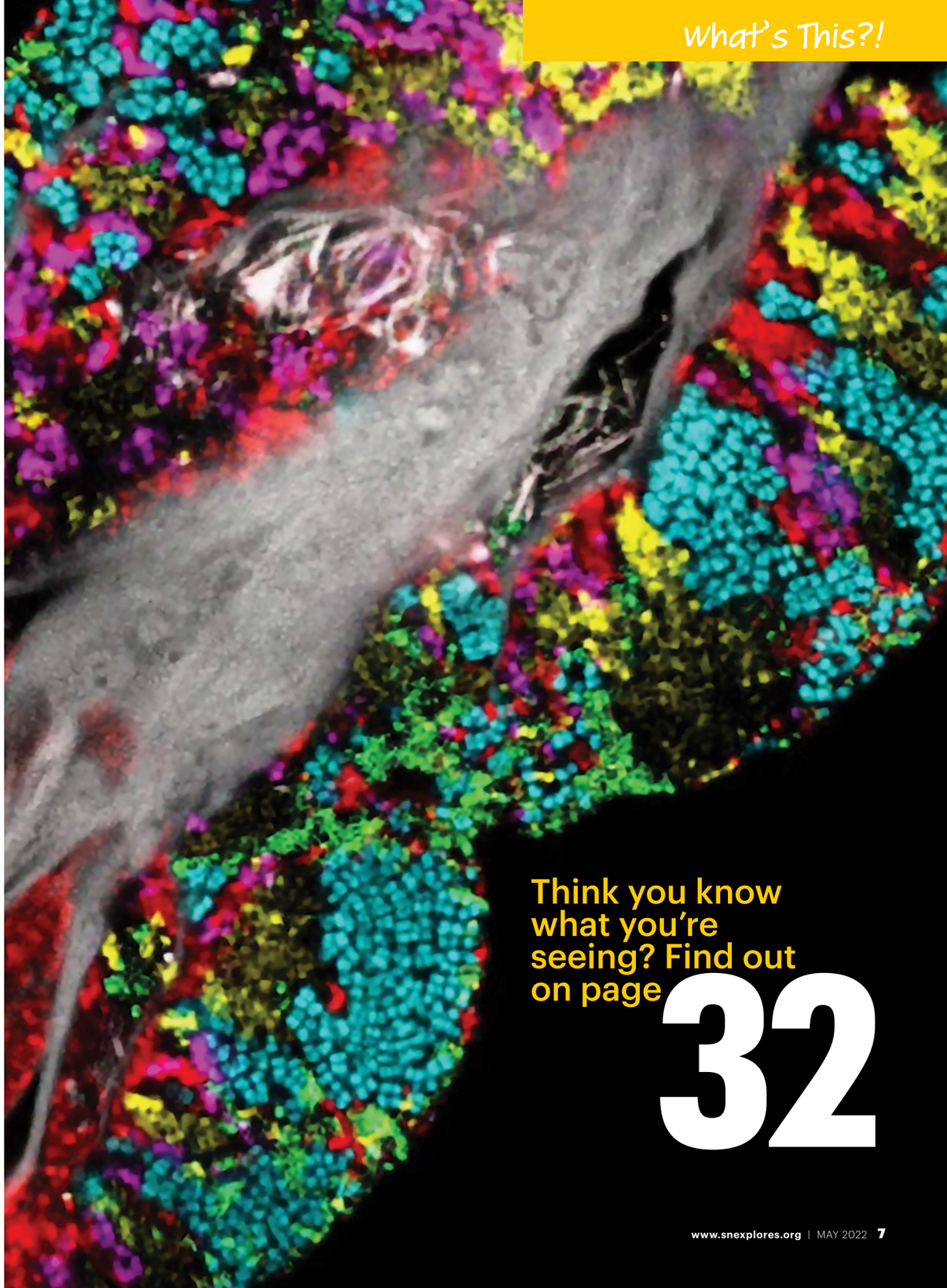
Vladislav Sorokin was surprised to see the effect. He is an engineer in New Zealand at the University of Auckland. Sorokin has studied why bubbles sink to the bottom of levitated liquids rather than float to the top. The new finding, he says, now hints that other weird effects are waiting to be discovered in levitating systems. — *Maria Temming*



B. APFFEL *ET AL*/*NATURE* 2020

Buoyancy explains how a boat can float upside down on a layer of liquid.

An antigravity effect in the lab allows toy boats to float upside down on the underside of levitating liquid.



S. WILBERT ET AL/*CELL REPORTS* 2020

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

By **Christopher Crockett**

ROGUE PLANETS

wander the galaxy all alone

Not all planets orbit stars. Some zip through our galaxy all on their own. And now astronomers may have found the smallest of these rogue planets yet.

>>

VADIM SADOVSKI/SHUTTERSTOCK

The newly discovered world has roughly the mass of Earth. If it's truly alone, then there would be no sun in its sky. It would always be nighttime. And that sky is a lot darker and filled with more stars than can be seen from any place on Earth.

"The sky must be marvelous," says Przemek Mróz. He is an astronomer at the University of Warsaw in Poland. He led the team that discovered the planet. But the lack of a sun does come at a cost, he says. "It must be freezing cold, too."

This drifter joins a small club. While astronomers now know of more than 5,000 planets in the galaxy, no more than 200 or so are suspected to not have stars of their own. Most are big balls of gas that are more like Jupiter than Earth. But scientists think these worlds are the tip of an enormous iceberg. In our galaxy alone, there might be billions out there awaiting discovery.

> The fact that we found it means a lot . . . because it means it formed in the first place.
> **— Diana Dragomir**

A valuable planet

Finding this tiny planet is "very valuable," says Diana Dragomir. She's an astronomer at the University of New Mexico in Albuquerque. She looks for planets around stars other than our sun. From this work she can start to figure out how many worlds other than Earth may be home to some type of life. There's probably nothing alive on this dark, frigid orphan planet. But its discovery gives Dragomir and other scientists information about worlds that are difficult to find.

"The fact that we found it means a lot, even if it's just floating, because it means it formed in the first place," she says.

Astronomers think that orphaned planets formed in solar systems like our own. But something kicked these planets out. Maybe the gravity of a larger world gave a planet the boot. Or perhaps a passing star got too close, and its gravity snagged a planet or two.

Dragomir says this newfound world probably formed pretty far from its home star. If it were too close, then the star's gravity would have kept it from escaping.

Planets, especially small ones, that are far from their stars are often tricky to find. Astronomers suspect that there are many planets barely holding on to their stars, but they can't be sure, says Dragomir. So finding even one that might have started off that way "is really helpful because it's adding to a very small sample." She adds that the discovery of this wandering planet is "telling us these small planets at a reasonable distance from their star do form."

When is a planet not a planet?

Most people think of planets as objects that orbit stars. In fact, the official definition says a planet must orbit a star. Specifically, our sun. Rogue planets don't meet this definition, which was decided on by the International Astronomical Union, or IAU, notes Jessie Christiansen. She's an astronomer at Caltech. Like Dragomir, she also is tallying all the types of planets that are out there. The IAU is the group that decides on official definitions and names for things in space.

But many now argue a planet should be defined only by how it formed. The IAU goes on to say that a planet is anything that's massive enough so that its gravity molds itself into a ball. Otherwise it would be a lumpy asteroid or comet. But the object can't be so massive that it crushes together atoms and starts to glow. Then it would be a star.

Based on their mass, rogue planets pass inspection. But "our institutions have not caught up to the fact that these planets exist yet," says Christiansen.

"NASA is literally rewriting the definition right now," she says. NASA keeps track of planets found outside our solar system in a computer database. It's called the NASA Exoplanet Archive. (An exoplanet is any planet that doesn't orbit our sun.) But Dragomir says this database does not yet include orphan worlds. "We're in the process of redesigning our archives so that we can host them," she says.

Really low odds

Astronomers find most planets by detecting how they influence the stars they orbit. That, of course, won't work for the orphans. They also don't emit light, so astronomers can't see them directly.

However, orphan planets can alter the light from stars that are much farther away. The process is known as gravitational lensing.

If something in space passes between Earth and a star, the object's gravity focuses light from that star onto Earth. "It's like a magnifying lens," Mróz says. To someone on Earth, the star brightens as the object passes by. And that's how researchers discovered this tiny rogue planet.

SIBERIAN ART/SHUTTERSTOCK

In June 2016, a faint star in the constellation Sagittarius brightened a bit. It then faded back to normal. Mróz and his team measured how long it took the star to brighten and dim. The change took about five hours. That told them the approximate mass of the passing object. They estimate that its mass could be as little as one-third the mass of Earth or as much as twice as massive as our planet. They shared their discovery in *Astrophysical Journal Letters*.

Mróz and his team noticed the planet with a telescope called OGLE. That stands for Optical Gravitational Lensing Experiment. The telescope sits in the Atacama Desert of Chile. It stares toward parts of our Milky Way that have lots of stars, such as the center of the galaxy. It then looks for changes in starlight caused by dark objects floating by.

The odds of finding just one object are, well, astronomical. The alignment between Earth, some object and a background star has to be almost perfect. "If you observed only one star, you would need to wait on average a million years" before anything passed by, says Mróz.

No one wants to wait that long. So to increase their chances, instead of watching one star, scientists watch millions. The OGLE telescope monitors the same 200 million stars every clear night, notes Mróz. That lets them find a couple thousand floaters every year, though most are just dim stars.

What's next

This teeny planet pushes the limit of what telescopes like OGLE can do, says Mróz. To find lots more, astronomers need a telescope in space that's up to the challenge.

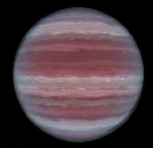
That's where the Nancy Grace Roman Space Telescope comes in. It's due to launch no later than 2027. It will be as large as the Hubble Space Telescope, but it will see 100 times more of the sky at once. The new telescope is named after Nancy Grace Roman, NASA's first chief astronomer. In 1959, she wrote that putting a telescope in space would let astronomers find planets around other stars. (Her namesake telescope won't be the first such planet-finding telescope in space. The Kepler space telescope, for example, found more than 2,700 exoplanets before running out of gas in 2018.)

The Roman telescope will live far above Earth's shaky atmosphere. From there, it will be able to find many roaming planets (and do lots of other science, too).

"Right now, we know very little about free-floating planets," says Samson Johnson. He is an astronomer at The Ohio State University in Columbus. Recently, he and other scientists calculated how many free-floating planets the Roman telescope might find. They estimate it could find at least 250, some as tiny as Mars. They reported these results in the *Astronomical Journal*.

THE EXOPLANET COUNT

The Milky Way holds at least 5,009 exoplanets, according to NASA's official tally. These exoplanets can be categorized and divided into several distinct types by their widths, of which planets the size of Neptune are the most common. Super-Earths, not seen in our solar system, are a close second. Jupiter-like giant, gassy planets come in third. Small, rocky worlds, some of which may resemble our own, come in fourth. Almost all of these planets have been found orbiting stars. — **Liz Kruesi**

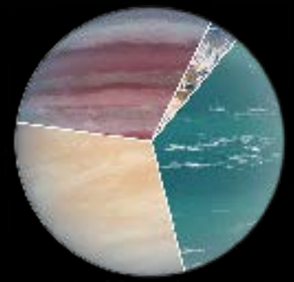


30% Gas Giant

These are gargantuan planets, such as Jupiter and Saturn, and are mostly made up of hydrogen and helium gas.

4% Terrestrial

About the size of Earth or smaller, these are small, rocky planets.



35% Neptune-like

Exoplanets similar in size to Neptune or Uranus are usually gassy surrounding rocky cores. These can be ice giants or hot desert planets.

31% Super-Earth

There are no super-Earths — planets larger than Earth but no more than twice Earth's width — in our solar system. Defined only by size, they can be rocky like our home planet or have thick gassy atmospheres or oceans surrounding their rocky cores.

5,000+
PLANETS FOUND

This is a colorized image of the galaxy Andromeda. Andromeda is a spiral galaxy that neighbors the Earth's home galaxy, the Milky Way.

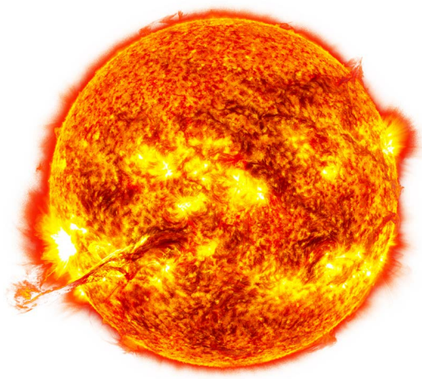
NASA/JPL-CALTECH

Such discoveries could tell astronomers a lot about how planets form. Some of the solar systems in our galaxy show hints of past messiness. They are home to planets with orbits that are tilted and spaced out in strange ways. But other solar systems are neat and orderly.

"One of the questions going forward is, which is more common?" Christiansen says. If the Roman telescope turns up lots of orphan planets, she says, then it may indicate planets get kicked out of their homes often. And that may mean that many young planetary systems are messy.

Even our own solar system was once chaotic. For hundreds of years, astronomers assumed our solar system has always looked the way it does now: nice and organized. They also thought other planetary systems would be similar to ours. But the variety of worlds we've discovered, including orphan planets, shows this isn't the case. And some scientists now think that our solar system lost a planet long ago.

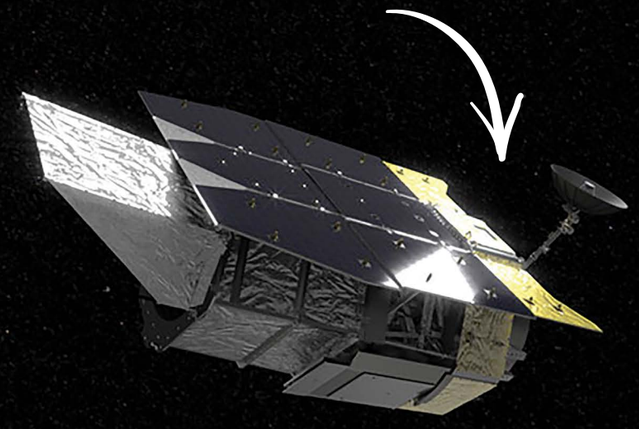
"One of the nice, most amazing, and exciting things that came out of exoplanets," says Christiansen, "is discovering that there are so many different types of planetary systems out there."



Our sun, the closest star, is 5,510° Celsius, 9,940° Fahrenheit or 5,780 kelvins.

NASA

The Nancy Grace Roman Space Telescope will launch no later than 2027. It will be as large as the Hubble Space Telescope, but it will see 100 times more of the sky at once.



The telescope has a 300-megapixel infrared camera that will let astronomers see distant galaxies, failed stars and rogue planets.

NASA named its newest space telescope in honor of Nancy Grace Roman, the agency's first chief astronomer. She was considered the "mother of the Hubble" for her work establishing the space-based astronomical observatory.

Before working on spacecraft, this engineer overcame self-doubt

Tiera Fletcher has gone on to help design vehicles for travel to the moon and Mars

Like many kids, Tiera Fletcher wanted to be many different things when she was young. A mathematician, an inventor, a scientist, an architect. But when she was 11, she figured it out. She wanted to build rockets and airplanes. And since then, she has been reaching for the stars — or at least thinking about how to travel closer to them.

Today, she's an engineer in Maui, Hawaii, at Boeing. That's an aerospace company that makes airplanes and spacecraft. Fletcher has helped design vehicles that may someday shuttle people to the moon or Mars.

In this interview, she shares her experiences and advice. And she wants kids to realize that believing in themselves is an important part of reaching their goals. (This interview has been edited for content and readability.) — *Carolyn Wilke*

©MICHAEL A. SCHWARZ PHOTOGRAPHY

Tiera Fletcher dreamed of working on spacecraft as a child. Now she is a rocket scientist.

Q How did you get where you are today?

A Ever since age 11, I remained focused on becoming an aerospace engineer. I even picked my activities and summer programs in middle school based on that goal. It also helped me to select my high school. I went to Wheeler High School in Marietta, Ga. They had a program that specialized in science, math and technology. It was out of my school district, so I rode the bus for an hour every morning from my home in Mableton, Ga. But I knew that it was the school for me and my goal. So I made it happen and so did my parents.

Along the way, my biggest hurdle was truly believing in myself. It's something that we all go through at some point in our lives. ... Even though I was excelling, I always thought that I didn't have the capabilities to fulfill my dreams. I finally started to believe in myself my sophomore year in college. It was shortly after I accepted an internship with the Boeing Company. I was halfway through this really hard course for aerospace engineers at MIT. I realized I was able to do this work. And I looked in the mirror and said, "I believe in you."

Q How do you get your best ideas?

A One way that I get my best ideas is silence. I just sit there and think about a topic. I think about how I can implement whatever the goal is or different avenues. Just by having that realm of silence and the room to think, that's when the ideas appear. I write them down, probably in a notepad or in my phone. And I'm able to expand on those ideas later.

Q What's one of your biggest successes?

A One of my greatest successes is marrying my best friend and becoming a mother. It's something I've dreamed of. But after it happens, you can't exactly calculate how things are going to turn out. You want to keep your little ones safe. But all sorts of different factors play a role.

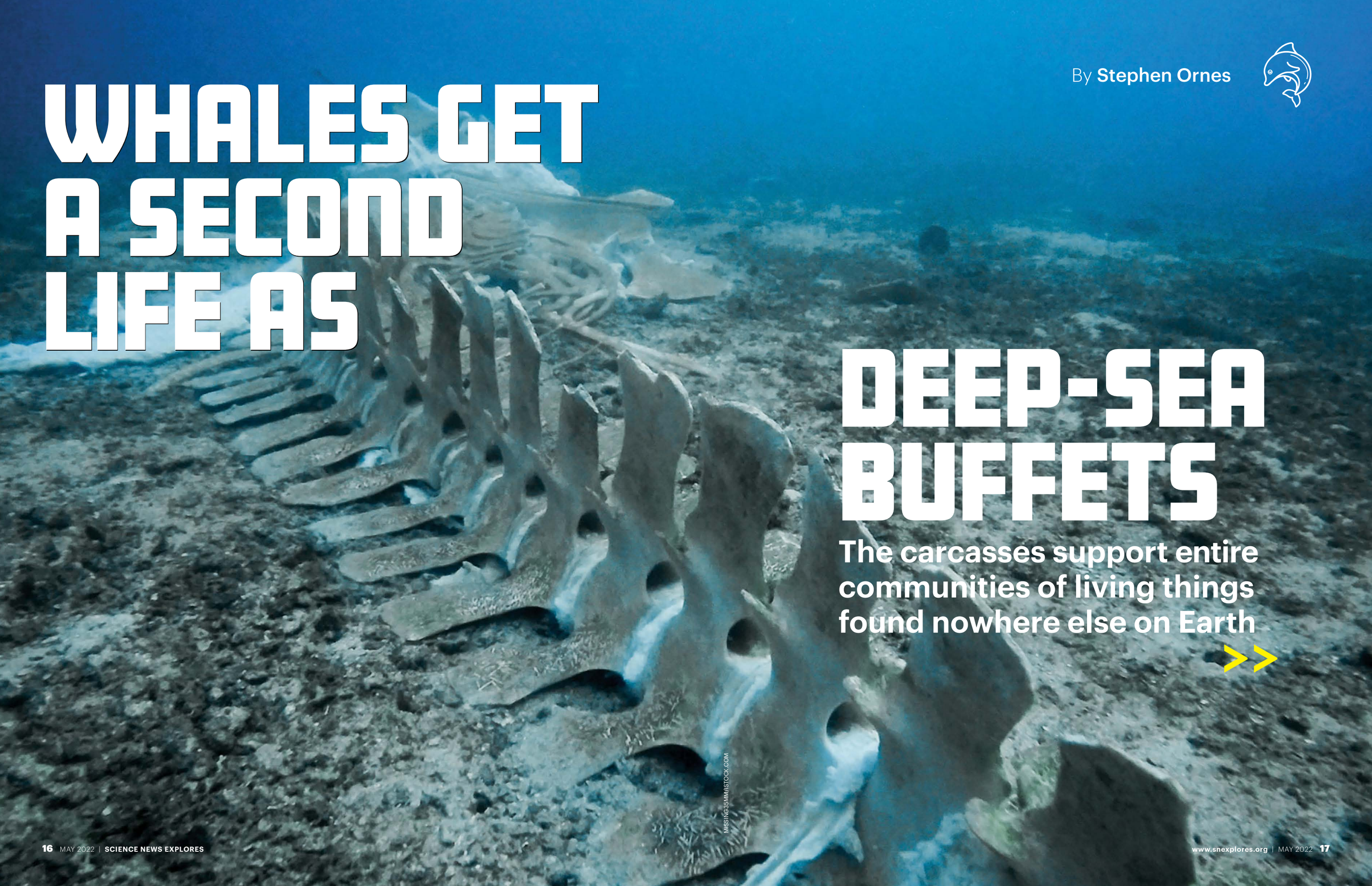
Q What piece of advice do you wish you had been given when you were younger?

A Allow failures to be learning lessons. Just because you fail, it's not a stopping point. It's a time for you to reorganize your approach and your thoughts. You can still reach whatever goal it is that you're trying to reach.

WHALES GET A SECOND LIFE AS DEEP-SEA BUFFETS

By **Stephen Ornes**

The carcasses support entire communities of living things found nowhere else on Earth



MISSING35MM/ISTOCK.COM

In October 2019, a team of marine explorers sent *Hercules* — a remote-controlled vehicle — to the bottom of the ocean. Its mission: to visit an octopus neighborhood. It was off the coast of central California, near an undersea volcano. Late one night, after scanning a long stretch of empty seafloor, *Hercules*' spotlight and camera revealed a parade of curious creatures. First was a slender bottom-feeder called an eelpout. It was half-buried in the sediment. Then came a sea pig — a squishy thing that looks like a living pink balloon, but with tentacles.

"And another sea pig and another sea pig," said Chad King, a marine researcher leading the watch. He works at the Monterey Bay National Marine Sanctuary in California.

"A whole squadron of sea pigs," added Megan Cook, who runs educational programs for the Ocean Exploration Trust based in Old Lyme, Conn. This research nonprofit ran the expedition.

Together with other researchers, King and Cook were watching on monitors in a boat floating around 3,000 meters (1.9 miles) above the seafloor. After the sea pigs, a smattering of octopuses came into view.

At last the rover's cameras revealed why these creatures — and hundreds, maybe thousands of others — had flocked to this undersea neighborhood. The carcass of a large whale had sunk to the spot near this long-dead volcano. The researchers gasped. They ooh-ed and aah-ed. "Whale fall," they said, one after another, in excited near-whispers.

For creatures that live in the deep, dark ocean, a whale fall is a gluttonous feast. ("Dinner is served!" shouted one watching scientist. "Come and get it!" said another.) The all-you-can-eat buffet brings out an exotic parade of creatures of various sizes, shapes and appetites. Think of it as a watery free-for-all: Hagfish, octopods, sharks, crabs and worms all gather and devour. It's a rich ecosystem all of its own. In deep water, where relatively few animals live, the feast may last for years.

For marine biologists, the body of a dead whale provides an opportunity to study life in one of the least explored places on Earth: the bottom of the ocean.

"Not very much is known about the deep sea, but it makes up most of the biosphere," says Craig Smith. He is an oceanographer at the University of Hawaii at Manoa. Smith has studied life on the seafloor all around the world. When he talks about the biosphere, he means all the places on the planet where life is found — including the remains of a giant whale. More than 20 types of organisms found on whale falls also have been found in other extreme locations. Those include hydrothermal vents and cold seeps. Both are breaks in the seafloor that release fluids rich in minerals. (The water from vents is hot, and water from seeps is about the same temperature as the surrounding sea.) But other creatures seem to show up only when a whale dies.

"There's a big diversity of animals that appear to live on whale falls," says Smith, "and nowhere else."

Here come the snotflowers

Skeletal remains of the whale that *Hercules* found stretched some five meters (16 feet) from mouth to tail — or what was left of these. Its jaw still had fragments of baleen. That's a tough material made of keratin. It's the same stuff that makes up fingernails and hair. Baleen whales don't have teeth. Instead, they use baleen screens to filter seawater and trap tiny prey, such as krill.

After a whale dies, it has a second life as food for at least 100 known species. Not all the animals come at once. The first to arrive are hungry and ruthless. They are what marine biologists call marine scavengers. These include sixgill sharks and rattail fish. They use teeth plates to gnaw flesh off the whale bones. They also may include giant isopods, which burrow into the body. They look like oversized versions of the roly-polies, or pillbugs, that you might find in a garden. Scavenging amphipods, which look like sand fleas, come out in droves.

Marine biologist Robert Vrijenhoek has spent decades studying the sea. He now works at California's Monterey Bay Aquarium Research Institute (MBARI). He calls the scavengers the start of a "feeding frenzy." Other creatures soon show up. Black hagfish burrow into the carcass to digest it from the inside out. Crabs dance along the bones, scraping and snacking. It's "like they're eating corn on a cob," says Vrijenhoek.

Other scavengers with hard outer shells arrive a bit later. "They sandpaper the bones down," Vrijenhoek says. All that scraping produces bone dust, which settles on the seafloor like sawdust under a workbench. At the same time, smaller creatures have to watch out. Octopuses, which prey on crustaceans, worms and mollusks, bob in and out of the bones. They're there to eat the things that are eating the whale.

ILLUSTRATION BY COLIN HAYES

Once the bones have been picked nearly clean, another phase begins. This is when the mysterious, hungry worms arrive. The scientific name for this group of creatures is *Osedax*, which in Latin means "bone-eating." The worms produce an acid that dissolves the hard, outer layer of bone. Then they reach small tendrils into the bone's center, almost like a plant growing roots. These tendrils devour the rich proteins, like collagen, found inside the bone. To *Osedax*, those proteins are a means of survival.

The arrival of the *Osedax* also launches an underwater back-and-forth battle. The crustaceans leave and the worms show up. Then the crustaceans return to try to eat the worms. As the worms retreat into the bones, the crustaceans leave once more. The worms re-emerge, which brings back the crustaceans.

"There's this remarkable tug of war," Vrijenhoek says.

Scientists sometimes call the *Osedax* "zombie worms." Vrijenhoek led the team of scientists that first found them in 2002. They were feasting on the carcass of a gray whale almost 2,900 meters (close to 2 miles) beneath the surface near Monterey, Calif. Since then, deep-sea observations have turned up at least 30 different species of *Osedax* worms. And because they produce blobs of mucus, they're sometimes called "snotworms" or "snotflowers."

Invasion of the zombie worms

Osedax worms have been found in oceans all over the world. They've only ever been spotted on bone, which makes some scientists think that the bone-eaters are specialized to live in odd ecosystems, such as whale falls. "Those kinds of animals are definitely uniquely adapted to the environment in which you find them," says marine biologist River Dixon. She is a graduate student at the University of Louisiana at Lafayette.

But as recent experiments show, the bone-eaters may not be picky about what type of bones they devour. In 2019, biologists spotted *Osedax* worms in the Gulf of Mexico for the first time. And not on whale bones. Dixon was part of a research team that made the discovery. Her group had sunk the carcasses of three alligators in water about 2 kilometers (1.2 miles) deep. Over the the following weeks, they sent a remote-controlled vehicle a few times to spy on what were essentially "alligator falls."

One had been dragged away. Only a harness and the weights used to keep it down remained. (Dixon suspects a shark was the culprit.) Another had been invaded by giant isopods — those big roly-polies — within a day of being submerged. Dixon says they already had bored their way through the tough alligator hide.

On the third, which the scientists revisited 51 days after they sunk it, "the flesh was gone," Dixon says. "It had been reduced to just the skeleton." And just as at whale falls, it hosted a carpet of bone-eating *Osedax* worms. These worms were similar to other bone-eaters but represented a never-before observed species. That means the scientists who found them get to name it (although Dixon says they haven't settled on a name yet).

The lab where Dixon works studies food systems in the deep ocean. The food web for most living things begins with the sun. Algae and plants use photosynthesis to turn sunlight into food. Animals eat those plants and algae to survive. Then larger animals may eat those animals.

But sunlight doesn't reach the deep ocean's bottom.

"There's no light. And because there's no light, there's no photosynthesis," says Dixon. "Almost all of the food in the deep sea basically rains down from the overlying waters." Scientists call this supply "marine snow." However, the amount of plants and algae that fall don't provide enough support for the diversity of life found at the bottom, Dixon says. "We study the different pathways for how food can make it to the deep sea."

The pink tendrils, here, are part of *Osedax* worms. They're at work devouring the collagen inside whale bones. An acid they emit dissolves bone so that they can get at what's inside. Because they produce blobs of mucus, these worms are sometimes called "snotflowers."

These pathways include whale falls and other carcasses, such as when fish or other larger creatures die. (They also include feces.) Studying alligator falls, Dixon says, could help show how life evolved in the deep sea. "In the ancient oceans, we had things like plesiosaurs and ichthyosaurs — large marine reptiles that dominated the oceans," she says.

***Osedax* worms have been found in oceans all over the world. They've only ever been spotted on bone. That makes some scientists think that these bone-eaters are specialized to live in unique ecosystems. These worms have been found feasting on the bones of dead alligators, fish, sea lions, elephant seals, turtles, whales and more.**

It's possible that the creatures found on whale falls and other falls today, she says, evolved from creatures that hundreds of millions of years ago would have devoured plesiosaur falls.

How to make a whale fall

In the 1980s, Craig Smith wanted to know how creatures on the seafloor got food. But where to look? He thought sunken whale carcasses would be a good place to start.

However, he notes, "It's hard to find them by luck." Tens of thousands of whales likely swim in the world's oceans. Smith says that there should be hundreds of thousands of whale falls on the seafloor. But finding them is another matter. The one discovered in October 2019 by *Hercules* was a lucky accident.

In 1987, Smith led a team that found a whale fall off the California coast. Their report on it a few years later offered the first observations of the wide variety of life found on a downed mammal. Since then, scientists around the world have been documenting the diverse species that thrive in this unusual ecosystem.

Some researchers have even created their own falls. In 2004, a blue whale died and washed up on a beach in downtown Monterey. Spanning about 17 meters (56 feet), it clearly wasn't full grown. Vrijenhoek saw this carcass as an opportunity. After waiting until high tide, when the whale carcass could float, he and his team tied it to a ship. They dragged the whale out to the ocean, attached some heavy weights — in this case, some old train wheels — and sank the carcass. Through experiments like this, scientists have learned that whale falls attract different scavengers and other creatures, depending on how deep they land.

Sharks generally avoid the deepest oceans, for example. As a result, those whale falls usually stay intact for years, or even decades. In contrast, whale falls in shallow oceans may vanish within a year or two. At 1,000 meters, the *Osedax* that appear include different species than the ones that show up at 4,000 meters deep.

Scientists are just beginning to understand what happens in the deep ocean. They suspect zombie-worm larvae drift in the water until they find some whale bones. And even though many species show up only when whales die, recent studies have found some of these zombies on other types of carcasses. "We now know the worms can grow and reproduce on the bones of fish, sea lions, elephant seals, turtles and even pig bones dumped at sea," Vrijenhoek says. Fish scales, too, might provide collagen.

The science of whale falls is a fairly new field. Vrijenhoek says it only exists — and moves forward — because of curiosity. "I see myself as a 9-year-old boy, turning over rocks and bones, to see what I would find," he says. "And every time we kick over a rock, we find something new."

Try This

This experiment will show you how to take advantage of tension

By **Bethany Brookshire**

Splash through a puddle and you get your feet wet. But little insects called water striders (right) can skim right across the water's surface. How do they do it? They're very small, but that's not it. They're very light, but that's not everything, either. The answer is surface tension. This is what happens when water molecules form a thin film at a liquid's surface. And you can explore this effect with a simple experiment.

HYPOTHESIS

Objects with a larger surface area will float more often than objects of the same mass with a smaller surface area.

METHOD

1. Obtain a spool of 0.25-millimeter- (0.01-inch-) thick wire, often called 30-gauge wire.

2. Cut the wire into 60 pieces of the same length: 20 centimeters (7.9 inches). Separate the pieces into five groups of 12 each.

3. Take a piece of wire from one group and loop it into a circle about 60 mm (about 2 inches) across, twisting the ends together. Repeat for the other 11 pieces from that pile, flattening each with a big, heavy book.

4. Repeat step 4 for the other four piles, making loops of around 30, 40, 45 and 50 mm in size.

5. One at a time, place each circle gently onto a tray of water.

6. Did it sink or float? Note which pieces sank and which floated for all 60 wire circles.

DID YOUR DATA SUPPORT YOUR HYPOTHESIS?
Find out how to analyze your data, and more, at
www.sciencenewsforstudents.org/water-walking

JANMIKO/ISTOCK/GETTY IMAGES PLUS

TECHNOLOGY

Ordinary paper turns into a flexible human-powered keypad

Tapping fingers power the device, which works even after folding or a spray of water

Smartphones, tablets, fitness trackers, headphones. Most of the electronic devices we use today are made of rigid metal, plastic and glass. But electronics don't have to be, says Marina Sala de Medeiros. Consider her team's new electronic keypad. It has no batteries. The user's touch gives it all the power it needs to run.

"Any electronics you have — just think if you could make that out of paper," she says. Paper is cheap and plentiful. It's also flexible and lightweight.

Sala de Medeiros is an engineer at Purdue University in West Lafayette, Ind. She and her colleagues found a way to turn an ordinary sheet of paper into a simple electronic keypad. Many teams around the world are working on paper-based electronics. But this new device is the first to power itself and also repel water and dust.

The researchers described this new invention in *Nano Energy*.

No single moment inspired her paper keypad, Sala de Medeiros says. Instead, she focused on devices other engineers have been working on. Then she asked herself, "What are the gaps? What can I overcome?"

If you had a device made out of the new electronic paper, you could fold it up, stick it in your pocket and take it to the beach. It resists sand and water and it's "cheap and easy to replace," says Sala de Medeiros.

COURTESY OF PURDUE UNIVERSITY

High cost was a problem with some flexible electronics. So she decided to work with low-cost materials. That would make it easier to eventually turn her idea into something most people could afford. She recalls also wanting something that felt like regular paper but wouldn't easily get wet or dirty. It also should "fit in your pocket," she says.

Teflon is a chemical coating that keeps food from sticking to pots and pans. Similar compounds can also make paper waterproof. So she started testing some of these so-called perfluorinated chemicals.

Strangely, the one that was supposed to do the best job didn't work at all. When she sprayed paper with it, water still soaked through. What went wrong?

After some research, Sala de Medeiros found out that this chemical reacts with air. "As soon as I opened the vial, I killed the chemical," she realized.

She had to buy more of the chemical — and special equipment that would let her use it without any pesky air getting in the way. Now, the chemical works as planned. After getting sprayed, paper still feels like paper. But water beads up on its surface instead of soaking through.

The next step was to add an electronic circuit. The team placed a stencil with the shape of a circuit onto the back of the paper. Then they sprayed on several layers of materials. Two layers contained tiny nickel particles. These act like wires to carry electricity through the circuit. The final layer is another coating of the Teflon-like chemical. Finally, the team flipped the paper over and printed a keypad of numbers on the other side. They also added a tiny Bluetooth chip. This let their paper device talk to a computer.

Microscope images of paper that Sala de Medeiros treated with the Teflon-like chemical reveal that the fiber structure of the paper has not changed. The chemical absorbed into the fibers without changing them. So the material still looks and feels just like normal paper.

COURTESY OF PURDUE UNIVERSITY

The circuit needs a source of electricity. That comes from the tap of a finger. "When you're typing we can use the energy," says Sala de Medeiros. Such triboelectric energy comes from the friction of two things touching or rubbing. (You can generate this type of static electricity yourself. Just walk across a fuzzy rug with socks on. You'll probably build up enough electric charge to feel a zap when you later touch a doorknob or some other person.)

In the new keypad, the pressure of a finger tap rubs together the layers of material sprayed onto the paper. This generates a small amount of power, usually around 20 volts. That sends electricity along the printed wires to the Bluetooth chip. The chip then signals a computer, telling it which number the person had pressed. That number now shows up on the computer's monitor.

The voltage the device generates from a finger tap isn't a lot, says Manos M. Tentzeris. An electrical engineer at Georgia Institute of Technology in Atlanta, he did not take part in the research. "For simple structures like a keyboard," he observes, "it's more than enough."

In fact, many useful devices don't require lots of power. Sala de Medeiros' team also printed a controller for a music player. Tapping arrows switches between songs. Sliding a finger along a printed bar turns the volume up or down. The music plays from a computer speaker, not the paper.

In the near future, such paper electronics will be most useful as sensors. For example, a simple sensor printed onto money could help prevent counterfeiting. Eventually, though, this type of innovation could lead to "paper that is actually interactive, like in Harry Potter," says Tse Nga Ng. She's an engineer at the University of California, San Diego who was not involved in the new research.

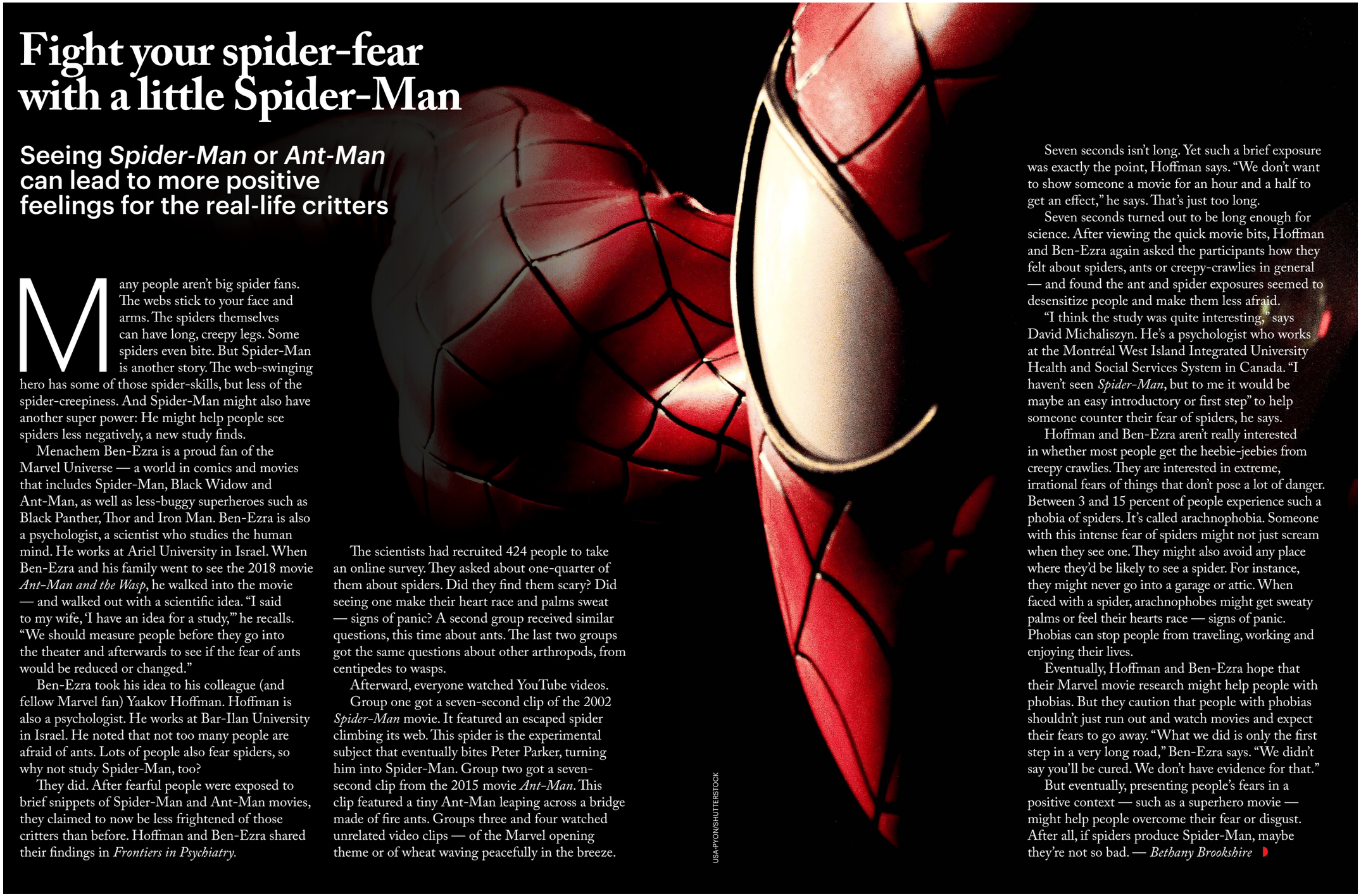
Someday, people may even be able to print their own paper tablets or music players.

— *Kathryn Hulick*

PSYCHOLOGY

Fight your spider-fear with a little Spider-Man

Seeing *Spider-Man* or *Ant-Man* can lead to more positive feelings for the real-life critters



USA-PYON/SHUTTERSTOCK

Many people aren't big spider fans. The webs stick to your face and arms. The spiders themselves can have long, creepy legs. Some spiders even bite. But Spider-Man is another story. The web-swinging hero has some of those spider-skills, but less of the spider-creepiness. And Spider-Man might also have another super power: He might help people see spiders less negatively, a new study finds.

Menachem Ben-Ezra is a proud fan of the Marvel Universe — a world in comics and movies that includes Spider-Man, Black Widow and Ant-Man, as well as less-buggy superheroes such as Black Panther, Thor and Iron Man. Ben-Ezra is also a psychologist, a scientist who studies the human mind. He works at Ariel University in Israel. When Ben-Ezra and his family went to see the 2018 movie *Ant-Man and the Wasp*, he walked into the movie — and walked out with a scientific idea. "I said to my wife, 'I have an idea for a study,'" he recalls. "We should measure people before they go into the theater and afterwards to see if the fear of ants would be reduced or changed."

Ben-Ezra took his idea to his colleague (and fellow Marvel fan) Yaakov Hoffman. Hoffman is also a psychologist. He works at Bar-Ilan University in Israel. He noted that not too many people are afraid of ants. Lots of people also fear spiders, so why not study Spider-Man, too?

They did. After fearful people were exposed to brief snippets of Spider-Man and Ant-Man movies, they claimed to now be less frightened of those critters than before. Hoffman and Ben-Ezra shared their findings in *Frontiers in Psychiatry*.

The scientists had recruited 424 people to take an online survey. They asked about one-quarter of them about spiders. Did they find them scary? Did seeing one make their heart race and palms sweat — signs of panic? A second group received similar questions, this time about ants. The last two groups got the same questions about other arthropods, from centipedes to wasps.

Afterward, everyone watched YouTube videos.

Group one got a seven-second clip of the 2002 *Spider-Man* movie. It featured an escaped spider climbing its web. This spider is the experimental subject that eventually bites Peter Parker, turning him into Spider-Man. Group two got a seven-second clip from the 2015 movie *Ant-Man*. This clip featured a tiny Ant-Man leaping across a bridge made of fire ants. Groups three and four watched unrelated video clips — of the Marvel opening theme or of wheat waving peacefully in the breeze.

Seven seconds isn't long. Yet such a brief exposure was exactly the point, Hoffman says. "We don't want to show someone a movie for an hour and a half to get an effect," he says. That's just too long.

Seven seconds turned out to be long enough for science. After viewing the quick movie bits, Hoffman and Ben-Ezra again asked the participants how they felt about spiders, ants or creepy-crawlies in general — and found the ant and spider exposures seemed to desensitize people and make them less afraid.

"I think the study was quite interesting," says David Michaliszyn. He's a psychologist who works at the Montréal West Island Integrated University Health and Social Services System in Canada. "I haven't seen *Spider-Man*, but to me it would be maybe an easy introductory or first step" to help someone counter their fear of spiders, he says.

Hoffman and Ben-Ezra aren't really interested in whether most people get the heebie-jeebies from creepy crawlies. They are interested in extreme, irrational fears of things that don't pose a lot of danger. Between 3 and 15 percent of people experience such a phobia of spiders. It's called arachnophobia. Someone with this intense fear of spiders might not just scream when they see one. They might also avoid any place where they'd be likely to see a spider. For instance, they might never go into a garage or attic. When faced with a spider, arachnophobes might get sweaty palms or feel their hearts race — signs of panic. Phobias can stop people from traveling, working and enjoying their lives.

Eventually, Hoffman and Ben-Ezra hope that their Marvel movie research might help people with phobias. But they caution that people with phobias shouldn't just run out and watch movies and expect their fears to go away. "What we did is only the first step in a very long road," Ben-Ezra says. "We didn't say you'll be cured. We don't have evidence for that."

But eventually, presenting people's fears in a positive context — such as a superhero movie — might help people overcome their fear or disgust. After all, if spiders produce Spider-Man, maybe they're not so bad. — *Bethany Brookshire*

WEATHER

Earth's water is all connected

It's a summer day at the lake. Creeks spill into clear water. Puffy clouds roll across the sky. A grey curtain of rain sweeps across distant snow-capped peaks.

This is Earth's water cycle in action. Water, shape-shifting through three phases — liquid, vapor and ice — is on the move 24/7, connecting every environment and living thing on the planet. Without the water cycle, life on Earth could not exist.

The water cycle is driven by a series of linked processes in an endless loop.

Let's start with *evaporation*. Heat from the sun causes liquid water from oceans, rivers and lakes to evaporate into an invisible vapor. Because vapor is lighter than air, it rises into the atmosphere.

Water vapor also enters the water cycle through *transpiration*: Water moves through plants and is released from plant leaves as vapor into the atmosphere.

Next up is *condensation*. As water vapor rises, it cools, causing the vapor to condense into tiny droplets we see as clouds.

Transportation of water occurs as water vapor is moved from place to place with wind, stream currents and clouds.

Cloud droplets merge into bigger drops to form *precipitation*. When the drops are heavy enough, down they come as rain, hail, sleet or snow. Not all precipitation reaches the ground. Some evaporates instead, or is transported back up by air currents.

When precipitation does reach the ground, it may soak into soil and percolate deeper into the ground. It may run off right away, or it may be intercepted by plants, collecting in leaves or taken up by roots.

Then, there may be a lull in the action — *storage*. Water may collect in lakes, ice, snow or underground as groundwater. But eventually, snow melts, lakes drain or evaporate, and ice becomes liquid or vapor. Even groundwater moves slowly back to the surface.

Then the water cycle repeats, starting with evaporation once again. — *Beth Geiger*

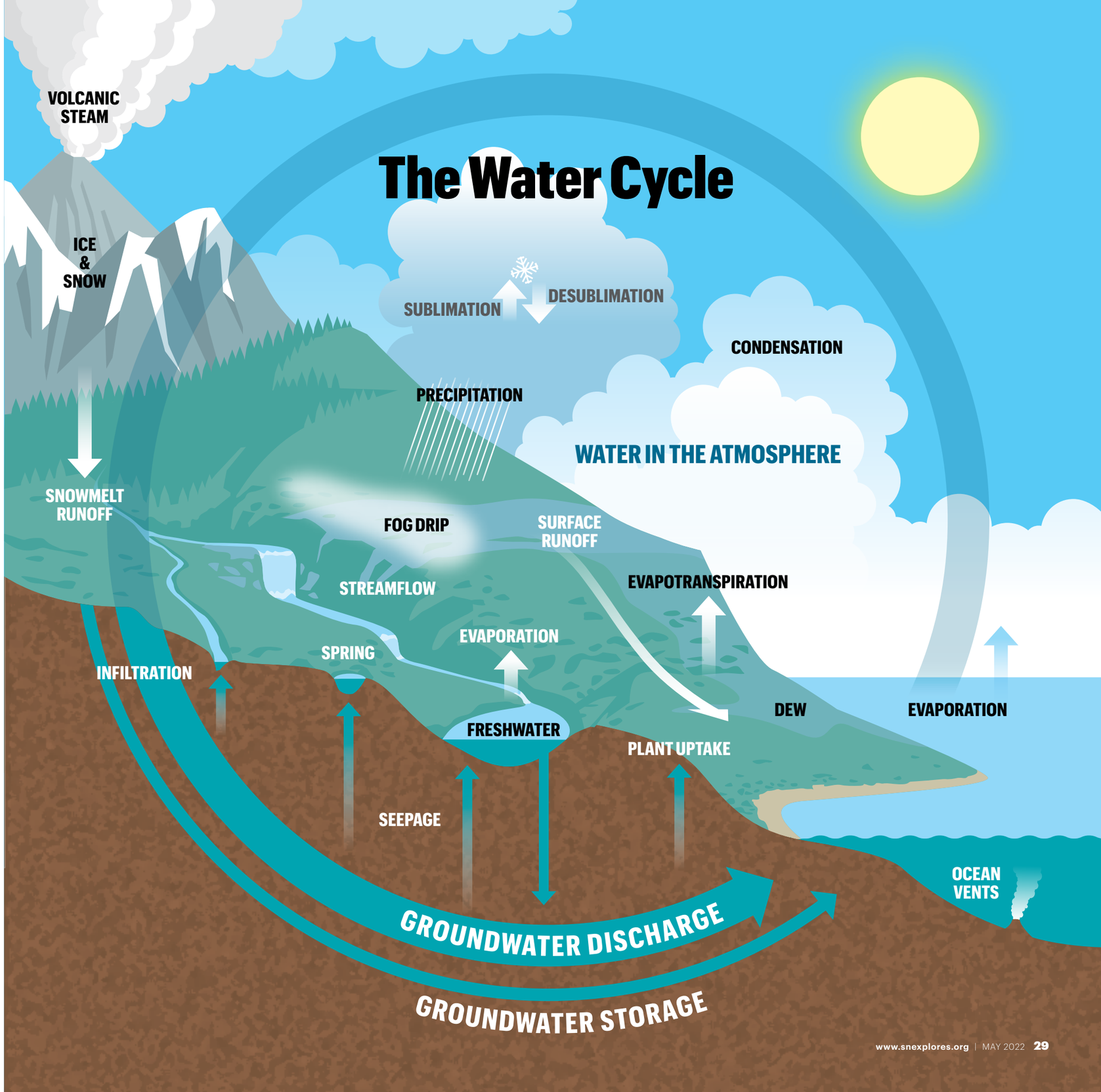


ILLUSTRATION BY STEVE MCCRACKEN

ENVIRONMENT

Finding microplastics on Mount Everest

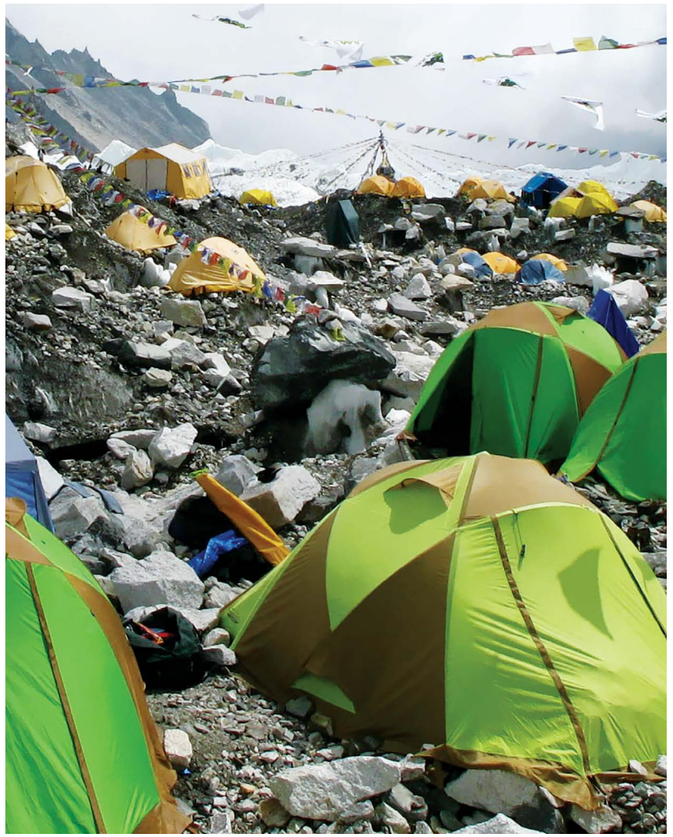
See where the tiny plastic fibers have been found on Earth's tallest peak

Bits and pieces of plastic are turning up all over, including in the snow on Mount Everest.

That mountain reaches 8,850 meters (29,035 feet) above sea level and is Earth's tallest peak. Researchers found plastic in snow scooped from a spot 8,440 meters (27,690 feet) high, near Everest's summit.

"We've known that plastic is in the deep sea and now it's on the tallest mountain on Earth," says Imogen Napper. A marine scientist at the University of Plymouth in England, she was part of the research team. Plastic is everywhere in our environment, says Napper, who is also a National Geographic Explorer.

In the spring of 2019, Napper's team collected snow and stream water samples from several areas on the mountain. The researchers brought those samples back to the lab and tallied the number and type of microplastics each contained. Microplastics are plastic shreds smaller than 5 millimeters (0.2 inch). They come from bags, bottles and other items that have broken down into pieces.



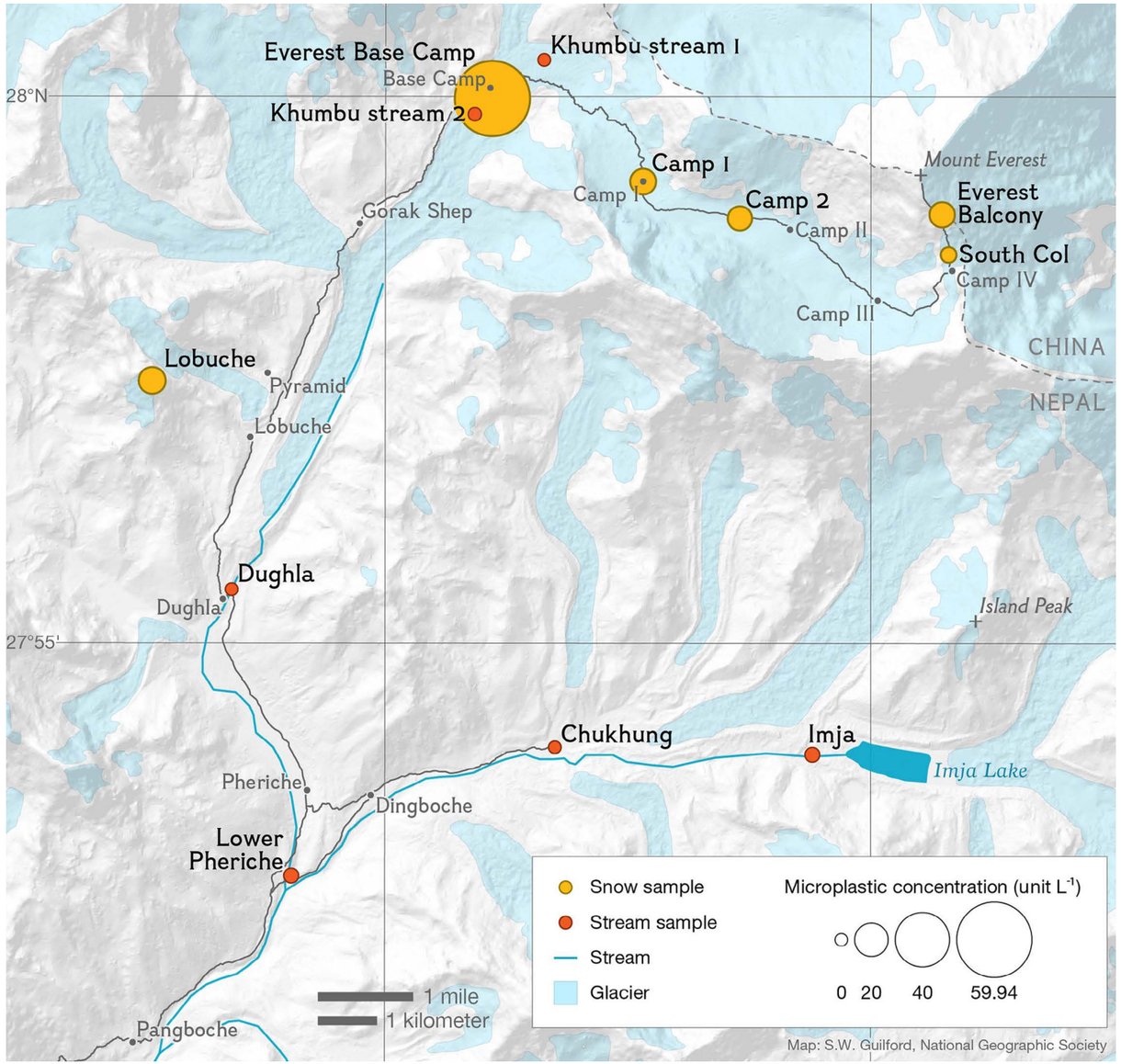
Tents abound at Everest Base Camp, a gathering spot for people attempting to reach the summit. Climbers' clothing, gear and the garbage they leave behind may be the source of plastic pollution recently found in Everest's snow.

R.M. NUNES/ISTOCK/GETTY IMAGES PLUS

All 11 snow samples from Everest contained microplastics. "I had no idea what the results were going to look like … so that really took me aback," Napper says. A remote mountain that some consider pristine is polluted with microplastics, she says. Plastics also turned up in three of eight stream water samples, the researchers report in *One Earth*.

Perhaps the findings should not have been surprising. Each year hundreds of climbers attempt to reach the mountain's summit. They discard so much junk along their treks that the mountain has been called "the highest trash dump in the world." Most of the microplastics the team found were fibers made of a plastic called polyester. The plastic pieces likely come from climbers' equipment and clothes.

— *Carolyn Wilke*



I.E. NAPPER *ET AL*/*ONE EARTH* 2020

DATA DIVE:

1. Look at the map. Which sampling location is nearest to the summit (point marked "Mount Everest")? What is the distance (in either miles or kilometers) between the summit and the sampling location?

2. Which of the snow samples had the highest concentration of microplastics? Which had the lowest concentration?

3. How do the microplastic concentrations in stream samples compare with those for snow samples?

4. What factors may explain the differences between snow and stream samples?

5. If you were one of the scientists behind this study, how else might you show what you found?

6. In many studies, researchers will gather hundreds or even thousands of samples for analysis. In this study, though, they collected only 19 samples because it is difficult to transport materials up and down Everest. If that wasn't a problem, where else might the scientists have collected samples for their study to help them learn about how widely plastic is spread on Everest?

Researchers trekked much of the trail that leads to Mount Everest's summit. Along the way they collected stream and snow samples that they later searched for microplastic pollution. This map shows those locations and the concentrations of plastics samples contained.

ANSWER

Check out the bacteria living on your tongue

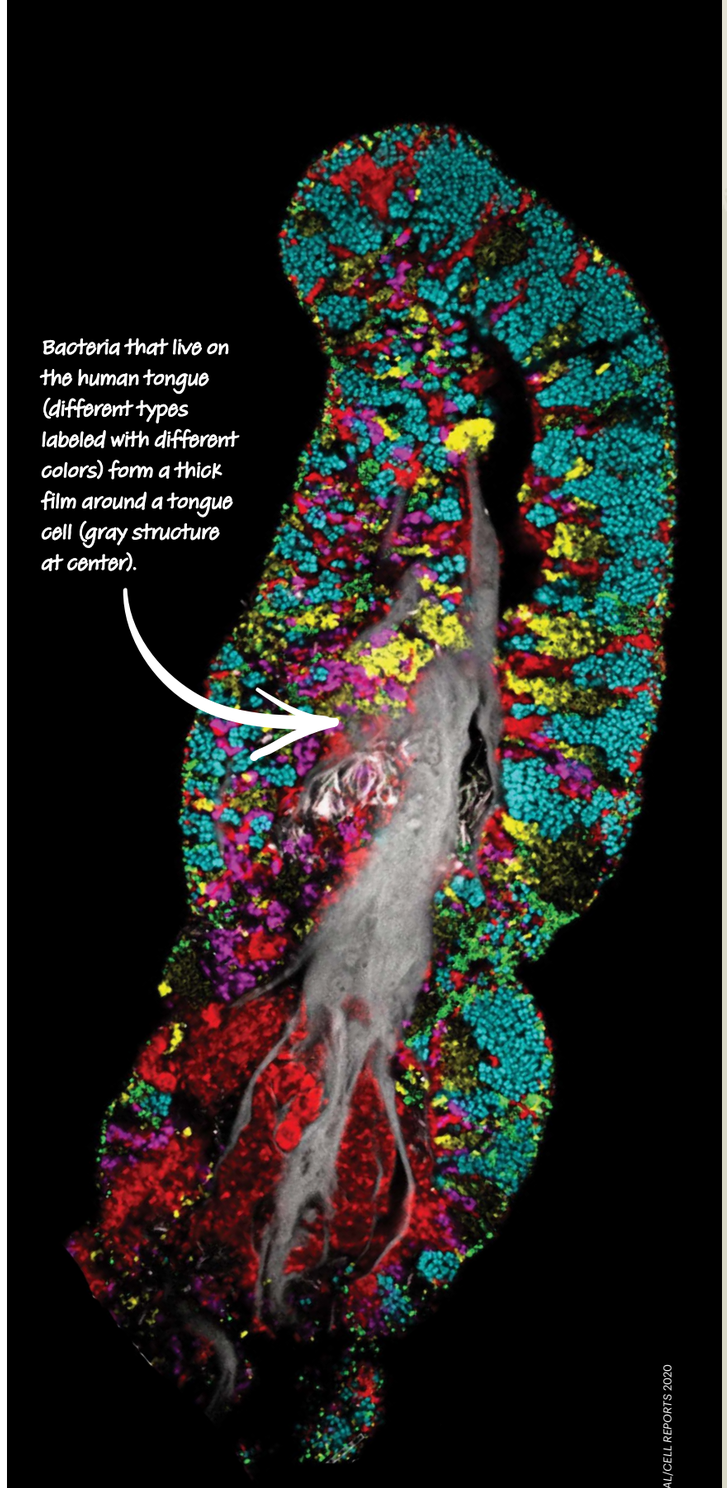
Mapping which are neighbors could uncover what they need to stay healthy

Lots of microbes live on human tongues. They're not all alike, however. They belong to many different species. Now scientists have seen what the neighborhoods of these microbes look like.

Jessica Mark Welch is a microbiologist at the Marine Biological Laboratory in Woods Hole, Mass. Her team labeled tongue bacteria with materials that glow when lit with a particular type of light. They used a microscope to make photos of the now-colored microbes. Those colors helped the team see what bacteria lived next to each other.

Like a quilt made from patches of fabric, the tongue is covered with patches of bacteria. Within each small patch, the bacteria are all the same. "It's amazing, the complexity of the community that they build right there on your tongue," says Mark Welch. Her team shared its discovery in *Cell Reports*.

The bacteria don't randomly settle on the tongue. They seem to have chosen particular sites. Knowing where each type tends to live on the tongue could help researchers learn how the microbes cooperate. Scientists might also use this information to learn how such bacteria keep us healthy. — *Erin Garcia de Jesús*



Bacteria that live on the human tongue (different types labeled with different colors) form a thick film around a tongue cell (gray structure at center).

S. WILBERT *ET AL*/*CELL REPORTS* 2020

BUILDING

ON THE 100-YEAR LEGACY OF *SCIENCE NEWS*

For years, people have asked us for a science magazine designed expressly for younger readers and their families.

WE LISTENED,
AND HERE IT IS

ScienceNews Explores