ScienceNews Explores
August 2023

TOO HOT TO PLAY?

NEANDERTALS WERE A LOT LIKE US

A POWERFUL LASER GUIDES BOLTS OF LIGHTNING
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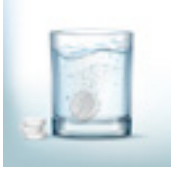

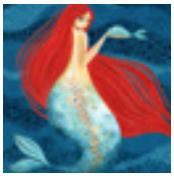

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Q What is the probability that there is other intelligent life in the universe?

— *Jack*

A That's a difficult question to answer, because scientists have searched so little of space for aliens so far. The search for extraterrestrial intelligence, or SETI, has been going on for about 60 years. In that time, "we have only searched 0.000000000000004 percent of the Milky Way galaxy for intelligent life," says Chenoa Tremblay. She's a radio astronomer at the SETI Institute in Mountain View, Calif. Upcoming searches for alien signals with the Very Large Array in New Mexico and the MeerKAT Telescope in South Africa will help scientists comb through space more quickly, Tremblay says. That should give scientists a better idea of how likely it is that other intelligent life forms exist. But Tremblay is hopeful. "We know we have over 400 billion stars in the Milky Way galaxy alone, and we have already discovered over 5,000 planets of different sizes, some rocky planets like Earth," she says. "So, I think it is a good chance we can find other intelligent life out there, and I hope we will find it in my lifetime."

Q How does seawater become salty?

— *Sarah C.*

A Some salts found in seawater come from rain that has run off land into the ocean. When carbon dioxide from the atmosphere dissolves into rainwater, it makes rain slightly acidic. When that slightly acidic water hits the ground, it leaches salts and minerals from rocks. Streams and rivers carry this rainwater to the ocean. Microbes consume some of the salts and minerals, such as zinc and iron. Sodium and chloride, though, are often ignored. These leftovers build up in seawater over time and make the ocean salty. Underwater vents also add salts to the ocean. Water entering cracks in the seafloor carry salts from the rock underneath as they pass through the vents back into the ocean.

Q If our average body temp is around 97 or 98-ish, why does it feel SO HOT outside on a 97-degree day?

— *Amelia C.*

A "Our bodies are always producing heat," says Zachary Schlader. He studies how heat affects the body at Indiana University Bloomington. Body heat comes from the chemical processes inside our cells, Schlader says. To avoid overheating, our bodies need to shed heat through the surface of our skin. This works best when outside temperatures are cooler than our bodies. When the weather gets closer to our body temperatures, our bodies can't cool down as easily. "That's why it starts to feel uncomfortable," says Schlader. "At that point, you're not losing heat very well to the environment." During hot weather, the body relies on evaporating sweat to whisk away heat from the skin's surface.

FIND OUT MORE USING THE QR CODES.

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

Sarah Zielinski
Editor, *Science News Explores*

SPACE

Planets like *Star Wars'* Tatooine could host life

Many real habitable planets may have two suns

Tatooine, Luke Skywalker's home planet in *Star Wars,* orbits two stars. Though Tatooine is fictional, pairs of suns — called binary stars — are real. Many should have planets orbiting them. Such planets might be the best places to look for life outside our solar system.

Earthlike planets could keep stable orbits around binary stars long enough to develop life, says Michael Pedowitz. He's an undergraduate student at the College of New Jersey in Ewing. He and astrobiologist Mariah MacDonald shared the finding at a meeting of the American Astronomical Society.

The researchers ran computer models of binary stars arranged in thousands of ways. Each had an Earthlike planet orbiting the two stars. The team modeled different sizes and shapes of the stars and their orbits. The scientists then tracked the motion of the planets for up to a billion years of simulated time. They watched for planets that stayed in the habitable zone. That's the region around a star where an orbiting planet's temperatures don't get too hot or cold, and water could stay liquid.

The team made models for 4,000 sets of planets and stars. About 500 had stable orbits that kept planets in their habitable zones 80 percent of the time.

"At the time *Star Wars* came out, we didn't know of any planets outside the solar system," says Jason Wright. He studies the physics of stars at Pennsylvania State University in University Park and was not involved in the study. "Now we know that there are many and that they orbit these binary stars."

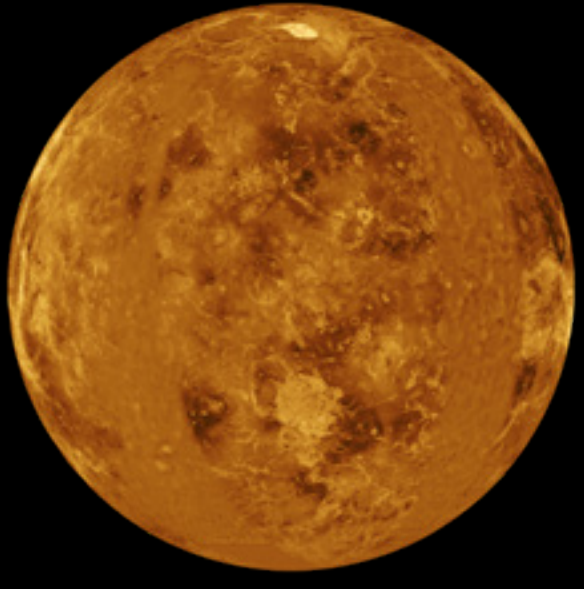
— *James Riordon*

PLANETS

Venus has some 85,000 volcanoes strewn across its surface

The count was made using radar images taken by NASA's Magellan spacecraft in the 1990s.*

**JGR Planets, March 24, 2023*



SUNS: JPL-CALTECH/NASA; VENUS: NASA/JPL

EARTH

As temps rise, baseball players hit more home runs

Warmer air has less friction on the ball

Baseball is a popular warm-weather sport. And rising temperatures may be transforming the game: Warmer air can help convert a strong hit into a home run.

The warming climate has led to more than 500 extra home runs in the major leagues since 2010, scientists have found.

Christopher Callahan is a PhD student who studies climate. He's also a baseball fan. In his free time, he decided to dig into the sport's mounds of data. (Baseball has so many stats collected that their analysis even has its own name: sabermetrics.)

Why might global warming affect home runs? The idea stems from fundamental physics: The ideal gas law says that as air temperature rises, its density will fall. And lower air density means less air resistance — friction — on the ball.

Callahan teamed up with other researchers at his school, Dartmouth College in Hanover, N.H. First, they looked at data for more than 100,000 major-league games. For every rise of 1 degree Celsius (1.8 degrees Fahrenheit) in a day's high temperature, the number of home runs in a game rose by nearly 2 percent.

The researchers found an overall trend of more home runs on warmer days going as far back as the 1960s. And from 2010 to 2019, warming linked to human activities led to an average of 58 more home runs each season.

The team also analyzed more than 220,000 individual batted balls. High-speed cameras have tracked the trajectory and speed of every ball hit during a major league game since 2015.

The research team compared balls hit in almost exactly the same way but on days with different temperatures. The team also accounted for other factors, such as wind speed and humidity.

This analysis showed a similar increase in home runs per each degree Celsius rise. Only lower air density — due to higher temperatures — was linked with extra home runs. The findings appear in the *Bulletin of the American Meteorological Society*.

"If we continue to emit greenhouse gases strongly, we could see much more rapid increases in home runs" moving forward, Callahan says.

There are ways teams can adapt to rising temperatures. Many could shift day games to night games, when temps tend to be cooler. Or they could add domes to stadiums. Callahan's group found no effect of outdoor temperature on home runs in games played under a dome.

Climate change could prompt other changes to America's pastime too, says Madeleine Orr. She studies the impacts of climate change on sports at Loughborough University London in England but wasn't part of this study. She notes baseball is susceptible to snow, storms, wildfires, flooding and heat — all of which are affected by climate.

"This sport, and all sports," Callahan says, "are going to see major changes in ways that we cannot anticipate."

— *Darren Incorvaia*

SARAH STIER/STAFF/GETTY

In March, Aaron Judge of the New York Yankees slammed a home run against the San Francisco Giants on opening day at Yankee Stadium.

ANIMALS

These beetles 'drink' with their butts

Red flour beetles use cells in their rear ends to suck water out of the air

When there's water vapor in the air, red flour beetles open their anuses. It's not to poop. These insects are taking a drink.

Water vapor from the air condenses on any poop in the insects' lower gut. Then special cells lining the gut draw the water out of the poop and into the beetle's body. It helps the insects survive. Researchers reported how these cells work in *Proceedings of the National Academy of Sciences*.

Kenneth Halberg calls the trick an "amazing mechanism." He led this research at the University of Copenhagen in Denmark. Halberg studies how hormones work in different insects. The new finding could help design new pesticides, he says. Such compounds could protect crops from beetles while keeping bees and other insects safe.

Beetles, including red flour beetles (*Tribolium castaneum*), can thrive in very dry places. That includes within stored wheat and other bone-dry crops, where the insects are destructive pests. One way beetles survive is by recycling water out of their poop. But researchers didn't know how the insects accomplished this.

Red flour beetles have a gene called *Nha1*. That gene is most active in cells in the rectal complex, Halberg's team found. This digestive organ is found near the end of the insect's digestive system.

Scientists had suspected these cells help suck water from poop. Halberg's team found that *Nha1* can help the cells to pull water through the wall of the rectal complex and into the rest of the body.

The researchers confirmed that the beetles opened their anuses in high humidity — times when there is more water vapor in the air. The scientists also tried turning off the *Nha1* gene to see what would happen. Beetles that lacked a working *Nha1* gene didn't survive as well in dry conditions as normal beetles.

It's not clear whether other beetles use this type of system, Halberg says. But the finding suggests how "nature has its way of developing some quite interesting solutions to some very interesting problems."

— *Freda Kreier*

The ability to suck water out of the air allows these beetles to thrive in very dry environments, such as stores of flour.

HHELENE/ISTOCK/GETTY IMAGES PLUS

Think you know what you're seeing? Find out on page **32**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By **Megan Sever**

TOO HOT TO PLAY?

How to be heat-safe when playing sports

Twelve-year-old Theo was excited when his soccer team made it to a regional tournament in June 2022. But when Theo took the field for his first game, something unexpected happened. The temperature was above 32° Celsius (90° Fahrenheit) with high humidity. Within minutes, Theo started to feel woozy. He got dizzy and experienced nausea. "It got really hard to hear. I couldn't really tell who or where the voices were coming from," Theo recalls. "I looked around and [everything] was really blurry." Then Theo went down on one knee and signaled to the coach that he needed to come out of the game. >>

FOTOKOSTIC/SHUTTERSTOCK

At the medical tent, medics poured cold water over Theo's head. He soon began to feel better. But he had to sit out the rest of the game in the shade. And Theo wasn't the only player who went down with heat illness that day.

The problem was not only the weather. These kids were playing on artificial turf. It absorbs more heat from the sun than grass does and has no natural way to cool off. So, the "feels like" temperature on the turf during that day's game was 53° C (127° F), medics told Theo's parents. U.S. Youth Soccer rules say to use the overall air temperature to determine how safe it is for kids to play. According to the rules, that temperature was high enough to give players extra water breaks but not enough to cancel the game.

Many youth-sports groups do not have any rules to protect players from high heat. Plus, some coaches and parents don't want to cancel or change games or practices. And kids may not want to admit when they need a break, for fear of seeming weak or letting down their team.

That can put young athletes in a dangerous spot. In the United States alone, heat sickens more than 9,000 high-school athletes each year. Better awareness among players, coaches and parents about heat's dangers could lead to better protections. Luckily, there are some simple strategies that both athletes and sports organizations can use to ward off heat illness.

Such protections will prove ever more important as climate change turns up the heat.

How hot is too hot?

Scientists use a measure called the "wet bulb globe temperature," or WBGT, to rate temperature safety. WBGT takes into account air temperature, humidity, wind speeds and the amount of heat from sunlight. Combining all these factors gives a better sense than air temperature alone of how dangerous the weather is. That's because it's harder for the body to cool itself without a breeze or in high humidity at any temperature.

An air temperature of 30° C (86° F) with 30 percent humidity (pretty dry) amounts to a WBGT of 26° C (79° F). With 75 percent humidity, that same air temperature becomes a dangerous WBGT of 32° C (90° F). By a WBGT of 35° C (95° F), the human body can no longer cool itself, notes Sylvia Dee. She's a climate scientist at Rice University in Houston, Texas. Under these conditions, someone can overheat and die.

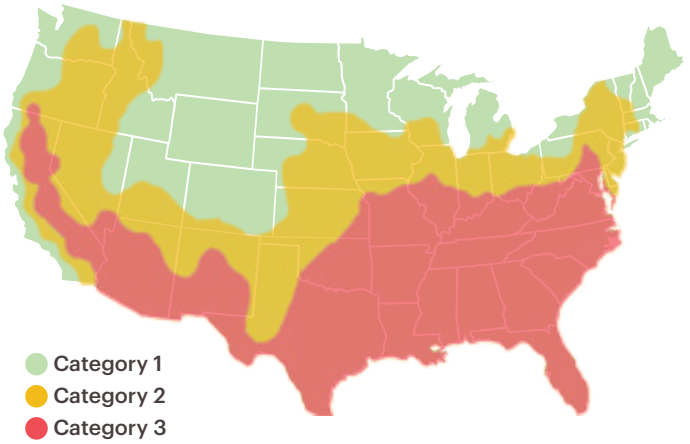
Short of death, assessing the risk of different WBGTs can get complicated. One reason: The WBGT value often is not the only thing that matters. Someone can have a bad reaction to any temperature that's a lot higher or lower than they're used to. So, a fluke spring or fall heat wave could be dangerous, says William Adams. He's a sports medicine scientist at the University of North Carolina Greensboro.

Geography matters, too. Say you're in a northern state, such as Oregon or Minnesota. You might be accustomed to early summer temperatures around 21° C (70° F). A 35° C (95° F) day would be a shock to your body, says Susan Yeargin. The same heat may not bother someone from Arizona or Louisiana, where it's much warmer year-round. Yeargin is an athletic trainer at the University of South Carolina in Columbia. She studies heat illness in athletes.

Scientists have come up with recommendations for how sports organizations should respond to high WBGTs. Those recommendations include extra water breaks, longer rest times and shortened

THE WASHINGTON POST/CONTRIBUTOR/GETTY

Hot, humid conditions put young athletes at risk of overheating. Better awareness of heat's dangers — especially among coaches and parents — could help protect players.



MAP: GRUNDSTEIN *ET AL/APPLIED GEOGRAPHY*, 2015

REGIONAL RULE DIFFERENCES

The United States is divvied up into three categories based on average temperatures. Each uses different wet bulb globe temperature (WBGT) cutoffs to determine youth-sports guidelines. For instance, in a category 1 state, such as Maine, a WBGT of 30.1º Celsius (86.2º Fahrenheit) would require canceling all outdoor workouts. But in a category 3 state like Florida, the same WBGT would only require giving players extra water breaks. Use the QR code to discover regional guidelines for how sports organizations should respond to high WBGTs.

CREDIT TK

or canceled games or practices. And the WBGT threshold for each recommendation varies by region.

That regional difference likely contributed to Theo's heat illness, his dad says. Theo is from Minnesota. There, the temps experienced at the tournament would have caused games to be moved to a cooler time of day or even postponed. But Theo's tournament took place in St. Louis, Mo. So U.S. Youth Soccer added extra water breaks, as per its rules.

This also means youth athletes who travel for tournaments need to be especially careful, Adams says. When they play in places that are warmer than they're used to, they may be at higher risk of heat illness.

Impacts of overheating

When things heat up, one of the body's first lines of defense is to sweat. This moisture carries away heat as it evaporates off your skin. If you can't sweat away the heat — say, because it's too hot or humid outside — then your blood starts to heat up. Your body's temperature will also rise. Your pulse can race as your heart struggles to cool your blood. This can make you ill.

When someone gets sick from intense activity in high temperatures, it's called exertional heat sickness. Symptoms include muscle cramps, excessive sweating or heat exhaustion. That last condition can involve dizziness, nausea and confusion.

Heat stroke is the most severe type of heat illness. This can happen when the body's core temperature exceeds 40° C (104° F). At that point someone can pass out, have seizures — even die.

If you're playing a sport and start to experience any of these symptoms, or even just feel extra hot, take a break immediately, experts say. Tell your coach or parents that you're overheating. Sit in the shade. Dump water over your head. And drink fluids. Do not push through it, says Tamara Hew-Butler. She's a sports scientist at Wayne State University in Detroit, Mich.

Some athletes face a greater risk of heat illness than others. Football has 10 to 11 times more heat illnesses than any other high-school sport. Football also has the most deaths from heat stroke in youth sports — 68 between 1996 and 2021. Most were high school athletes. That's because football is an intense sport with a lot of exertion. It also starts in August — the hottest time of year in the United States. The athletes' heavy protective equipment also makes it hard to keep cool.

Cross country has the second most heat-related illnesses. But even kids who swim or play indoor sports can experience heat illness, Adams says. So can kids in marching bands or those playing outside during gym class or recess.

Luckily, there are ways to protect against dangerous overheating.

Prevention is the best medicine

Preventing exertional heat illness starts with hydration.

Water is key to controlling body temperature, Adams says. It helps you sweat. If you're dehydrated, your body will hold onto the water it has rather than sweating it away. And that makes it harder to cool off and easier to get heat illness.

Water is the best thing to drink. But when you sweat, you also lose salt. Salt helps the body stay hydrated. It also keeps minerals in your body balanced so that muscles and nerves can work properly. Electrolyte sports drinks, such as Gatorade, can help replace that key nutrient.

Schools, sports leagues and coaches can also help protect players when it's hot by easing them into games and practices. It takes at least three days in a row of warmer-than-usual temperatures for the body to start adapting, Yeargin says. It's during those first three days, when the body makes no adaptations, that youth athletes are at highest risk for heat illness. It takes seven to 14 days for your body to fully adapt to better handle the heat, she adds.

Ramping up sports practices and games faster than that in warm weather can be dangerous. Most heat-related deaths in youth football happen during the preseason — that first week or two of practice when kids are not used to exercising in the heat or are trying extra hard to make the team.

U.S. high-school football programs have 14-day adaptation plans so that athletes' bodies can ease into working in the heat. For example, players don't wear pads on the first two days, and they have fewer and shorter practices. Similar recommendations exist for some soccer and field-hockey programs and a few other sports. And research has shown that such heat adaptation plans are effective.

But most youth programs don't have rules — or even recommendations — for easing into the season. Says Yeargin: Every athletic program *should* have heat safety rules for when to add more breaks, shorten athletic events or even cancel them.

Cross country has the second-most heat-related illnesses among young athletes. Football has the most.

MARCHING BAND: DBSTOCKPHOTO/ISTOCK; FIELD HOCKEY: ALEXANDER KALINA/SHUTTERSTOCK; RUNNING: WOODYSPHOTOS/SHUTTERSTOCK

WHAT TO DO IF YOU OVERHEAT

Feeling too hot in the middle of a sports practice? **Don't push through it.** Here's what you can do to stay safe:

Move to shade or air conditioning

Lie down with your legs above your head

Hydrate with water or a sports drink

Pour cool water over your head or sit in a tub of cool water, use cooling rags or ice packs

Remove extra clothes or equipment

Seek medical attention when the situation warrants

Learn the difference between heat exhaustion and heat stroke — and what to do for each — on page 29.

Heat-related illnesses can hit kids participating in any outdoor activity, such as marching band (upper left), field hockey (left), gym class or recess. Even swimmers or kids playing an indoor sport can be at risk.

Keeping cool in a warming world

Protections against heat illness are growing even more important as climate change warms global temps and triggers more heat waves.

And in many parts of the United States, summer WBGTs are projected to increase beyond safe levels for outdoor sports by the mid to late part of this century, notes Dee. That will require radically rethinking when, where and how long it's safe for kids to play.

Groups like the National Athletic Trainers' Association and the Korey Stringer Institute have offered some suggestions. (Named for a football player who died from exertional heat stroke, the Korey Stringer Institute provides education and outreach to prevent heat illness and death among athletes.) Sports organizations, schools, teams and coaches need to develop heat policies, they say, and monitor WBGTs so that they can make practice or game changes as needed. Those changes could include scheduling events when it's cooler — earlier or later in the day — or moving inside to air-conditioned facilities. Practices could also be made less intense by skipping timed drills or adding more breaks. Coaches and referees also need to know the signs of heat illness and have cold water, ice packs or ice buckets at the ready.

"We need to be responsive and have backup plans for when the weather is not conducive to athletics or playing outside," Hew-Butler says.

In the meantime, it's important for athletes to listen to their own bodies. They also need to speak up when they need breaks. During his tournament, Theo worried that leaving the game would let his coach or his team down. But in hindsight, he says, he should've taken himself out sooner. It may be hard to put your health first during the heat of competition, or when you're trying to make a team or even just having fun playing a game you love.

But ignoring the risk of heat sickness is dangerous. And it can be deadly.

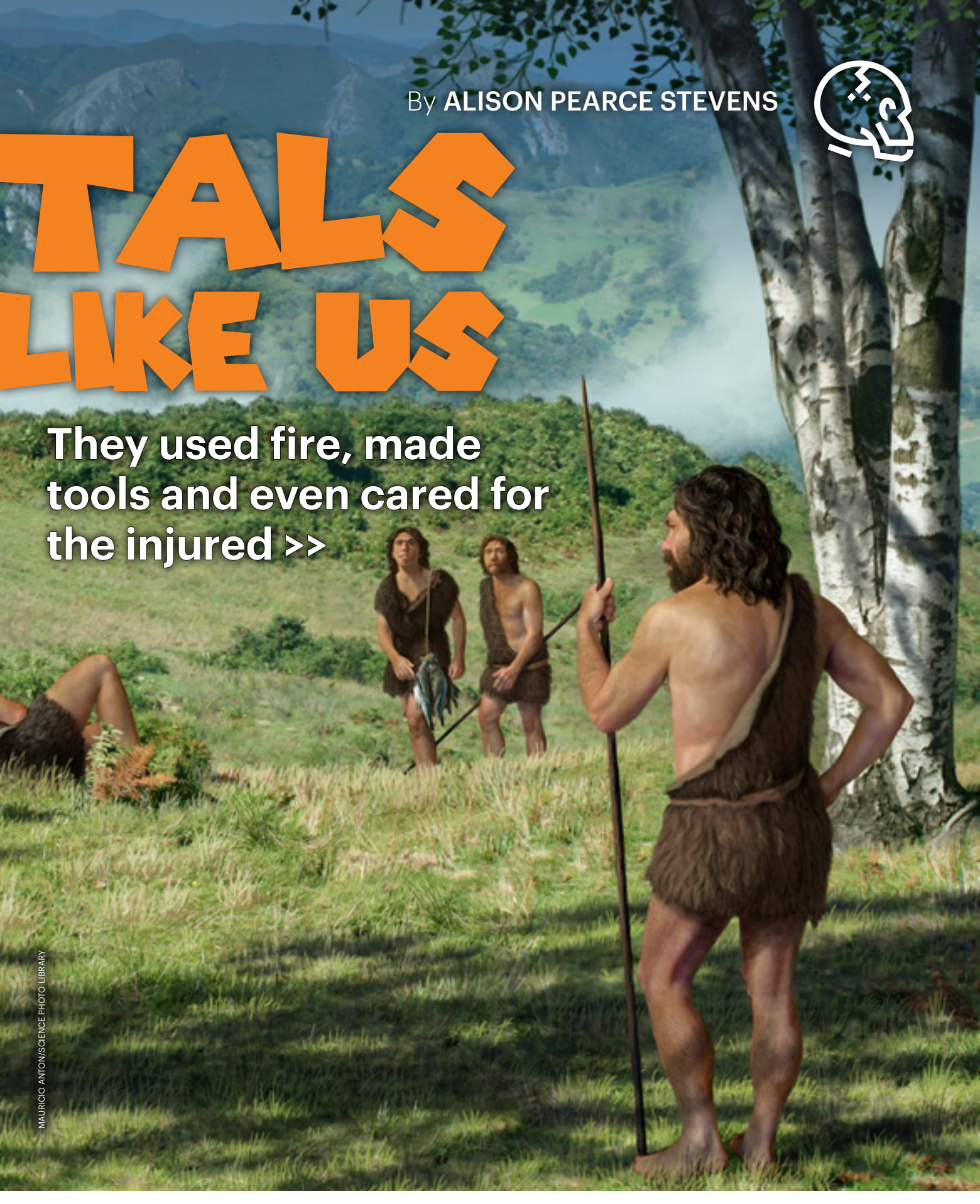
ILLUSTRATION: ELENABSL/SHUTTERSTOCK; BOOK COVER: LERNER PUBLISHING GROUP

NEANDER
WERE A LOT

By **ALISON PEARCE STEVENS**

TALS LIKE US

They used fire, made tools and even cared for the injured >>



MAURICIO ANTON/SCIENCE PHOTO LIBRARY

If someone accuses you of being a Neandertal, it's not a compliment. The name is used to make people feel less than human. And that's long been the view most people have taken of our prehistoric cousins. But recent research has been uncovering evidence that Neandertals were anything but clumsy or stupid.

For hundreds of thousands of years, Neandertals (*Homo neanderthalensis)* inhabited much of Eurasia. They looked a lot like modern humans (*H. sapiens*), though a bit wider and squatter. They overlapped — and even interbred — with our species for several thousand years before going extinct. That's why most people today carry bits of Neandertal DNA.

Since modern humans are the only human species left, it's easy to think we must have been somehow better than Neandertals. For decades, even scientists tended to share that view. But that attitude is starting to shift. And it's backed by evidence that Neandertals were highly capable people. They were intelligent, innovative and social. They used tools and wore jewelry. They also appear to have taken care of their sick and injured.

What can bits of tools, bones and fibers tell us about these mysterious people? More than you might think.

Into the fire

A natural hot spring lies at Poggetti Vecchi, in central Italy. Its waters have drawn people and animals to the site for hundreds of thousands of years. In 2012, work near the spring turned up buried bones and tools. That's when Biancamaria Aranguren got involved. She's an archaeologist in Florence, Italy. She works at the Superintendence of Archaeology, Fine Arts and Landscape of Tuscany. Italy is rich with archaeological finds. Aranguren is part of a team working to preserve artifacts found there.

Items at the site were found beneath three meters (10 feet) of soil that was wet from the hot spring. Each day, the team had to pump out the water before getting to work. The researchers uncovered flint, elephant bones and pieces of wood.

Stone tools and bone aren't unusual. The wood, however, was a remarkable find.

Unlike rock and the mineral parts of bone, wood is made of plant material that decays easily. Wooden tools are common today and probably have been for hundreds of thousands of years. But they decompose rapidly when exposed to air. Ancient ones rarely last long enough for study.

Here, though, they were "soaked in the thermal water," Aranguren says. "That helped preserve them for 170,000 years." Modern humans didn't live in Europe back then. So the tools must have belonged to an ancient group of Neandertals.

The researchers found 39 pieces of wooden tools. A thin layer of burned char coated 12 of them. That offers evidence that Neandertals had worked the sticks in fire. As the team analyzed the artifacts, they discovered that these had been made from boxwood. It's a very hard wood that's difficult to shape. Fire, the team found, made that process easier. Fire would have aided "removal of the outer bark and the processing of the handle and the tip" with stone tools, Aranguren explains.

The finished products were digging sticks, like those often used today by people who forage for food. The tools at Poggetti Vecchi are about one meter (three feet) long, with a rounded handle at one end and blunted tip at the other. They can be used to dig up roots and tubers or to hunt small prey. In the case of Neandertals at Poggetti Vecchi, the sticks could have been used to drag an elephant carcass out of the hot spring, so these folk could eat its meat.

LaFerrassie I is the most complete Neandertal skull ever found. It belonged to an adult male and was found in France in 1909.

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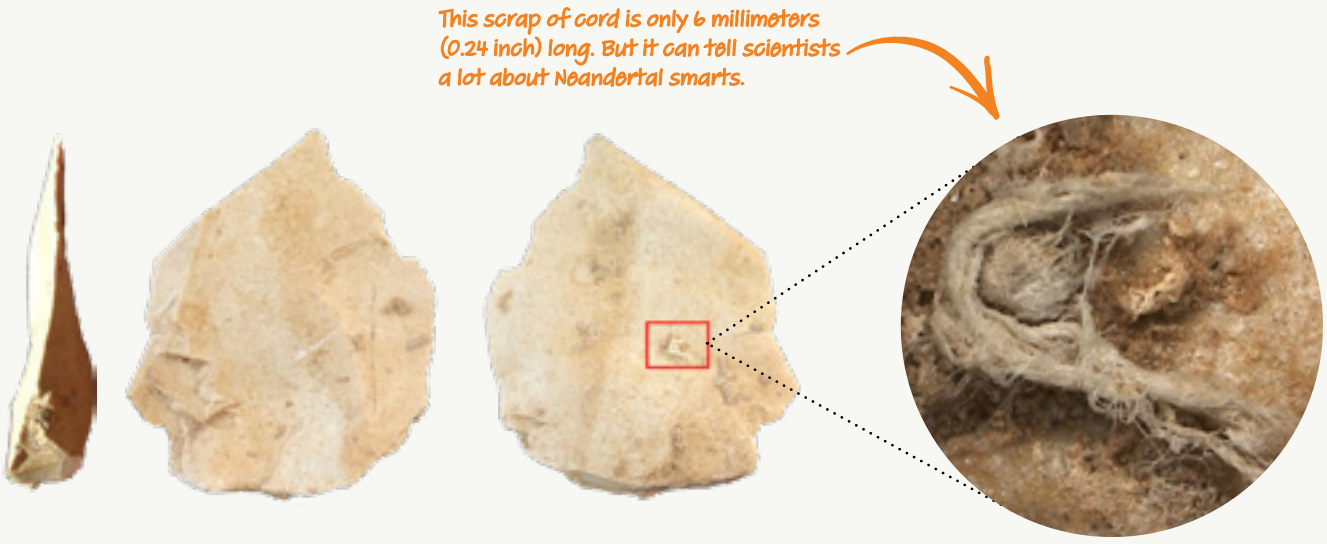


STONE: M.-H. MONCEL (CC BY 4.0); CORD FRAGMENTS: BRUCE HARDY/KENYON COLLEGE/*SCIENTIFIC REPORTS* 2020 (CC BY 4.0)

COMPLEX CORD

This stone flake (shown from the side, back and front) was a tool used by Neandertals. The flake is sharpened at one end for use in scraping or hacking. The box highlights a piece of cord (right: magnified) clinging to the stone. Made of three strands, the cord would have been very strong. Hardy's team isn't sure how the cord was used, but it could have tied the stone flake to a handle or been tied with others to create a net or bag. The cord suggests Neandertals were capable of higher-level thinking.

DIGGING STICK: P. NANNINI/MIC ITALIAN MINISTRY OF CULTURE

This digging stick (above) was discovered at the Poggetti Vecchi archaeological site in Italy. The rounded end to the right would have been the handle. Dark coloring shows where fire charred the stick.

In addition to telling us about their tools, the site also makes it clear these people lived in groups. Alone, one Neandertal would not have been able to retrieve an elephant from the water.

"Even before 170,000 years ago," Aranguren says, "Neandertals possessed a complex knowledge of pyro-technology." They could control fire and use it for specific tasks. This "could also suggest the ability to light a fire, although there is no direct proof of this," she adds.

Tying up loose ends

In southern France, near the Rhône River valley, a different archaeological site revealed another rare find: a piece of cord. Trapped beneath a stone flake (a type of tool), the six-millimeter (0.24-inch) length of cord managed to avoid rotting for some 50,000 years. "It likely got covered up fairly rapidly with sediment," says Bruce Hardy. "Any time that happens, we get better preservation," he explains.

An archaeologist, Hardy works at Kenyon College in Gambier, Ohio. With microscopes, he analyzes the outside surface of stone artifacts. He's looking for evidence that might otherwise go undetected. The piece of cord was an unexpected find. And it provides a surprising amount of insight into the Neandertals who made it.

"We know what it takes to make a cord," Hardy says. "You get bundles of these fibers, and you can simply take them and put them on your leg and roll your hand [down your thigh] and twist them. If you know what you're doing, the force of the twist will cause it to twist back in the other direction." It's that secondary twist that keeps the cord from unraveling. "Physically, it's not that hard to do," Hardy says. "Coming up with that idea — and understanding how it would work — that's where we get an insight into Neandertals."

Hardy's analysis found the fibers came from conifers. Making cord from them isn't easy — or obvious. The fibers come from the inner bark of the

tree. That's where the tree adds new growth (tree rings) each year. Inner bark is easy to remove in June, at the start of the growing season. But as it turns more and more woody, removing the fibers gets harder and harder. So Neandertals had to know when to harvest the fibers.

What's more, they had to know fibers were there in the first place. "Looking at a tree, you see nothing that tells you anything about a cord," Hardy notes. "You have to strip off the outer bark to get to the inner bark." That suggests some high-level thinking, he says. It also suggests the ability to communicate information about their location and the timing for harvesting to others.

Making cords is similar to language, Hardy argues. You need sounds to make up words to build a sentence. To make a cord, you need the individual fibers. Then you need to arrange them next to each other and twist them just so. "It's the same kind of scaffolded task that you can't get to in one step," he explains.

The cord also had more secrets to reveal about its makers. It was three-ply, so three sets of fibers twist around each other, instead of two. Modern-day survivalists make two-ply cords, Hardy notes. It makes them strong. But adding a third strand greatly increases a cord's strength. The more fibers there are and the more layers in the cord, the harder it is to pull them apart. A three-ply cord suggests Neandertals had a sense of numbers. "Yet again," he argues, this points to "some pretty complex mental capacities."

How was the cord used? No one knows. It could have tied the stone flake to a wooden handle. Or perhaps it was part of something more complex. It could have been tied with others to create a net or bag. Perhaps the tool was being carried in a bag that fell, never to be retrieved. "Any one of those things is possible," says Hardy. What's not possible, he adds, is "for us to know which one it is."

In sickness and in health

Neandertals were capable of far more than simply making and using a variety of tools. There's now evidence they knew something about health care. And that's good. Almost every skeleton found shows signs of illness or injury. Catching a cold or cutting your finger won't leave a mark on your bones. But a serious disease or broken bone will sometimes permanently scar or alter bone, says Penny Spikins. She's an evolutionary anthropologist at the University of York in England.

Scientists have used fossils to map out the known range of Neandertals. The species lived in Europe some 400,000 years ago. Eventually, Neandertals could be found as far east as Siberia, as north as England and as south as Spain, Italy and the Middle East. But by about 40,000 years ago, they had disappeared.

Shanidar Cave in Iraq held several near-complete Neandertal skeletons. One belonged to a badly injured man who lived on for more than a decade despite his severe disabilities.

GEORG KRISTIANSEN/ALAMY; MAP: M. HAJDINJAK *ET AL/NATURE* 2021

NEANDERTALS VS. HUMANS

Neandertals and humans were so similar that the two species interbred. But they did have physical differences. Neandertals' physical traits would have helped them survive in colder environments and perhaps have given them an advantage when hunting.

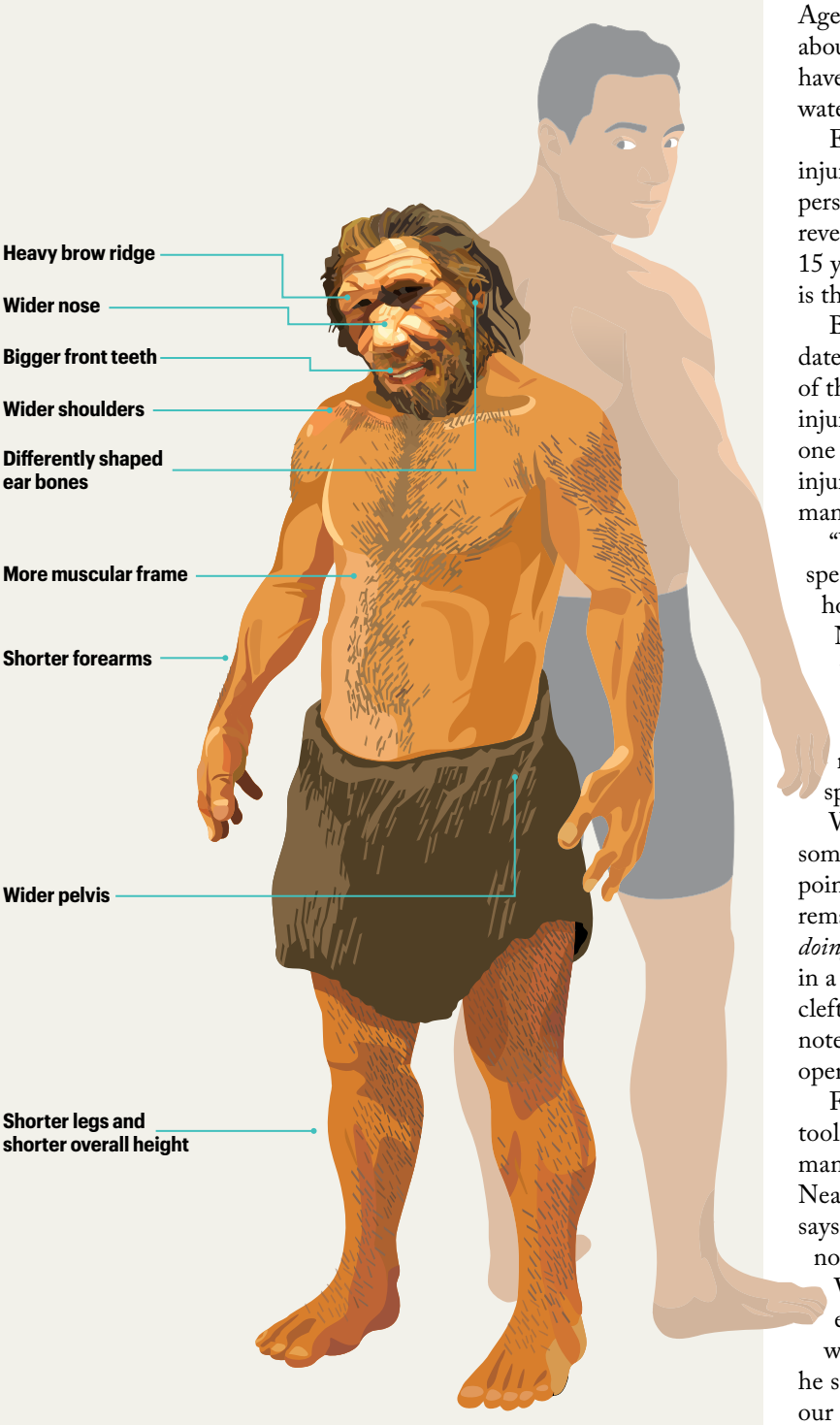


ILLUSTRATION BY STEVE MCCRACKEN

Breaking an arm or losing sight in one eye might not stop someone from feeding themselves or finding their own shelter. But a broken leg is another story. Neandertals moved around a lot, Spikins says. Someone with a broken leg couldn't have fended for themselves back in the Stone Age when there were large predators prowling about. Anyone with a serious leg injury would have needed someone else to bring them food and water and then protect them until they'd healed.

Explains Spikins: "We can look at those injuries and illnesses and then see, well, did the person survive after that?" In some cases, skeletons reveal that the injured person lived another 10 to 15 years. The only way to interpret that, she notes, is that "other people must have helped them."

Based on Neandertal skeletons unearthed to date, it appears anywhere from 80 to 95 percent of the population may have suffered traumatic injuries. Why did they get injured so often? No one can be sure. But evidence suggests many injuries occurred while people were hunting mammoths and woolly rhinos.

"You really need to get up close with a really big spear to hunt them down," Spikins notes. Tusks, horns and large feet would have easily injured Neandertal hunters. What about fights? "Only two Neandertals have evidence for the kind of patterns of injuries which would indicate conflict with other people," she says. And those may have come from members of our own species, rather than from other Neandertals.

When individuals died, there must have been some burial or mortuary practice. Indeed, Spikins points out, "The reason why we have the skeletal remains today is by and large because they were *doing something*." Perhaps they buried the body in a cave. Or maybe they deposited it down a big cleft in the ground. What is fairly obvious, Spikins notes, is that if they had left bodies out in the open, the bones would have decayed long ago.

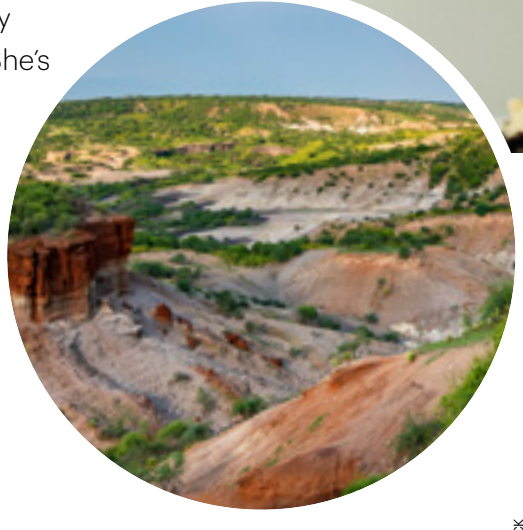
From burials and health care to fire use and toolmaking, Neandertals were more like us than many people have wanted to believe. "For me, Neandertals are a reminder of our arrogance," says Hardy. We're still here and Neandertals are not. "We usually take that as, we're the winners. We made it, Neandertals didn't. They went extinct, they must have done something wrong." But when we look without that bias, he says, we find much more to show how similar our two species were.

This archeologist reconstructs the past with animal bones

Visits to the museum as a kid inspired Pamela Akuku to explore human origins

As a kid, Pamela Akuku spent her weekends exploring the National Museums of Kenya in Nairobi, tagging along with her mom who worked there. Akuku became fascinated with the researchers she saw fiddling with complicated equipment and lugging around fossils. "But I didn't know what they were doing at the time," she says. "I kept asking [my mom] about it." Akuku's mom saw her daughter's curiosity and signed her up for the museum's Young Researchers Club. Akuku soon reconstructed bones and took part in mock excavations.

The museum experiences helped inspire her career as an archeologist, Akuku says. She is now at the Catalan Institute of Human Paleoecology and Social Evolution (IPHES-CERCA) in Tarragona, Spain, and affiliated with the Rovira i Virgili University. There she studies how ancient humans modified animal bones. Her research is helping to reveal more about where early humans lived and how those environments have changed over time. She's currently studying remains from Tanzania's Olduvai Gorge (funded by SSHRC and the Leakey Foundation), where researchers previously discovered stone tools and evidence of early human ancestors going back as far as 2 million years. In this interview, Akuku shares her experiences and advice with *Science News Explores*. (This interview has been edited for content and readability.) — *Aaron Tremper*



Archaeologist Pamela Akuku (top) studies ancient animal bones to learn more about how early humans lived. The remains come from Olduvai Gorge in Tanzania (inset). Stone tools and bones found there over the past century have helped scientists learn about how humans have evolved.

YAKOV OSKANOV/SHUTTERSTOCK

Q What's one of your biggest successes in your career?

A I received an offer for a fully funded master's at the University of Witwatersrand in South Africa, which is a great university. The master's was supposed to take two years, but I finished it in one year. I wanted to get it done so I could go back home to my daughter.

I remember the day the results of my studies came back. I was at home with her and found out I got a master's *with* distinction. My mom and my daughter were so proud of me. I've received better scholarships and funding since then. But if it wasn't for that hectic one year, I wouldn't be where I am today. And I think that has been my greatest achievement.

MARIA DOLORS GUILLÉN, IPHES

Q What was one of your biggest failures, and how did you get past it?

A It's not really a failure. It's a downside. I've had rheumatoid arthritis since I was 13 years old. When I got the scholarship for graduate school, I was supposed to go in 2017. But my left knee became completely destroyed and fused. I couldn't walk for months. It was the hardest thing because I was used to doing fieldwork, running around and taking my daughter to school. I couldn't do any of those things anymore.

Q What do you like to do in your spare time?

A I love watching anime and Korean thrillers. The thrillers are so well done. I also dance and go to the gym.

Q What piece of advice do you wish you'd been given about your career when you were younger?

A Be prepared to encounter what we call impostor syndrome. This field is white-dominated and still male-dominated. So going into it as a woman of color, you always feel inferior. You're made to feel inferior. Or sometimes you feel you're not working hard enough or that you don't fit in. But I've learned to deal with it. Now I always tell everyone they are worthy and smart enough. That they *belong* here because they will tell a story about their past. Don't feel like you don't belong here. What you're doing counts.

CHEMISTRY

Creating a faster, more furious fizz

Explore how temperature affects a chemical reaction

By Science Buddies

Alka-Seltzer medicine tablets fizzle furiously when dropped in water. The moment a tablet starts dissolving, its ingredients undergo a chemical reaction. That reaction releases a flurry of carbon dioxide bubbles. In this experiment, we'll clock how long the chemical reaction takes in water of different temperatures.

OBJECTIVE

Measure the effect of temperature on the rate of a chemical reaction

JULIA-ART/SHUTTERSTOCK

EXPERIMENTAL PROCEDURE

1. Fill a glass with 200 milliliters (0.85 cup) of water. Place a piece of tape on the outside of the glass to mark the water level and empty the cup.

2. Fill the glass to the marked level with water at one of three temperatures: hot tap water, cool tap water or water that has been chilled with ice.

3. Measure the water's temperature with a thermometer and record the result in a notebook. Take the thermometer out of the water.

4. Drop an Alka-Seltzer tablet into the water and start a stopwatch at the same time.

5. Watch the tablet bubble. As soon as all the solid material has disappeared and the bubbles have stopped, stop the stopwatch. Record that reaction time in your notebook.

6. Repeat these steps twice more with water at the same temperature. Then, repeat these steps three times each with water at the other two temperatures.

7. Calculate the average reaction time for tablets dissolved in water at each temperature.

8. Graph average tablet reaction time (y-axis) versus water temperature (x-axis).

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

SCIENCE BUDDIES

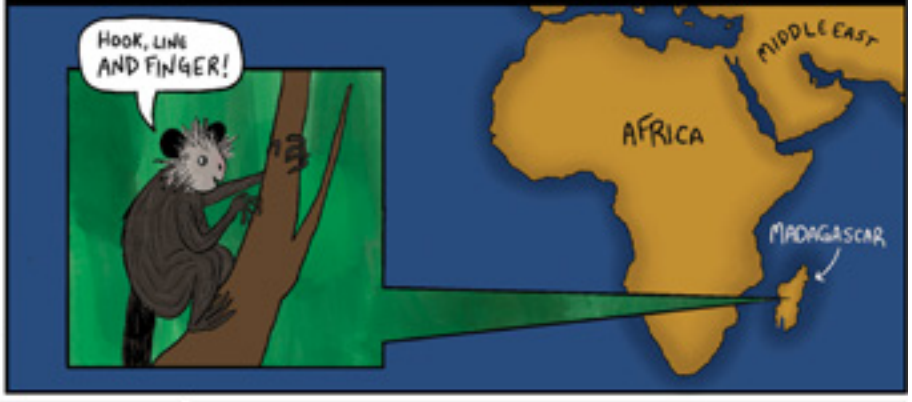
Aye-ayes take nose-picking to a new level

Written by Maria Temming
Illustrated by JoAnna Wendel

You might find it gross when someone picks their nose (even if you do it yourself).

But human nose-pickers have nothing on aye-ayes.

These weird nocturnal lemurs are native to Madagascar, an island off the coast of Africa. Besides looking a bit bizarre, aye-ayes are known for their super-long middle fingers. They use those fingers to fish tasty grubs from tree bark.



Biologist Anne-Claire Fabre was studying these primates at the Duke Lemur Center in Durham, N.C. One night, she caught an aye-aye doing something unexpected.

Fabre filmed the lemur sticking its long middle finger up its nostril, then licking off the snot.

"I was wondering where the finger was going," says Fabre, who works at the Natural History Museum of Bern in Switzerland.

By looking at CT scans of an aye-aye's head, her team found that the animal's eight-centimeter-long finger may poke all the way back to its throat.

Aye-ayes and humans are not the only nose-pickers in the primate family tree. Fabre's team confirmed that aye-ayes are the 12th primate species known to pick their noses and snack on the snot.

Nose-picking species tend to have nimble hands and use tools.

Since so many primates pick their noses and eat the boogers, researchers wonder...could this nasty habit have some hidden benefit?

Finding out will require a more complete census of what species mine and munch on their own mucus.

That could mean researchers spending more time in the field watching animals — or perhaps you paying more attention on that next trip to the zoo.

TECHNOLOGY

This self-cleaning sponge took inspiration from a loofah

The new solar-powered gel purifies water in a flash

A new gel can sponge up dirty water. When the gel warms in sunlight, it shrinks and releases fresh, clean water. The inspiration for this gel? The same loofah you might use in the shower.

The new material is a hydrogel. It has spongelike tangles of stringy molecules that stick to — and absorb — water. Like a strand of beads, it's made of large molecules called polymers that are strung together from repeating units. A plain old hydrogel sitting in dirty water would get scummy on the outside. Clean water would get dirty again when it flowed out of the gel. But the new hydrogel is self-cleaning.

When dropped in polluted water, the gel absorbs the water. But it blocks entry to things that could make someone sick. These include bacteria, oils, heavy metals and salts. A special polymer net throughout the hydrogel repels oil and bacteria from the gel's surface. So put this gel in water and any oil on the outside immediately jumps off, says Xiaohui Xu. She's a chemical engineer at Princeton University in New Jersey. Her lab created the new gel.

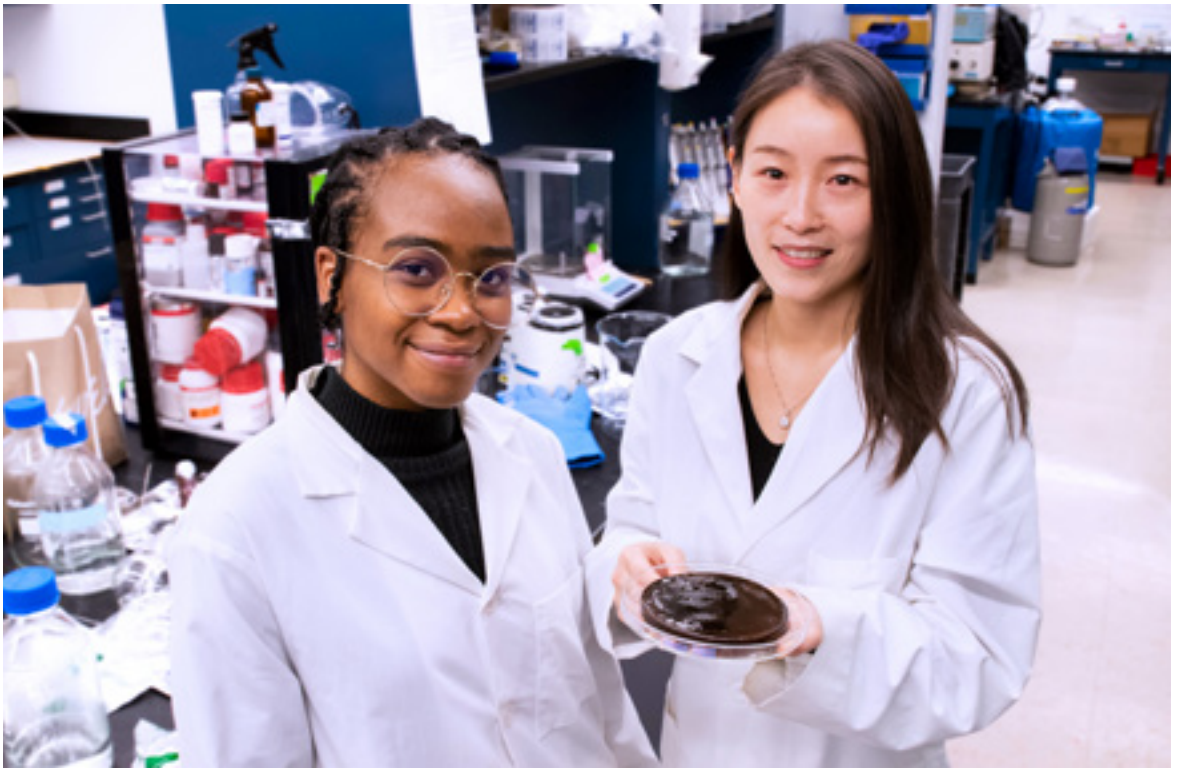
Allowing the gel to warm up in sunlight self-squeezes out its now-filtered water.

"It may be a great way to make pure water for families," says Edward Cussler. He's a chemical engineer at the University of Minnesota in Minneapolis and wasn't involved in the study. Such a gel might cut risk of disease. Right now, drinking dirty water kills more than 1.5 million people worldwide each year.

Researchers described the new material in *ACS Central Science*.

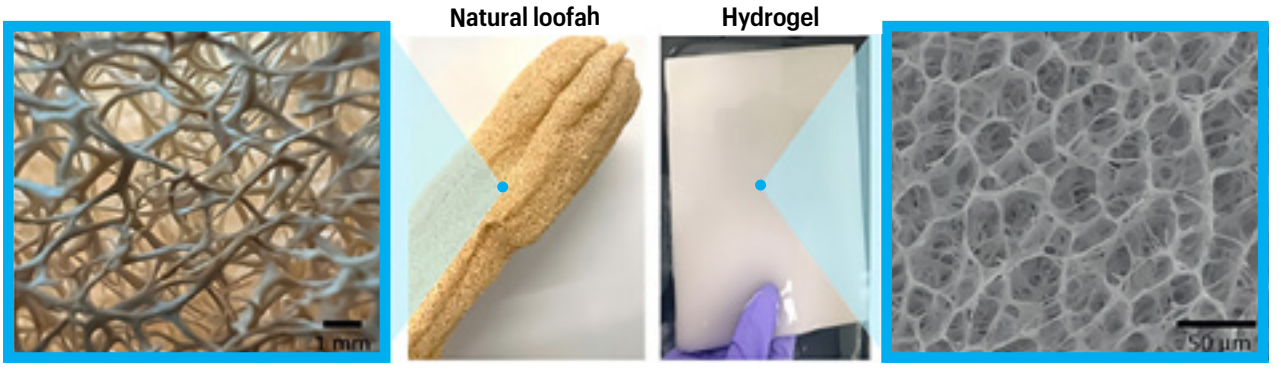
SCUM-REPELLING AND SUPER-FAST

In the lab, Xu's team tested the gel's ability to repel *E. coli* bacteria. When the gel was removed from microbe-tainted water, it held no

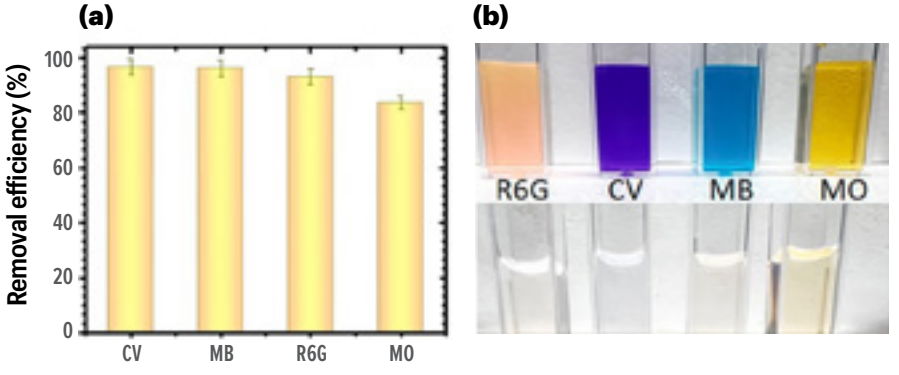


BUMPER DEJESUS/PRINCETON UNIVERSITY

Researchers Néhémie Guillomaitre and Xiaohui Xu hold a sample of their water-purifying hydrogel.



Photos and zoomed-in microscope images show the structure of the natural loofah fruit (left) and the loofah-inspired hydrogel (right). The open web of fibers allows water to flush out easily.



Bars on the chart (left) show how effective the new gel is at purifying water colored with each of four dyes: crystal violet (CV), methyl blue (MB), rhodamine 6G (R6G) and methyl orange (MO). Photos (right) show the color of the water before purification (top) and after (bottom).

E. coli hitchhikers. However, Xu points out, other bacteria may be able to stick even if *E. coli* can't. That's why her team is now working on a new version of the gel that does more than block microbes. It will kill them, too.

In an hour, one square meter of the new gel can clean up about 26 liters (7 gallons) of water. Nibedita Nandi thinks this technology could help solve problems of scarce drinking water. Nandi studies biochemistry at the University of Freiburg in Germany. She, too, did not take part in the gel's creation. She says the new gel can clean enough water to meet someone's daily needs for drinking, washing and other household tasks.

The new material also absorbs and releases water faster than earlier water-purifying gels. Most water-cleaning hydrogels trap water inside bubblelike spaces. This can make it hard for water to get out again. But in the new gel, "we created a unique open-pore structure," Xu says.

Her team's inspiration was the loofah, a fruit that becomes spongelike when dried. Tangled molecules inside the new gel look like the loofah's connected fibers, Xu says. They let water flush out easily.

POWERED BY SUNSHINE

Water purification often takes a lot of energy. The new hydrogel doesn't. It runs on sunlight. For Cussler, that's the coolest part.

Parts of the gel's threads attract water and other parts repel water, Xu explains. At cooler temperatures, the water-attracting forces are strongest. So, the gel absorbs water.

A black coating helps the gel heat up quickly in sunlight. As the gel warms, its threadlike molecules lose their ability to hold water. But the water-repelling forces stay the same.

The water-attracting forces become weakest at 33° Celsius (91° Fahrenheit). That's when clean water rushes out.

The gel shrinks when it's warm and expands when it's cool. That's the opposite of how most materials respond to warming. But this shrinking at warm temps explains how the sponge essentially wrings out its water.

That weird property also may make this hydrogel helpful in other areas, such as robotics. Machines built with the gel could behave in ways that devices made with other materials can't. Imagine a hydrogel robotic hand, says Xu. Temperature changes could cause "the entire structure to conform or to respond in a certain way … maybe to grasp something."

— *Katie Grace Carpenter*

ANIMALS

Mermaids would sound weird underwater

Mythical half-fishes would need sea creature features to sing like Ariel

Mythical mermaids like Disney's Ariel are often known for their alluring songs. But if you were underwater with one, a mermaid's tunes wouldn't sound quite like they do in the movies.

Even next to a mermaid, the song would sound muffled and would seem to come from all around, says Jasleen Singh. "You could still make out what she is saying, but it would sound fuller with less clarity." Singh studies human hearing at Northwestern University in Evanston, Ill.

If mermaids existed, their hearing and sound-making setups might resemble those of marine creatures instead of humans. To understand why, you have to start with the basics of sound and hearing.

Sound is produced when an object vibrates. Touch your throat while you talk, and you can feel your vocal cords vibrating inside your neck. These vibrations can travel through gases, liquids and solids. Each medium's atoms and molecules get pushed around by a sound source's back-and-forth motion. These particles bump into each other in a rippling pattern of waves, spreading sound.

Humans' hearing starts with sound waves entering the air-filled space in each earhole. Through series of actions, the waves vibrate a structure in the inner ear called the cochlea, which converts the vibrations into electrical signals that the brain understands as sound.

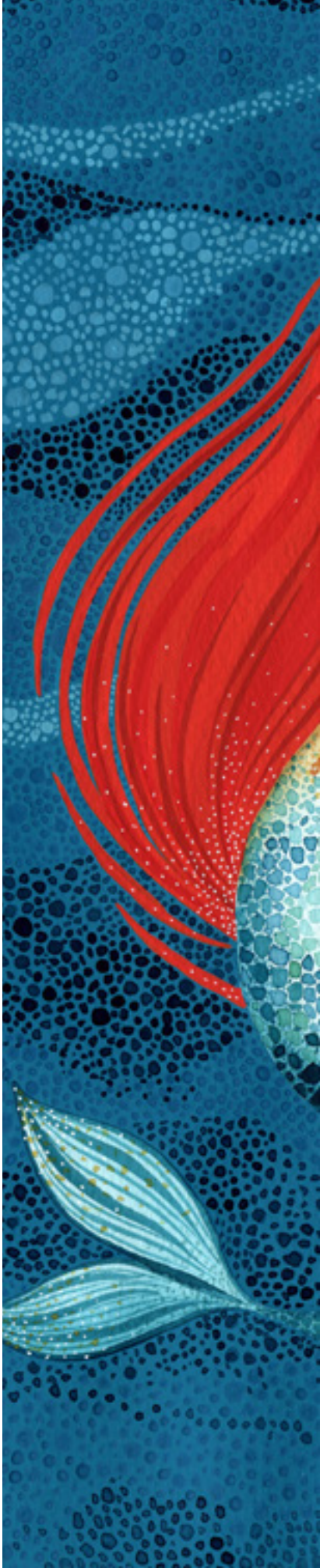
Underwater, it's a different story. Since water plugs your ears, sound waves directly vibrate the skull. This happens on land too, but it works better below the water's surface. That's because water and bone have similar densities. When sound waves gently rattle the skull, "that is directly stimulating the inner ear — the cochlea itself," Singh says. This is called bone conduction. Humans are much more attuned to sound waves coming in through the ears. As a result, the sound quality of bone conduction is not as good as regular air conduction.

Plus, it's difficult to figure out where a sound is coming from underwater. On land, if someone starts talking on your right side, sound waves hit your right ear before your left. This slight variation in timing helps your brain find the source of a sound. But sound travels much faster in water than in air. So in water, there is virtually no time difference between sound hitting each ear. That's why a noise seems to come from everywhere.

SEA-DWELLING RELATIVES

To hear her friends talk and sing properly, a mermaid might have evolved hearing structures more like aquatic animals.

Marine mammals, such as whales, dolphins and seals, hear in a way very similar to humans, notes Colleen Reichmuth. A biologist, she studies marine mammals at the University



DOINAZAVADSCHI/SHUTTERSTOCK

of California, Santa Cruz. These creatures have cochleae like us, but they have evolved some adaptations to help them hear under the sea.

The lower jaws of dolphins and some whales, for instance, contain fat that directs sound to the middle ear. Other marine mammals, such as seals, have convertible ears. On land, the animals can have open ear holes that pick up sound waves traveling through air. But when diving, their ear tissue swells with fluid, plugging the holes. The fluid-filled ears help transfer sound from the water to the cochleae.

Those features could help a mermaid hear her friends' songs more clearly. But if mermaid voices were more like those of marine mammals, their vocal systems could get a major upgrade, too.

For a voice that really carries, mermaids might be built like baleen whales. These whales, which include humpbacks, have huge vibrating structures in their throats that toss out sound. Some can make noises so loud and low-pitched — too low for humans to hear — that the songs could travel more than 1,000 kilometers (1,600 miles) in the ocean. (Lower-pitched sound waves lose less energy when traveling through the ocean than higher-pitched ones.)

SOMETHING SOUNDS FISHY

A mermaid's mammal upper half may not be the only part that could make noise. Many fish click or rub their body's bony structures together to make sounds. Sea horses, for example, produce clicks by knocking the tops of their skulls into the horns on their heads. You can think of it like clicking your teeth together, says Audrey Looby. A marine ecologist, she studies fish at the University of Florida's Nature Coast Biological Station in Cedar Key.

Other species can use their muscles to vibrate an internal organ, like playing a drum, Looby says. "Some fish can even communicate by expelling air out their backside — essentially, fish communicating through farting."

If you met a mermaid, she might have both fishlike and mammalian structures to communicate with her underwater friends. Her ears may work like a seal's to hear both in and out of water, and her conversations may be sprinkled with teeth chattering and even farting.

— *McKenzie Prillaman*

CLIMATE CHANGE

How hot weather turns deadly

The human body is good at cooling itself off — but only up to a point

The human body can't handle excessive heat. The processes that keep us alive work best within a certain temperature window. That's generally between about 36° and 37° Celsius (96.8° to 98.6° Fahrenheit), depending on the person.

To get rid of excess heat, blood vessels in the skin dilate, or expand. At the same time, the heart begins beating faster. That pushes blood flow to the skin. There, the blood can release heat to cool down. Meanwhile, sweating kicks in to cool the skin.

When people experience high temperatures again and again, their bodies can get better at shedding excess heat. That's why someone can move from cold Minnesota to steamy Florida and get used to the higher heat and humidity.

But there is a limit to how much the body can adjust. That limit depends on an individual's health, as well as the temperature and humidity outside. If the outside temps are hotter than the body, blood at the skin won't release heat. And where humidity is high, sweating won't cool the skin. That's because the sweat can't evaporate.

If the body has to keep dealing with heat without a break, it gets worn out. People can experience *heat exhaustion*, which causes weakness, dizziness and nausea. If a person still doesn't cool off, *heat stroke* may occur. This signals that the body's ability to regulate heat has broken down. This can allow core body temperature to climb to 40° C (104° F) or higher. Heat stroke can trigger seizures, convulsions or a coma. Without treatment, death may follow.

No one is immune to heat. But it hits some groups harder than others. The elderly are among the most vulnerable. Children, too, are at risk because they haven't fully developed the ability to regulate heat. Pregnant women can struggle because of the demands that the fetus puts on the body. People with chronic diseases and those without housing, who are incarcerated or work outdoors are also at high risk from heat.

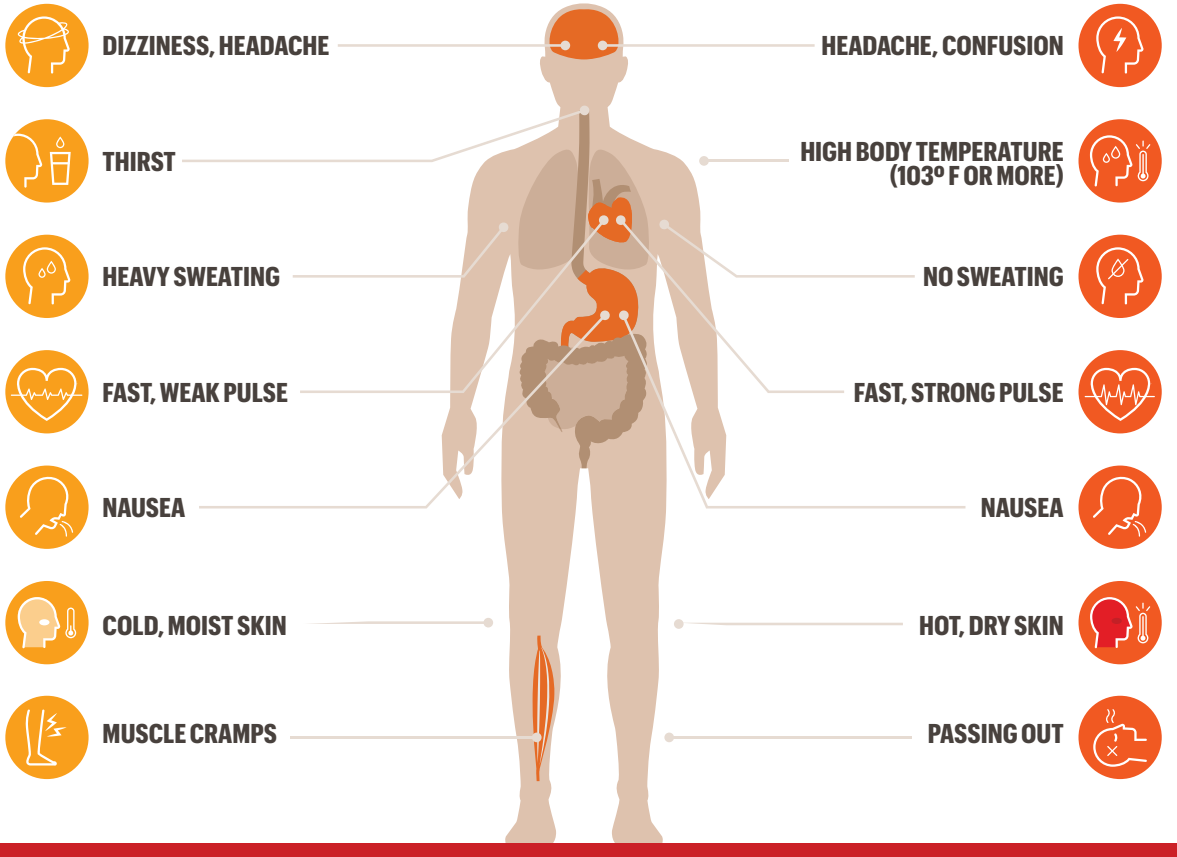
Many people see heat as more of an annoyance than a threat. But climate change, extreme heat and human health are all connected. As Earth's temperatures climb, extreme heat waves will probably become more common, endangering more people.

— *Aimee Cunningham*

WHITE SPACE ILLUSTRATIONS/SHUTTERSTOCK

HEAT EXHAUSTION OR HEAT STROKE

TYPICAL SYMPTOMS INCLUDE:



WHAT TO DO

- MOVE SOMEWHERE COOLER
- TAKE SIPS OF COOL WATER
- LOOSEN TIGHT CLOTHING, TAKE A COOL BATH OR SHOWER
- USE COLD COMPRESSES
- GET MEDICAL HELP IF THROWING UP OR IF SYMPTOMS WORSEN OR LAST MORE THAN AN HOUR

CALL 911 (OR THE LOCAL EMERGENCY LINE) IMMEDIATELY

- Move the person somewhere cooler
- Apply cool cloths or put the person in a cold bath
- DO NOT give the person anything to drink

Everyone is at risk, but some groups are more so:

Children | Elderly | Pregnant women | People with chronic illnesses | People without housing | People who work outdoors

ELENABSL/SHUTTERSTOCK

PLANTS

Distressed plants sound off

Listening for ultrasonic clicks could help farmers monitor crops

Plants may tell us when they're in trouble.

Thirsty tomato and tobacco plants make clicking sounds, researchers have found. The sounds are ultrasonic, meaning they are too high-pitched for human ears to hear. But when the noises are converted to lower pitches, they sound like popping bubble wrap. Plants also make clicks when their stems are cut.

It's not like the plants are screaming, Lilach Hadany told *Science News* (*Science News* is the sister publication to *Science News Explores*). An evolutionary biologist, she works at Tel Aviv University in Israel. Plants may not mean to make these noises, she says. "We've shown only that plants emit informative sounds."

Hadany and her colleagues first heard the clicks when they set microphones next to plants on tables in a lab. The mics caught some noises. But the researchers needed to make sure that the clicking was coming from the plants.

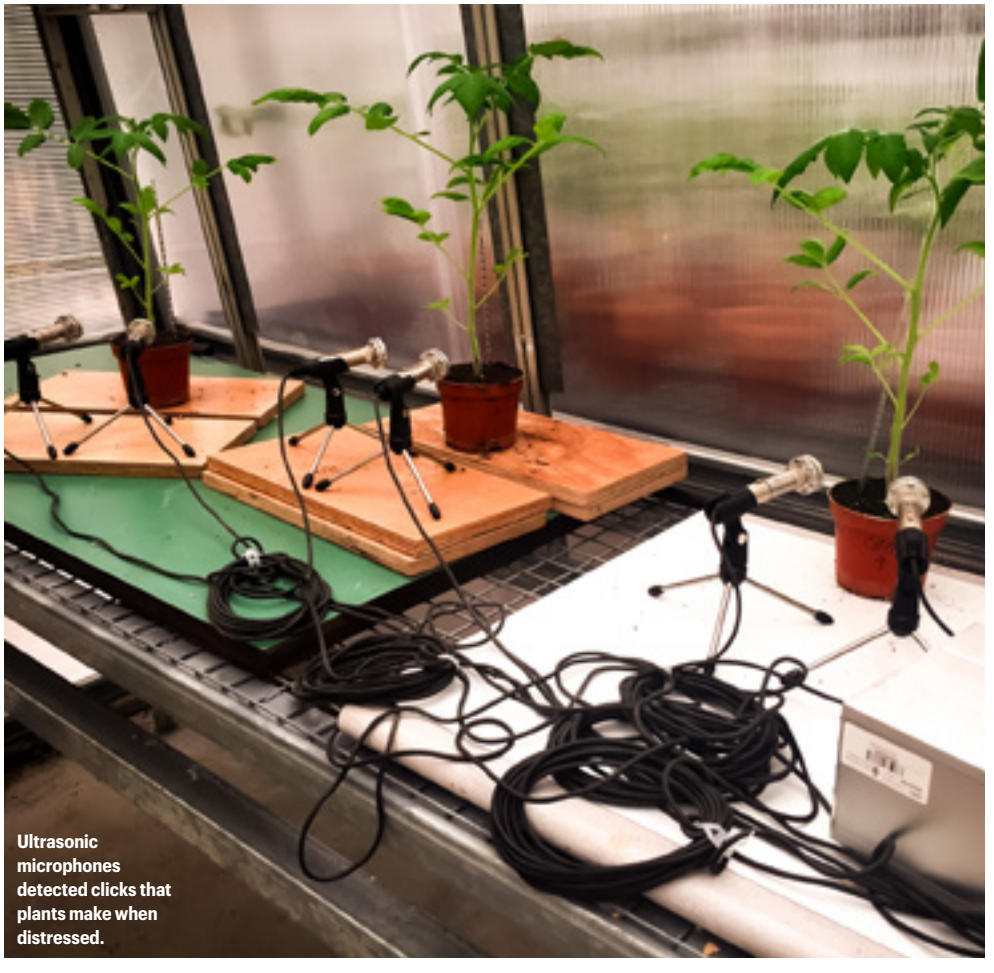
So, the scientists placed plants inside sound-proofed boxes in the basement, far from the hubbub of the lab. There, microphones picked up ultrasonic pops from thirsty tomato plants. Though it was outside humans' hearing range, the racket made by plants was about as loud as a normal conversation.

Snipped tomato plants and dry or cut tobacco plants clicked, too. But plants that had enough water or hadn't been snipped stayed mostly quiet. Wheat, corn, grapevines and cacti also babbled when stressed out. These findings appeared in *Cell*.

The researchers don't yet know why plants click. Bubbles forming and then popping inside plant tissues that transport water might make the noises. But however they happen, pops from crops could help farmers, the researchers suggest. Microphones, for instance, could monitor fields or greenhouses to detect when plants need water.

Hadany wonders whether other plants and insects already tune into plant pops. Other studies have suggested that plants respond to sounds. And animals from moths to mice can hear in the range of the ultrasonic clicks. Noises made by plants could be heard from around five meters (16 feet) away. Hadany's team is now investigating how plants' neighbors react to this chatter.

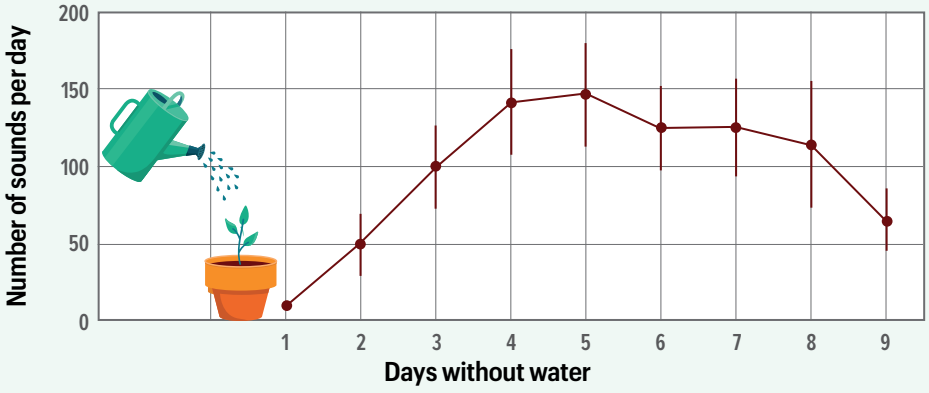
— *Carolyn Wilke*



Ultrasonic microphones detected clicks that plants make when distressed.

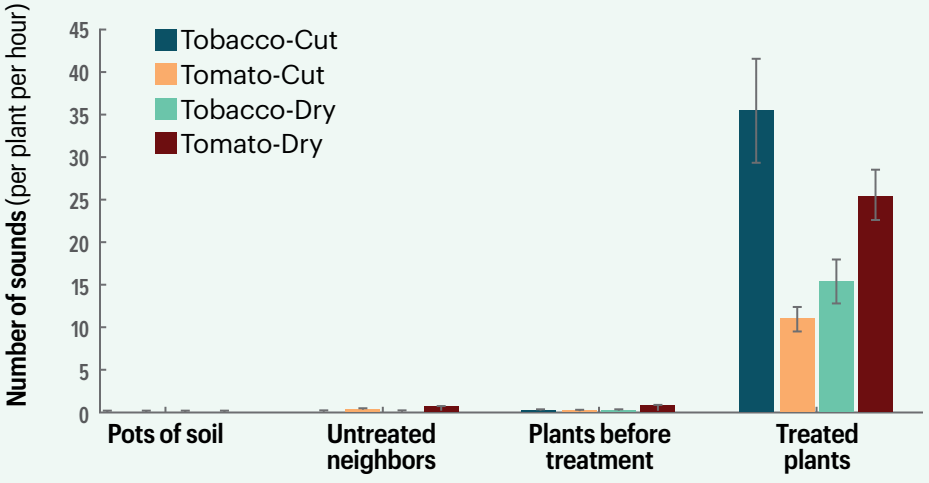
OHAD LEWIN-EPSTEIN

FIGURE A



Scientists stopped watering tomato plants in a greenhouse. They then tracked the number of sounds those plants made over the following days.

FIGURE B



Scientists placed plants in a quiet, soundproofed box. Nearby microphones recorded sounds from plants that were dry or cut ("treated plants"). The mics also recorded sounds from the same plants before they were treated, neighboring plants that weren't treated and pots that had soil but no plants.

DATA DIVE

1. Look at Figure A. Over which days did the number of sounds from the tomato plant increase?

2. How could you calculate the rate at which the number of sounds increases over the first four days?

3. Look at Figure B. How do the treated plants (dry or cut) compare with their untreated neighbors? How do plants differ before and after treatment?

4. Of the treated plants, which ones made the highest number of sounds per hour?

5. Why did the researchers record sounds from the pot of soil alone?

6. What animals do you think may be listening to plants' sounds? What could they learn? How could this information be helpful to animals?

ANSWER

A powerful laser guides bolts of lightning

This technology might someday improve lightning protection

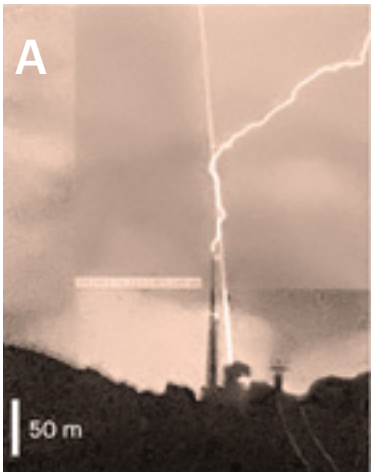
Like a high-tech hammer of Thor, a powerful laser can grab hold of a lightning bolt and reroute its path through the sky.

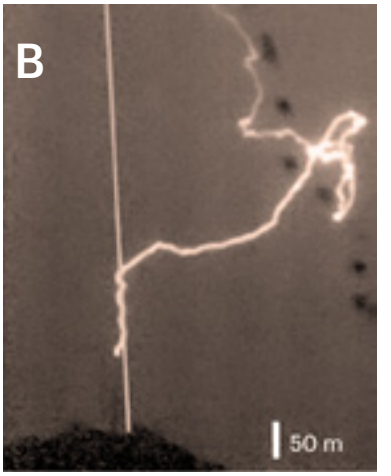
Scientists beamed an infrared laser into the sky during six hours of thunderstorms. They did this atop the Säntis mountain in Switzerland. The laser light carved out an easy path for electricity to follow through the air. This allowed the laser beam to lure four bolts of lightning out of the sky toward a lightning rod. That metal stick ferried the electricity safely into the ground.

In this experiment, the laser beam guided lightning over about 50 meters (164 feet). But in the future, a more powerful laser might be able to snag lightning bolts that are kilometers (miles) away, says Aurélien Houard. A physicist, he works at Institut Polytechnique de Paris in Palaiseau, France.

Lasers that can reach far into the sky to guide lightning bolts toward safe spots on the ground could better protect people, buildings, airports and wind farms from lightning strikes. Houard's team shared the results in *Nature Photonics*.

— *Maria Temming*





Atop a mountain in Switzerland, researchers installed a powerful infrared laser to catch lightning beside a tower with a lightning rod (far left). On July 24, 2021, fairly clear skies allowed high-speed cameras (A and B) to capture these images of lightning.

LASER: TRUMPF, MARTIN STOLLBERG; LIGHTNING: A. HOUARD *ET AL*/*NATURE PHOTONICS* 2023

INSIDE THE MIND OF A YOUNG SCIENTIST

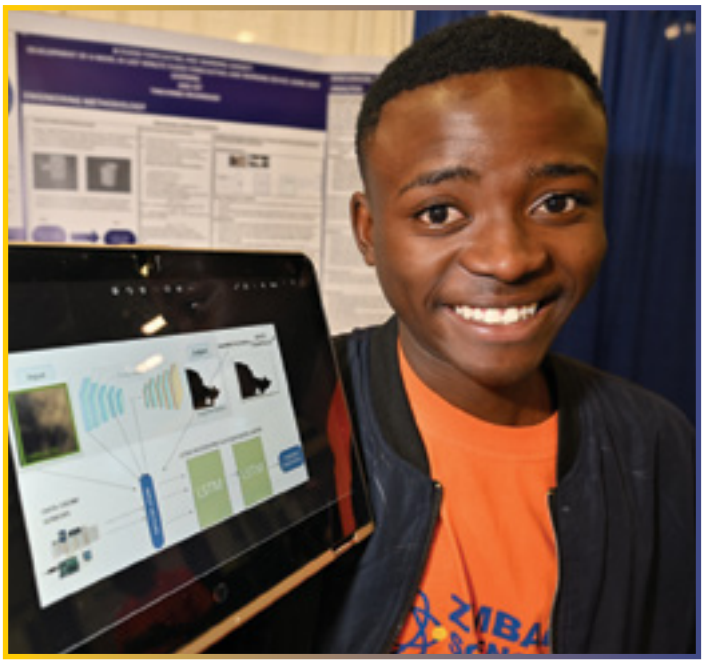
A winner of the Regeneron International Science and Engineering Fair answers three questions about his science

Science competitions can be fun and rewarding. But what goes on in the mind of one of these young scientists? Tinevimbo Musingadi, who won a Fourth Award in Earth and Environmental Sciences at the 2023 Regeneron International Science and Engineering Fair (ISEF), shares some of his science inspiration and advice.

Q What inspired your project?
A I was inspired by my grandparents. They live in a rural area of Zimbabwe. And in 2019, that area was affected by Cyclone Idai. They were not warned at the time that the cyclone was going to their area. My grandparents faced death and had to relocate. But luckily, they were safe. I made it a lifetime goal to develop something that might be useful and potentially save lives.

Q What was the biggest challenge you faced in this work?
A I had to face multiple challenges. The first challenge was funding. The next step was actually learning. I had to learn multiple coding languages, artificial intelligence and climate science in nine months. Then, some people didn't support it. Some teachers said, "You're wasting your time." No one in my community had attended ISEF or the national fair. The other thing was just electricity. Our country is facing economic problems; there's often no electricity in the suburbs where I live. That's a challenge when you need to be staying on the cloud to do computing and coding.

Q What's your advice for other students?
A As cliché as it sounds: Never give up. It's persistence that brought me here. And if it doesn't work, you can always go back to the drawing board. Don't be afraid to do things over again.



Fourth Award Winner, Earth and Environmental Sciences

Tinevimbo Musingadi

Countries such as the United States have access to technologies that can accurately predict storm intensity and flooding risk. But this tech can be inaccessible in low-income nations due to a lack of funds and infrastructure. So Tinevimbo, 18, developed a low-cost, intelligent device that uses a combination of the Internet of Things and deep learning to forecast floods and provide flood alerts to local people. Tinevimbo attends Mabvuku High School in Harare, Zimbabwe, and dreams of one day being an artificial intelligence researcher and astrophysicist.

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Why do we knead bread?