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INSIDE

COOL TRICK! U.S. snowboarder Jamie Anderson competes at the 2014 Olympics. She hopes to show off her moves at the upcoming 2018 Winter Games.

PHYSICS

BIG AIR!

Olympic athletes push physics to the limit in a new snowboarding event

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SCIENCE WORLD FEBRUARY 12, 2018 VOL. 74, NO. 8 **Editorial Director:** Patricia Janes **Senior Editor:** Jennifer Barone **Associate Editor:** Jacob Batchelor **Senior Education Editor:** Christina Romano **Contributing Editor:** Andrew Klein **Editorial Consultant:** Cody Crane **Intern:** Cici Zhang **Education Editor:** Matt Friedman **Online Editor:** Catherine Wilshusen **Senior Art Director:** Sarah Irick **Photo Editor:** Els Rijper **Production Editor:** Allan Molho **Senior Copy Editors:** Ingrid Accardi, Suzanne Bilyeu **Copy Editor:** Troy Reynolds **Digital Imager:** Vanessa Irena **Media Editor:** Marie Morreale **Executive VP, Scholastic:** Hugh Roome **Creative Director:** Judith Christ-Lafond **Design Director:** Felix Batcup **Executive Director of Production and Operations:** Barbara Schwartz **Executive Editorial Director, Copy Desk:** Craig Moskowitz **President, Chief Exec. Officer, and Chairman of the Board of Scholastic Inc.:** Richard Robinson. **POSTAL INFORMATION:** *SCIENCE WORLD* (ISSN 1041-1410; in Canada, 2-c no. 55948) is published 12 times annually; biweekly: September, October, March; monthly: November, December, January, February, April, May; by Scholastic Inc., 2931 East McCarty St., P.O. Box 3710, Jefferson City, MO 65102-3710. Periodical postage paid at Jefferson City, MO 65102 and at additional mailing offices. POSTMASTERS: Send notice of address changes to *SCIENCE WORLD*, 2931 East McCarty St., P.O. Box 3710, Jefferson City, MO 65102-3710.

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SCIENCE NEWS

ENGINEERING: ENVIRONMENTAL ENGINEERING

SOLAR CHAMPS

Every two years, a grueling 3,000 kilometer (1,864 mile)-long race called the World Solar Challenge takes place in the Australian Outback. The cars that compete aren't your typical gasoline-powered vehicles—they run entirely on *solar power*.

To make it to the finish line, teams of university students and engineers from private companies must build cars that efficiently soak up sunlight and convert its energy into electricity. They also design their cars to be *aerodynamic*. The cars have a sleek shape that allows them to cut through the air, reducing *drag*—the force of air molecules pushing against an object. That way, the cars can go farther while using less energy.

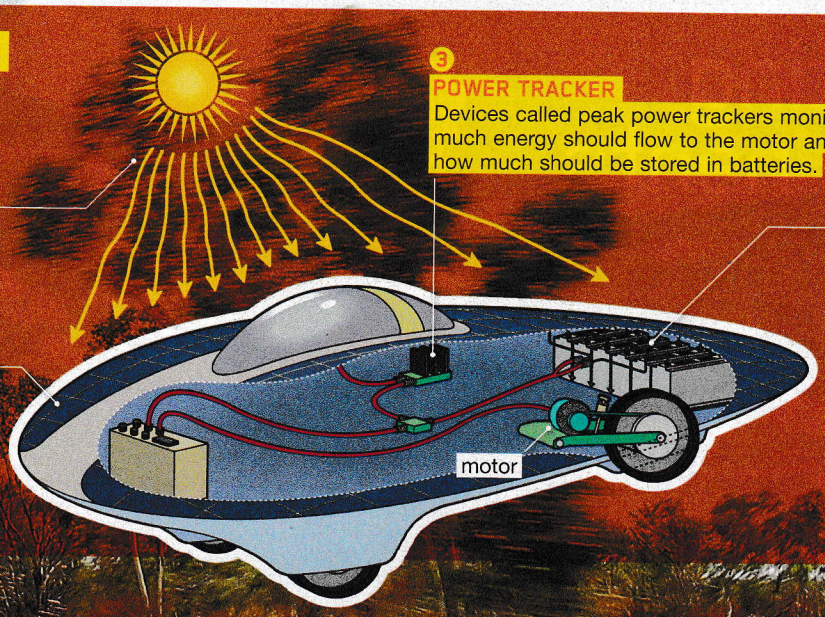
"Driving that far through the middle of nowhere with a car that runs purely on solar energy is an amazing experience," says Daniël Willemsen of the Netherlands. He's on the Nuon Solar Team, which won the race last October. —*Greg Uyeno*

PATH TO VICTORY

Here's the 3,000 kilometer (1,864 mile) path contestants in the 2017 World Solar Challenge traveled. It winds from Darwin, on Australia's tropical northern coast, to the finish line in Adelaide, a seaside city in the south.

SHINING SPEED

See how a solar vehicle generates the power it needs to go the distance.



1 SUNSHINE
Sunlight is made up of particles of light energy called *photons*.

2 SOLAR CELLS
Photovoltaic cells on the car's solar arrays absorb photons from the sun, converting them into electrical energy.

3 POWER TRACKER
Devices called peak power trackers monitor how much energy should flow to the motor and how much should be stored in batteries.

4 BATTERY PACKS
These batteries store up energy that can be used when the sun isn't shining.

ZOOM!
Most solar vehicles in the race have an average speed of about 100 km/h (62 mph).

MARK KOLBE/GETTY IMAGES FOR SATC (SOLAR RACER); JIM MCMAHON/MAPMAN® (MAP); COLIN HAYES (DIAGRAM)

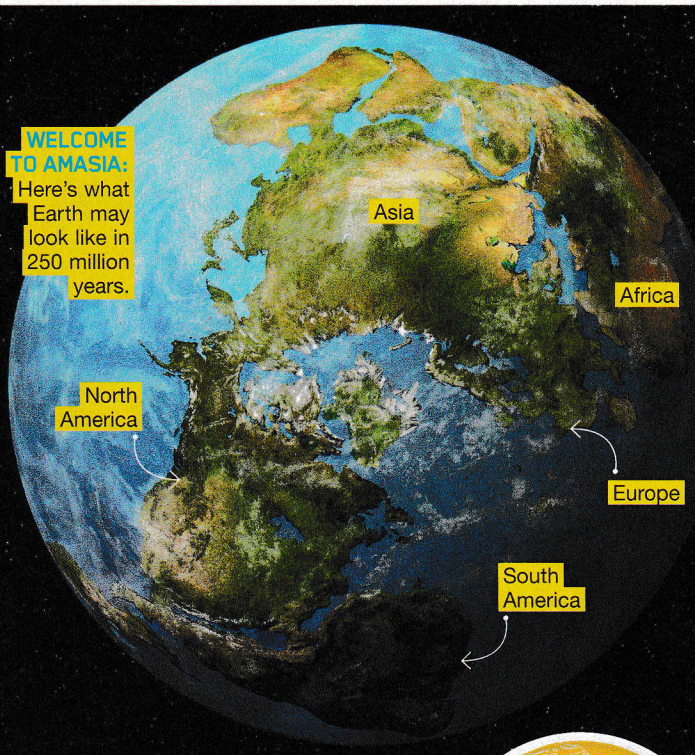
EARTH SCIENCE: LANDFORMS

Shifting Continents

Earth hasn't always looked the way it does today. Long ago, nearly all of Earth's landmasses formed a giant *supercontinent* called Pangaea. According to a new study, that history could repeat itself.

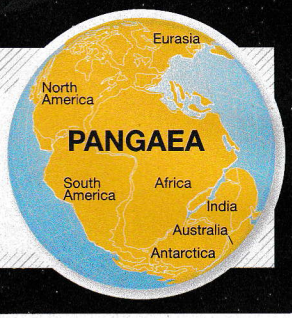
Earth's continents rest on *tectonic plates*. Geological activity inside Earth causes these giant slabs of rock to move a few centimeters per year. Over time, these small movements can lead to big changes.

Using computer projections, scientists at the Japan Agency for Marine-Earth Science and Technology predicted that five of Earth's continents—Australia, Europe, Asia, North America, and Africa—may combine in about 250 million years to form a new supercontinent, called Amasia. "Amasia will be near the North Pole, so it will likely form a massive ice cap," says Masaki Yoshida, a geophysicist who worked on the study. —*Jeanette Ferrara*



ANCIENT EARTH

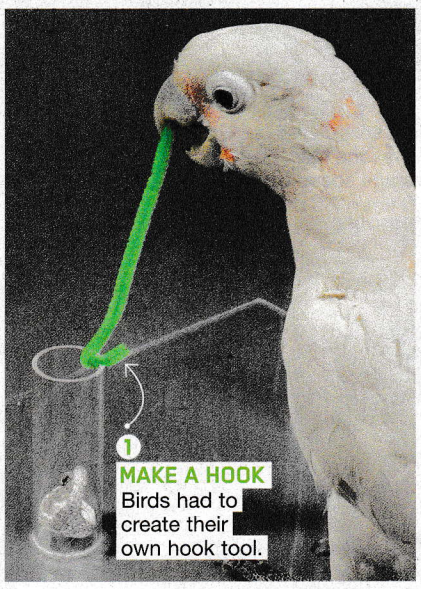
About 300 million years ago, nearly all of Earth's landmasses joined into a supercontinent called Pangaea. Geologists think that Pangaea was the third supercontinent in Earth's history—and that it won't be the last.

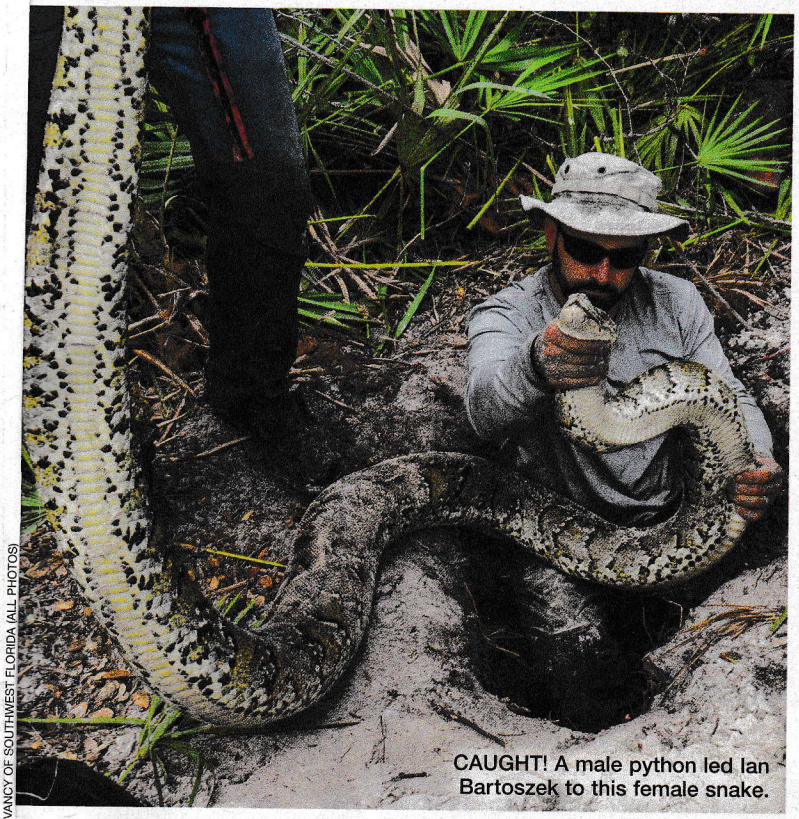


BIOLOGY: ANIMAL BEHAVIOR

Clever Cockatoos

A group of cockatoos recently proved their smarts. Researchers at the University of Vienna in Austria set up a tricky task for the birds: Reach a cashew inside a basket at the bottom of a vertical tube using only a pipe cleaner. The cockatoos had to bend the pipe cleaner into a hook to snag the reward. A second test required the birds to straighten a bent pipe cleaner to push a snack out of a horizontal tube. Several cockatoos mastered at least one of the puzzles, and one bird even solved both problems. The results were surprising since cockatoos aren't known to use tools in the wild. —*Greg Uyeno*





CAUGHT! A male python led Ian Bartoszek to this female snake.

TRACKER: A field technician uses a radio antenna to track a tagged python.

PAGE 4: NICOLE R. FULLER/SPL/SCIENCE SOURCE (AMASIA); JIM MCMAHON/MAPMAN® (PANGAEA MAP); BENEDIKT CROY (COCKATOO); PAGE 5: LEIF JOHNSON/CONSERVANCY OF SOUTHWEST FLORIDA (ALL PHOTOS)

BIOLOGY: ECOLOGY

SNAKE STOPPERS

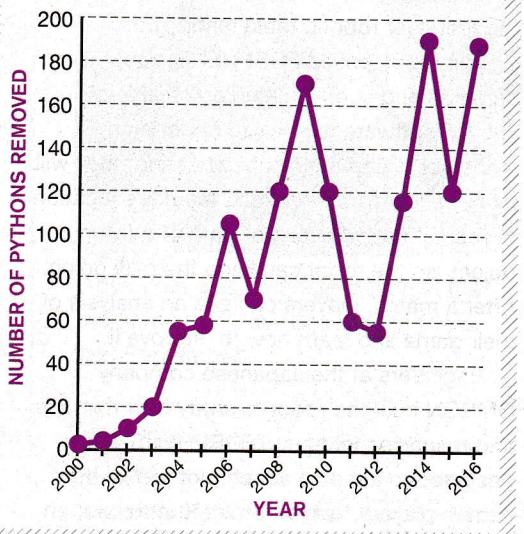
Crossing paths with a 5 meter (16 foot)-long Burmese python might scare some people—but not Ian Bartoszek. He's a wildlife biologist with the Conservancy of Southwest Florida and part of a group of scientists working to catch and kill *invasive* Burmese pythons in the Florida Everglades.

These non-native reptiles likely came to the U.S. as pets but escaped or were carelessly released into the wild by their owners. They've been negatively affecting the local *ecosystem*—a community of animals interacting with their environment—ever since. "Our native wildlife has no defense against a giant snake predator, and some species seem to be disappearing," says Bartoszek.

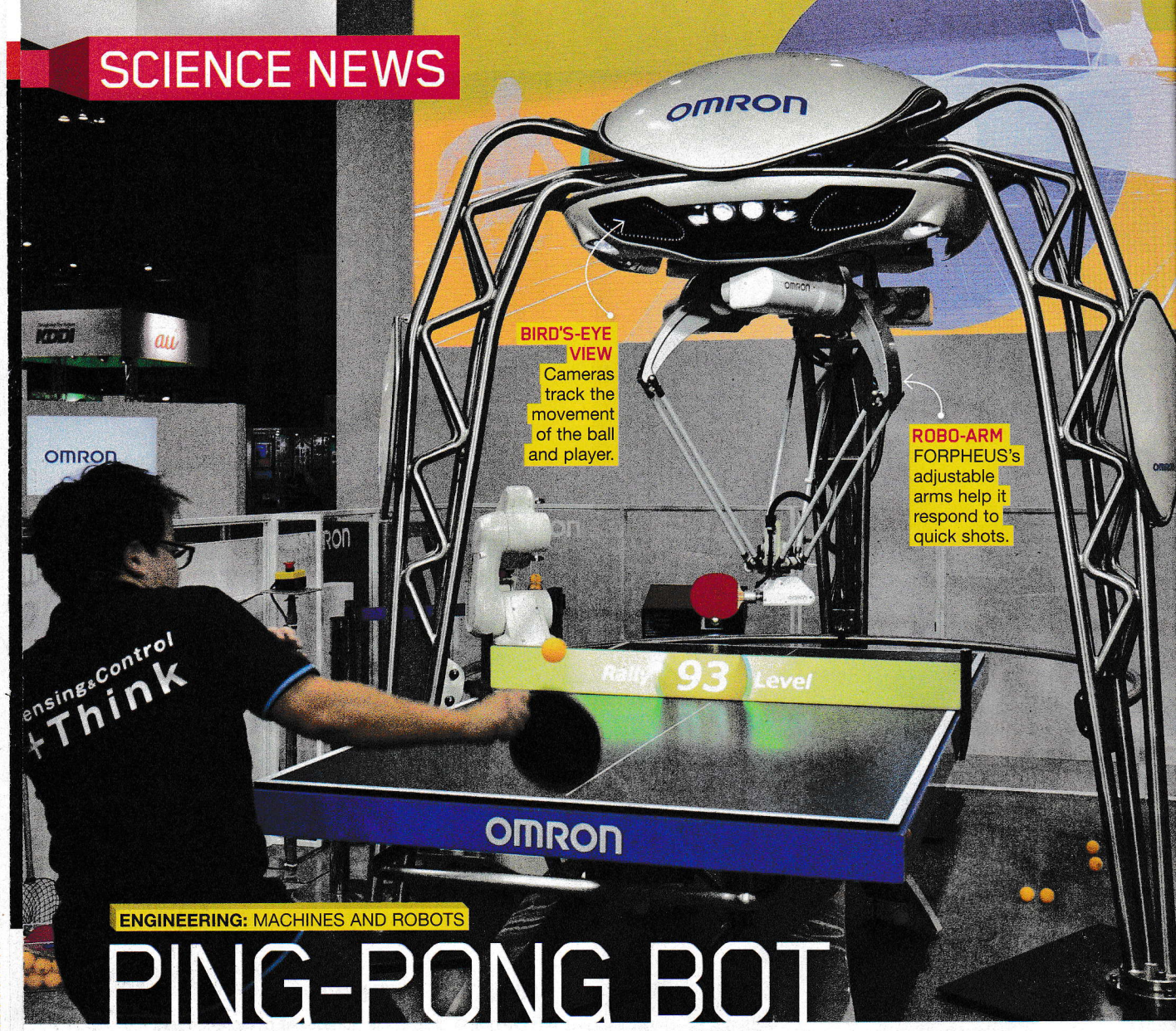
Bartoszek's team has come up with a clever way to round up the invaders. They use male pythons tagged with radio trackers to lead them to breeding females. They've removed hundreds of pythons using these "sentinel snakes." But Bartoszek worries it's not enough. "There's a lot at stake for native species and the health of the Everglades ecosystem," he says. *—Hailee Romain*

HUNTING PYTHONS

This graph shows the number of pythons caught and killed each year in Everglades National Park in Florida. Is there a trend in the data? If so, what might account for it?



SOURCE: EVERGLADES NATIONAL PARK, U.S. GEOLOGICAL SURVEY, AND FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION



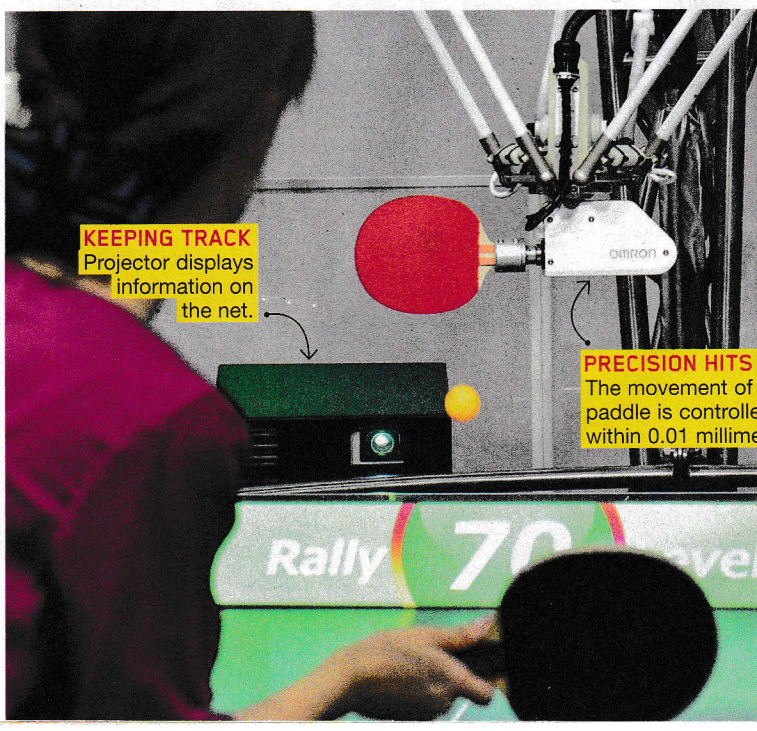
ENGINEERING: MACHINES AND ROBOTS

PING-PONG BOT

This robot can play Ping-Pong like a pro. In fact, Guinness World Records just named it the first-ever robotic table tennis tutor.

The robot, called FORPHEUS, uses cameras and sophisticated *artificial intelligence* software to analyze opponents' movements and anticipate what shot they will hit next. Sensors then track the ball's location to predict its *trajectory*, or path of a flying object, so the robot can keep the rally going. After a match, players can see an analysis of their game and learn how to improve it.

Engineers at the Japanese company OMRON built the robot to study how humans and machines interact. "FORPHEUS was designed to act as a coach, not just to beat human players," says Haruka Kumazawa, an OMRON spokesperson. —*Hailee Romain*



DID YOU KNOW? There are an estimated 50,000 varieties of pepper.

CHEMISTRY: CHEMICAL REACTIONS

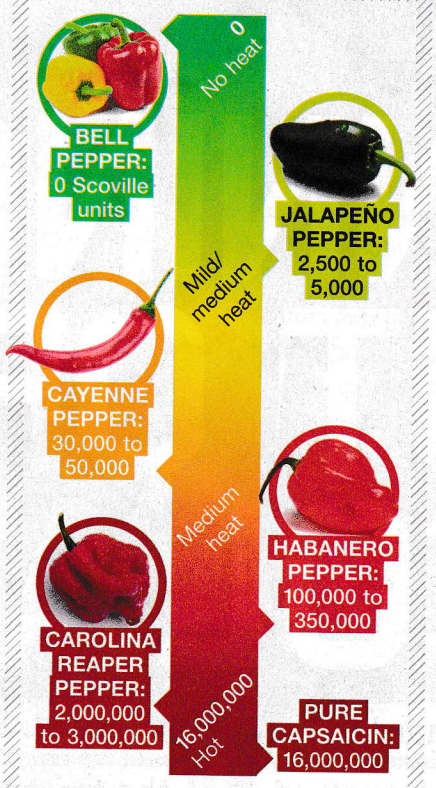
Salt or Pepper?

Instead of reaching for the saltshaker during your next meal, consider grabbing some hot sauce instead. A diet high in salt can raise your *blood pressure*—the force of the blood flowing through your blood vessels—and potentially increase your risk for heart disease. A new study has found that *capsaicin*, a chemical found in the chili peppers used to make hot sauce, does the opposite. It can help lower your blood pressure.

That's not the only reason to choose spice over salt: "Eating spicy food can also increase salty taste sensitivity," says Zhiming Zhu, a cardiologist at the Third Military Medical University in Chongqing, China, who led the study. That means eating spicy foods may encourage you to use less salt. —*Jeanette Ferrara*

SCOVILLE SCALE

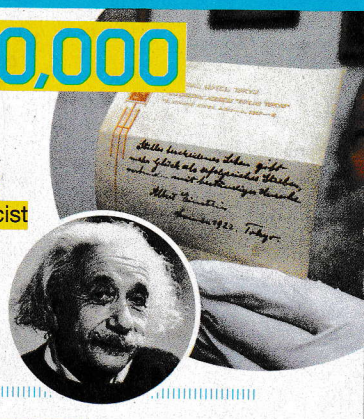
Not sure you can stand the heat? Don't worry, not all chili peppers are hot. How badly a pepper burns depends on its capsaicin level, which is measured in *Scoville units*. The more Scoville units a pepper has, the hotter it tastes.



NUMBERS IN THE NEWS

$1,560,000

Price fetched at auction for a handwritten note by famous physicist Albert Einstein detailing his "theory of happiness."

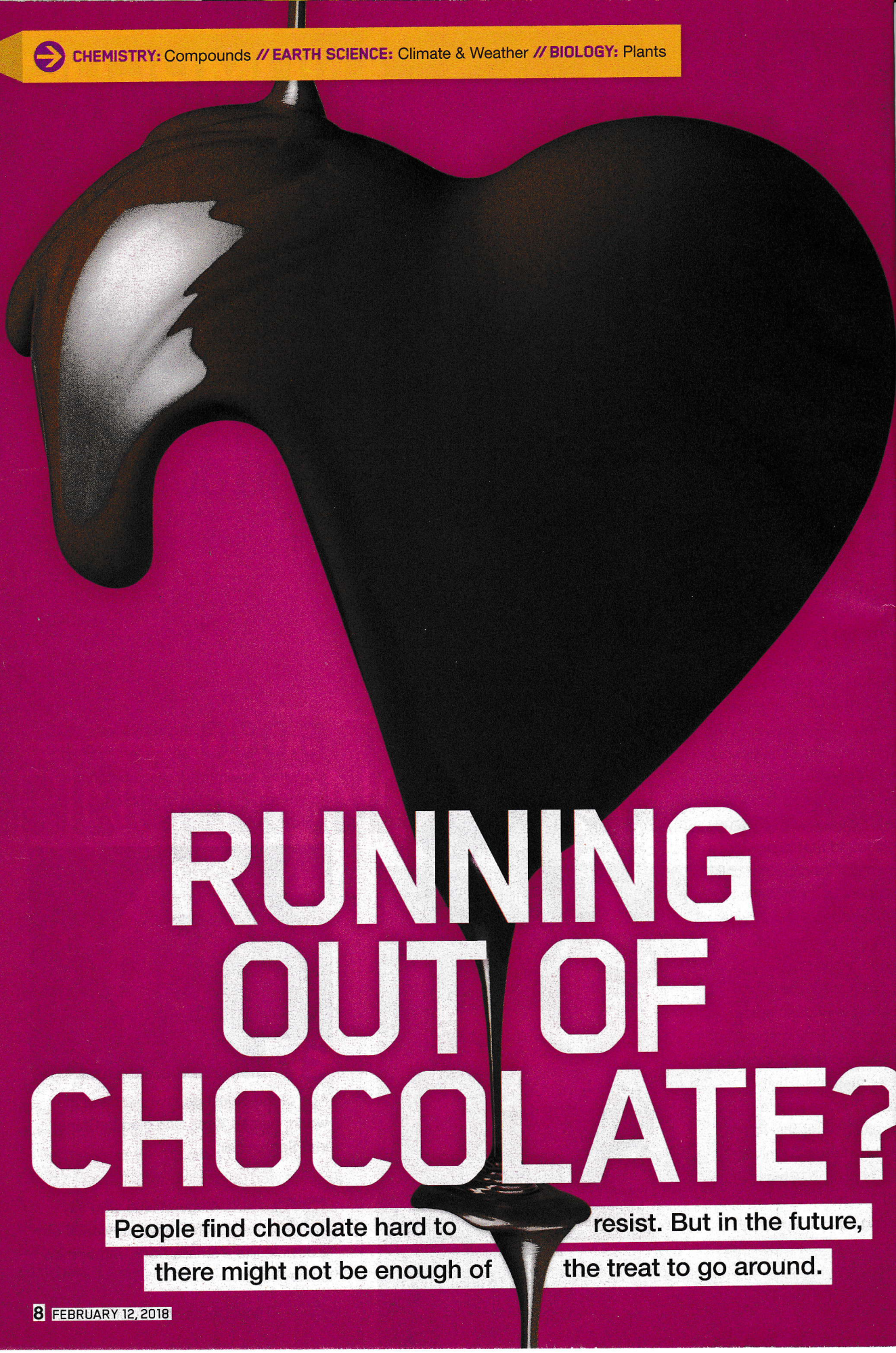


940,000 Amount of butter in metric tons Americans consumed in 2017—up 10 percent from 2016.

6,000 Age in years of an ancient human skull that scientists believe belonged to the earliest victim of a tsunami.

37 Age of the oldest captive panda in the world, named Basi. She died in China last September.

32 Percentage of kids who say they prefer to watch videos on a device, like a smartphone, rather than a television.



RUNNING OUT OF CHOCOLATE?

People find chocolate hard to resist. But in the future, there might not be enough of the treat to go around.

ESSENTIAL QUESTION: What factors may influence the world's chocolate supply?

Everyone loves to receive a big box of chocolates on Valentine's Day. But our appetite for this tasty treat isn't limited to Cupid's favorite holiday. Last year alone, people devoured more than 7 million tons of chocolate—and that amount is expected to grow.

Every year, more and more consumers around the world are getting hooked on chocolate. Once they've had a taste, they usually want more. That's because people tend to find chocolate's unique smell and texture—a result of its chemical makeup—simply irresistible.

It may be hard to meet this increasing demand in the future. Farmers grew record amounts of *cacao*, the plant responsible for chocolate's key ingredient, last year. But it's under threat from diseases and climate change, putting the global chocolate supply at risk. To stave off a chocolate-industry meltdown, chocolate manufacturers and researchers have teamed up to help cacao farmers improve the resilience of their crops.

CHEMICAL APPEAL

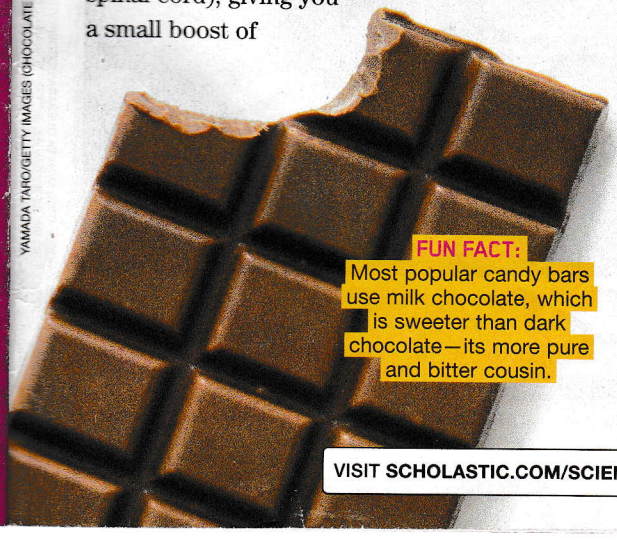
Chocolate is a mixture of sugar, milk, and cocoa, which comes from the cacao tree. The treat is one of the most craved foods on the planet. The reason for chocolate's desirability is complex and not fully understood. But food scientists believe the treat's appeal is rooted in its unique chemical and physical makeup.

Scientists know that chocolate contains *caffeine*—also present in most coffee and many teas—and *theobromine* (*see Chocolate Chemistry, right*). Both chemicals stimulate your *central nervous system* (the brain and spinal cord), giving you a small boost of energy. But the jolt you get from eating chocolate is much weaker than what you get from drinking a cup of coffee, says Gregory Ziegler, a food scientist at Pennsylvania State University.

Ziegler says caffeine and theobromine alone can't account for all of chocolate's appeal. Cocoa butter and sugar also add to the snack's allure. Cocoa butter is a type of fat. It has a *melting point*—the temperature at which a solid turns into a liquid—of about 32°C (90°F), or just below body temperature. This ensures that chocolate melts in your mouth, allowing you to fully appreciate its flavor and texture. Sugars play a key role too. They trigger your brain to release *dopamine*—a chemical that gives you a sense of well-being.

Continued on the next page →

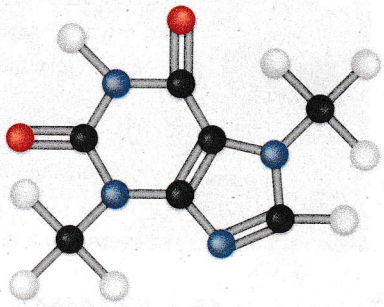
DID YOU KNOW? Cocoa beans were considered so valuable by ancient Aztecs and Maya that they were used as currency.



FUN FACT: Most popular candy bars use milk chocolate, which is sweeter than dark chocolate—its more pure and bitter cousin.

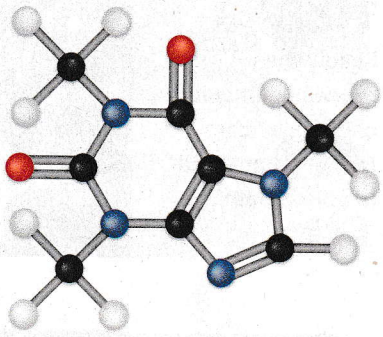
CHOCOLATE CHEMISTRY

Chocolate contains two chemicals that scientists believe contribute to its allure: theobromine and caffeine. Both stimulate the central nervous system and give you an energy boost. Compare the compounds' chemical structures, shown here. Why might they affect the body in a similar way?



CHEMICAL NAME: Theobromine

CHEMICAL FORMULA: $C_7H_8N_4O_2$



CHEMICAL NAME: Caffeine

CHEMICAL FORMULA: $C_8H_{10}N_4O_2$

KEY

- Hydrogen
- Carbon
- Oxygen
- Nitrogen

RESISTANT TREES: A man collects cacao pods from a disease-resistant variety of cacao tree.

In addition, people are enticed by chocolate's *aroma*. Its signature smell is created by hundreds of individual flavor *compounds*—substances made of two or more different elements that are chemically combined. Chocolate's aroma can even trigger responses that are based on people's memories and past experiences with the sweet snack. "If your parents used chocolate as a reward or treat, you'll react to the smell as a reward," says Ziegler. "You experience the chemistry in context."

DELICATE CROP

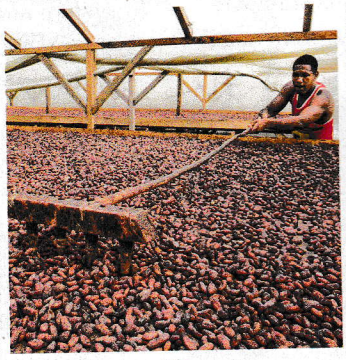
Creating chocolate is a long, difficult process (*see From Bean to Bar, below*). For starters, each cacao tree takes three to five years to produce its first *cacao pods*—the tree's fruit, which contains the cocoa beans used to make chocolate.

Once cacao pods are harvested from a mature tree, farmers remove the cocoa beans from the pods. The beans come naturally coated in a thin, white layer of wet pulp. Workers allow the beans to *ferment*—a process in which microorganisms break down a substance—to get rid of the pulp and decrease the beans' bitterness. The beans are then dried and sold to chocolate manufacturers, which clean, roast, and grind them into a paste. The paste is mixed

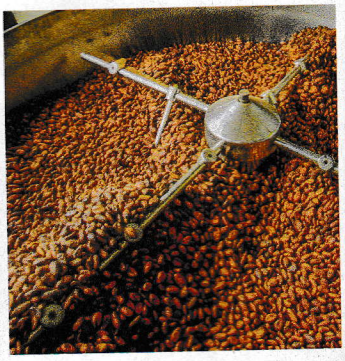
FROM BEAN TO BAR

Follow the process of making chocolate, from a farmer's backyard to your mouth.

1 Cacao pods are harvested from trees to gather cocoa beans.

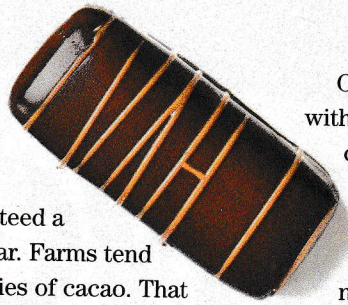


2 Cocoa beans are fermented and dried.



3 Manufacturers roast beans to bring out flavors and further reduce their acidity.

with other ingredients and poured into molds to create that perfect gift for your sweetheart.



Farmers aren't guaranteed a good cacao crop each year. Farms tend to grow only a few varieties of cacao. That means the plants lack *genetic diversity*—the variety of *genes* (units of hereditary material) within a species. Because most cacao plants grown today share the same genes, they're vulnerable to the same diseases. Unfortunately, many farmers either don't have access to or can't afford the *pesticides* and *fungicides* that kill disease-carrying pests and harmful fungi.

Hotter temperatures and extreme weather patterns brought on by *climate change* compound these problems, says Ethan Budiansky, the director for environment at the World Cocoa Foundation in Washington, D.C. "Cacao trees like heat, but not too much, and they require sufficient rain," he says. "As the climate becomes less hospitable, there's less land that's suitable for growing these plants."

PLANTING SEEDS

Leading chocolate manufacturers are working to overcome problems threatening cacao trees and keep up with global demand for chocolate. They're investing billions of dollars to improve cacao farming practices. Through a plan called CocoaAction, companies are working to help farmers around the world produce more cocoa beans.

One effort involves providing farmers with pesticides, fungicides, and fertilizer that can help grow more-robust trees.

Another project involves *crossbreeding* different species of cacao trees to develop new varieties that are naturally resistant to disease. Scientists grow these new breeds in greenhouses. Once the seedlings are strong enough, they're sent to farmers for planting.

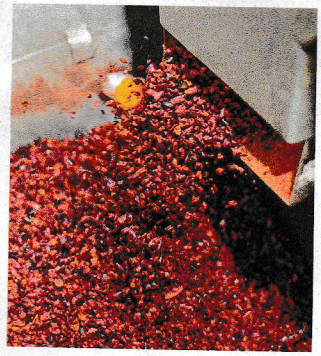
The CocoaAction initiative has already shown some positive results, says Budiansky. "We're making progress, but there's still a long way to go," he says. As long as people keep discovering—and loving—chocolate, more work will be needed to ensure a chocolate supply for many Valentine's Days to come.

—Jacob Batchelor

CORE QUESTION

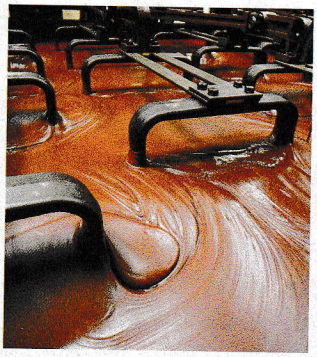
What role does chemistry play in the growing demand for chocolate?

GROWING THE FUTURE: Researchers care for cacao seedlings that will be sent to farmers.

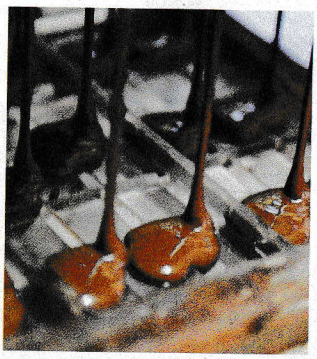


4 Beans are poured into a machine and crushed to remove the tough outer shell.

5 The crushed beans are pressed to produce chocolate paste.



6 The paste is heated and cooled at specific temperatures to get the right texture.



7 Chocolate is mixed with sugar and milk, then poured into molds. Enjoy!

CATCHING BIG AIR

Find out how physics makes the new high-flying snowboarding event at the 2018 Winter Olympics possible

ESSENTIAL QUESTION: What factors might affect how well a snowboarder pulls off a trick?

2 TAKEOFF PHASE

Before a rider flies off the jump, he or she has forward *momentum*—mass times velocity. The more momentum an object has, the more difficult it is to stop. At takeoff, athletes flex and extend different muscles to generate *angular momentum*, or momentum of rotation. It drives a snowboarder's ability to flip and spin in the air. The force of *drag*—from air pushing against a snowboarder—reduces the athlete's momentum during the approach and takeoff phases.

1 APPROACH PHASE

A snowboarder starts a run with an initial amount of *gravitational potential energy*—stored energy determined by an object's height. The *law of conservation of energy* states that energy is constant and never lost. As gravity's pull accelerates a rider down the ramp, stored potential energy turns to *kinetic energy*, or the energy of motion. Forces like *friction*—made when a snowboard rubs against the ramp—work to slow the rider and transform some energy to heat.

OLYMPIC BIG AIR: The 2018 Winter Olympics Big Air snowboarding course in South Korea

This month, you'll get the chance to see snowboarders soar like never before at the 2018 Winter Olympics in Pyeongchang, South Korea. Extreme athletes can now participate in a new event called "Big Air." It requires riders to launch themselves down a 49 meter (160 foot)-long ramp and off a jump to perform multiple flips and spins in midair.

A panel of six judges evaluates each competitor's performance for difficulty, execution, and whether he or she landed under control and in the designated landing area. Pulling off the sickest tricks requires snowboarders to know how to use forces, like the downward pull of *gravity*, to their advantage.

"Having a greater knowledge of physics can help a coach or athlete make more informed decisions to maximize performance," says Brennan Metzler, a member of the American Association of Snowboard Instructors in Colorado.

Science World spoke with Metzler to find out more about the physics behind big air.

—*Andrew Klein*

CRAZY TRICK Snowboarder Marcus Kleveland on a Big Air run in Norway.

3 MANEUVER PHASE

After takeoff, a snowboarder tucks in his or her legs and arms to increase the rate of the flips and spins. Pro snowboarders can perform as many as five spins and flip up to four times during only a few seconds of airtime, says Metzler.

4 LANDING PHASE

To land safely with good form in the designated landing zone, or "sweet spot," a snowboarder needs to slow his or her rate of rotation. The athlete achieves this rotational *deceleration* by extending his or her arms and legs. When riders land, they stomp the edges of their boards into the snow, which creates a resistive force to help them further decelerate their angular momentum.

CORE QUESTION

How might the height and weight of a snowboarder affect the forces involved in a Big Air run?

CATCHING BIG AIR

Find out how physics makes the new high-flying snowboarding event at the 2018 Winter Olympics possible

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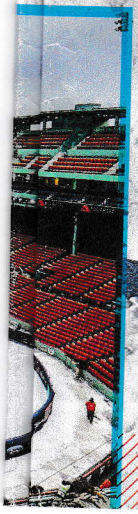
CRAZY TRICK Snowboarder Marcus Kleveland on a Big Air run in Norway.

3 MANEUVER PHASE

After takeoff, a snowboarder tucks in his or her legs and arms to increase the rate of the flips and spins. Pro snowboarders can perform as many as five spins and flip up to four times during only a few seconds of airtime, says Metzler.

4 LANDING PHASE

To land safely with good form in the designated landing zone, or "sweet spot," a snowboarder needs to slow his or her rate of rotation. The athlete achieves this rotational *deceleration* by extending his or her arms and legs. When riders land, they stomp the edges of their boards into the snow, which creates a resistive force to help them further decelerate their angular momentum.



CORE QUESTION

How might the height and weight of a snowboarder affect the forces involved in a Big Air run?

HOLDING BACK THE FLOODS

AFTER THE STORM: Rescue workers and a group of Houston residents wait for emergency crews in the wake of Hurricane Harvey in August 2017.

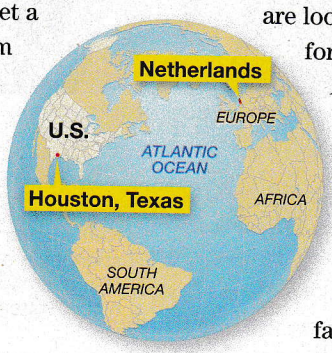
After one of the worst hurricane seasons on record, what can the U.S. learn from countries with centuries of experience managing floods?

ESSENTIAL QUESTION: Why might collaboration be important when it comes to solving large engineering problems?

Last August, Hurricane Harvey barreled into the Texas coast. In just a few days, the storm dumped more than 1.2 meters (4 feet) of rain on Houston, America's fourth most-populous city, and surrounding areas. It set a new record for rainfall from a single storm and led to widespread flooding. Dozens of people died. Tens of thousands had to evacuate, with many still unable to return to their flood-damaged homes.

Like Hurricane Sandy, which hit the Northeast five years earlier, and Hurricane Katrina, which devastated the Gulf Coast in 2005, Harvey demonstrated how vulnerable U.S. coastal communities are to flooding. More than 120 million Americans—nearly 40 percent—live in a coastal county. And that population is growing rapidly.

Scientists believe *climate change* could bring even more intense flooding to the U.S. Warming temperatures and shifting global climate patterns are not only raising sea levels but could also potentially cause more extreme storms. As a result, U.S. coastal communities are looking for ways to prepare for the future (*see Fighting Floods Worldwide, p. 17*). They're gathering data locally and collaborating with experts around the world to identify the best strategies to keep people and essential facilities above water.



KEEPING A COUNTRY DRY

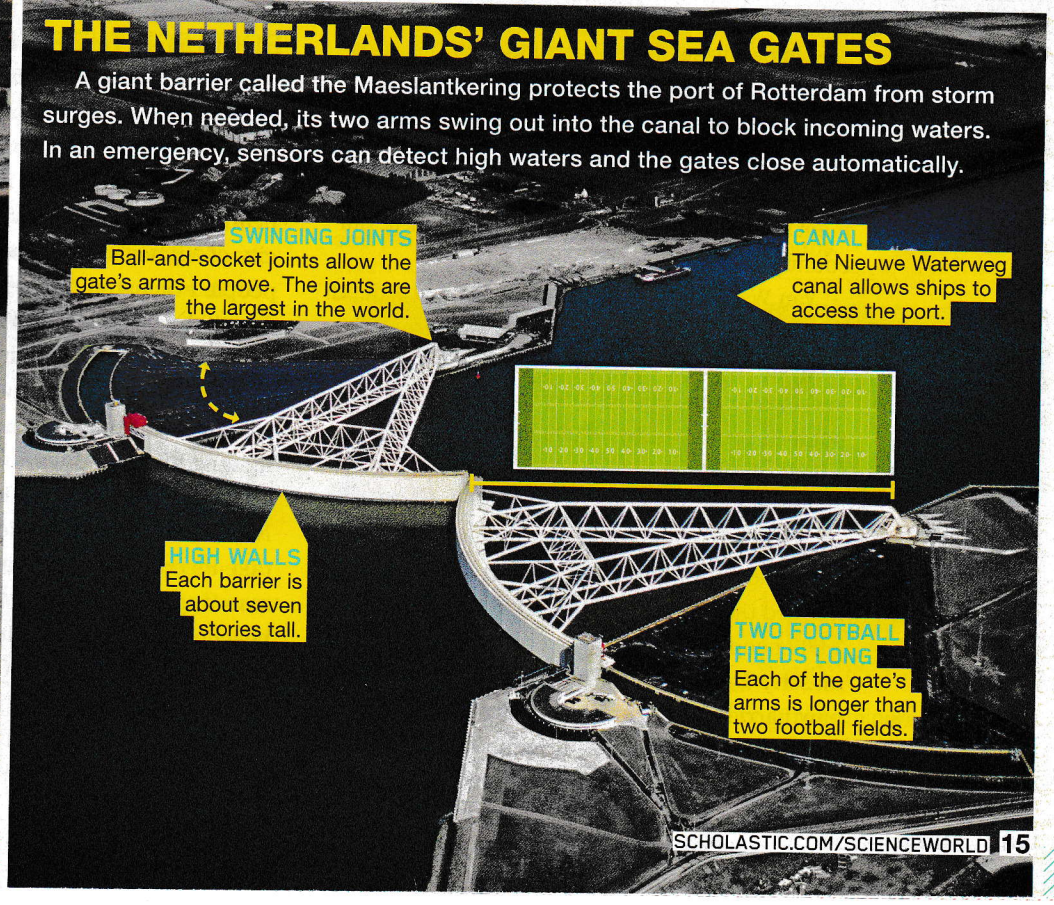
Perhaps no country on Earth has as much experience protecting against floods as the Netherlands. About a third of the small European nation's

Continued on the next page →

ALYSSA SCHUKAR/THE NEW YORK TIMES/REDUX (FLOOD); FRANS LEMMENS/ALAMY STOCK PHOTO (SEA GATES); TELNOV OLEKSII/SHUTTERSTOCK (FOOTBALL FIELD); JIM MCMAHON/MAPMAN® (MAP)

THE NETHERLANDS' GIANT SEA GATES

A giant barrier called the Maeslantkering protects the port of Rotterdam from storm surges. When needed, its two arms swing out into the canal to block incoming waters. In an emergency, sensors can detect high waters and the gates close automatically.



FLOATING COMPLEX
These houses in Amsterdam can rise and fall with changing water levels.

BOOSTING DEFENSES
Workers in the Netherlands strengthen a dike to prepare for higher waters.

land is below sea level—and much of that area would be underwater if not for centuries of expert engineering. "Flood protection is a huge part of our history and culture," says Harold van Waveren, a senior adviser for the Dutch government's flood-prevention agency. "Without it, our country wouldn't exist."

Van Waveren lives near Amsterdam at a depth of 5 m (16 ft) below sea level in a *polder*—an area surrounded by walls, called *dikes*, that keep water out. The country has nearly 3,500 polders, protected by 40,000 kilometers (25,000 miles) of dikes and dams.

Flood protections have continued to evolve since Dutch farmers built the first dikes a thousand years ago. A major storm in 1953 that flooded the southwest Netherlands and killed 1,800 people motivated the country to build the massive Delta Works. This project constructed new barriers and dams to protect against *storm surges*—increases in sea level due to wind and air pressure changes during storms. The project also included channels called *sluices*, which drain excess water during floods.

The crown jewel of the Delta Works is the Maeslantkering (*MAHS-lawnt-keh-ring*), a giant barrier completed in 1997 that protects Rotterdam, one of the world's busiest ports, from the sea. Ships must enter and exit the por so building a permanent barrier that blocked the sea wouldn't work. Instead, the governmen decided on a huge gate that remains open mos of the time and swings shut during storms (*see The Netherlands' Giant Sea Gates, p. 15*).

ROOM FOR THE RIVER

The Maeslantkering successfully held back the sea during a 2007 storm. But storm surges aren't the Netherlands' only flood threats: In 1995, dikes surrounding the narrow Waal Rive nearly failed during heavy rains, threatening t city of Nijmegen (*NYE-may-ken*). Some 200,0 people evacuated. "That led to a big change i our strategy," says van Waveren. "Until then, we thought we could manage nature and have it do as we wanted. But we realized nature is sometimes stronger than we are. We had to s fighting it and find ways to work with it."

Current flood protection strategies in the Netherlands focus on allowing nature to safe take its course during floods. Workers are restoring and protecting coastal lands like beaches, marshes, and dunes, which provide natural buffers against storms.

At more than 30 sites around the country, engineers are also creating additional places where water can go. The city of Nijmegen is

part of this program, which is called Room for the River. There, workers recently built an extra channel so river water can flow around the city when the level rises. Low-lying areas are being turned into parks, gardens, sports fields, and other amenities that can act as reservoirs for floodwaters in emergencies without harming people or infrastructure. Builders are also moving dikes farther from the river to create additional space for floodwaters.

BRINGING IT HOME

On the coast of Texas, the U.S. Army Corps of Engineers (USACE) is investigating similar plans to combat storm surges. "The biggest element we're considering is a large gate structure in the Houston-Galveston area that could be closed if a storm is coming," says Sharon Tirpak, who is overseeing the study. One possible design resembles the Maeslantkering. "If it's chosen, it would be one of the largest structures in the world," she says.

For storms like Harvey that dump massive amounts of rain, a sea gate would do little to stop flooding. So the Texas study is also evaluating how natural features like wetlands could help absorb heavy rains. The fact that so much of Houston is covered in concrete is one reason it flooded so badly, says Henk Ovink, the Dutch special envoy for water affairs. His job is to share Dutch expertise in flood management with countries around the world. Restoring native prairies and wetlands, which can soak up water, could help protect Texas and other areas against future floods.

A team from USACE recently visited the Netherlands to tour Dutch coastal defenses. And Dutch flood engineers came to the U.S. to compare methods for evaluating the stability of *levees*—our version of dikes.

Ovink says the challenges ahead represent an opportunity for coastal communities to come together to innovate. "In the form of rising seas and storms, water gives a tangible meaning to climate change that we have to prepare for," he says. "But we can do this. It doesn't have to be something we fear." *—Jennifer Barone*

CORE QUESTION

Explain why a sea gate alone might not be enough to protect Texas from future floods.

FIGHTING FLOODS WORLDWIDE

Besides the Netherlands, other countries and cities around the world are developing innovative approaches to prevent and adapt to floods. Here are a few.

CHICAGO

The city is building "green alleys" made with *permeable* materials like special kinds of concrete and paving stones that allow water to pass through or between them instead of collecting on the surface.

CHINA

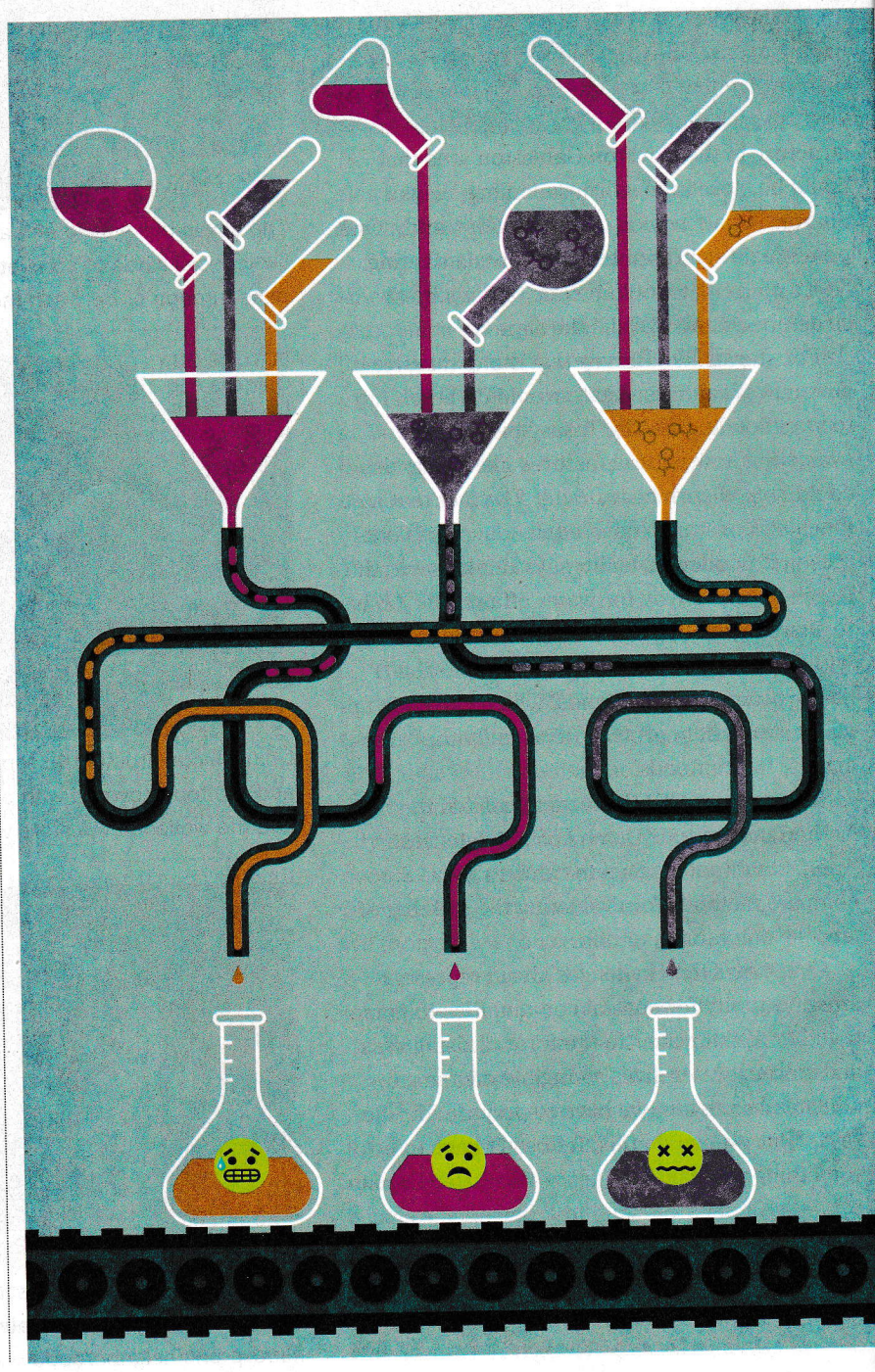
China is constructing 16 "sponge cities" that incorporate wetlands and rooftops covered with plants. The plants will soak up water, and the wetlands will store water during storms.

BANGLADESH

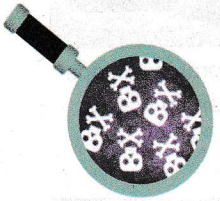
A new project will bring five floating shipping containers—including essential facilities like a floating classroom and a kitchen—to a flood-prone neighborhood.

NOT FIT FOR HUMAN CONSUMPTION

You probably know that drugs that don't come from a pharmacy or other legal distributor can be dangerous. But they also may not be what they seem.



IN RECENT YEARS, emergency room doctors have reported a growing number of overdoses related to the use of certain types of **synthetic drugs**. Most drugs—even the ones that help people—are synthetic, which means that they're produced by mixing and creating chemicals in laboratories. The ones that are prescribed by doctors and bought in pharmacies or other legal retailers are tested to make sure that they are safe.



But now synthetic drugs are also being made in illegal or unregulated laboratories, mostly in foreign countries. The makers of these drugs create chemicals that act like other drugs, such as marijuana or prescription pain medications. The drugs are then sold on the street, online, or in gas stations or other stores, and are often marked with misleading labels.

While many drugs pose a risk for addiction and overdose if they are misused, these counterfeit synthetic drugs can carry additional risks. There is no way to know what chemicals the drugs contain or in what amounts. A product bought on the street or online may look the same as a familiar drug. It may even look identical to a pill a person would buy in a pharmacy. But the drugs can contain completely different chemicals and be much more powerful, and potentially deadly.

Read the sidebar below to learn more about the dangers of counterfeit synthetic drugs.

Bottom line: Never take any prescription drug that is not prescribed for you and is not bought in a pharmacy.

DANGEROUS EFFECTS OF SYNTHETIC DRUGS

OPIOIDS

Example: Fentanyl

Opioids are powerful drugs that doctors prescribe to relieve pain. They can be **extremely addictive** and even **deadly** if they are misused. **Fentanyl** is a synthetic opioid that is much stronger than other opioids. It is prescribed only to treat extreme pain in patients with cancer or following surgery.

Recently, there has been a rise in the illegal production of fentanyl. Illegally made fentanyl is often mixed with other drugs or hidden in fake prescription medications that are sold on the street. Users may not know they are taking it.

A surge in deadly overdoses related to opioids has been linked in part to products that contain hidden fentanyl. It is never safe to take prescription drugs that are not prescribed for you or that are bought anywhere other than at an official pharmacy because you don't know what chemicals they really contain.

CANNABINOIDS

Examples: Spice, K2

Often called "synthetic marijuana," these drugs are made of dried plant material that is sprayed with chemicals. These chemicals, called **synthetic cannabinoids**, are similar to THC, the main active ingredient in marijuana. But they are much more powerful than THC. The drugs can cause **paranoia and violent behavior** as well as serious health problems, including **seizures, heart attacks**, and **death**. Studies have also shown that the drug called Spice can be **addictive**.

130 people were treated over three days in New York City in 2016 for **overdosing on synthetic cannabinoids**. Health officials believe that the cause was a powerful batch of **K2**. Because the laboratories that make these products are not regulated, each batch can be very different, even if the packaging looks the same.

CATHINONES

Example: "Bath Salts"

Fake "bath salts" are different from the products used in your bathtub. These bath salts are synthetic drugs that contain chemicals called **cathinones**, which are designed to be similar to stimulant drugs such as amphetamine and MDMA (also known as Ecstasy or Molly). But these drugs can have more powerful effects. They can **increase heart rate and blood pressure** as well as **cause hallucinations and paranoia**.

Intense cravings have been reported by people who use bath salts. That's a sign that they have become **dependent on the drug**.

Makers of illegal synthetic drugs, including bath salts, sometimes try to avoid the law by labeling products as "Not for Human Consumption." Many states have passed laws to stop this practice.

TAKE ACTION

» If someone you know has a bad reaction to what you think is a synthetic drug, **call your local poison control center at 1-800-222-1222.**

» If they stop breathing, collapse, or have a seizure, **call 911 immediately.**

MORE INFO: For additional facts about drugs and health, visit **scholastic.com/headsup** and **teens.drugabuse.gov.**

From Scholastic and the scientists of the National Institute on Drug Abuse, National Institutes of Health, U.S. Department of Health and Human Services

FROGS FOR SALE

A group of scientists aims to put frog smugglers out of business

ESSENTIAL QUESTION: How can scientists fight the illegal trade in wildlife?

A few years ago, a passenger was making his way through the security check at the airport in San Jose, Costa Rica. He seemed like an ordinary tourist, except for one thing—his luggage was filled with food containers. When officials opened them, they found 184 frogs and 203 tadpoles. The stash was one of Costa Rica's biggest wildlife-smuggling cases ever.

Police believe the man planned to sell the animals, which had been taken illegally from the wild. Why would people want to buy stolen frogs? "They're beautiful," says Sebastián Valdivieso, head of the Wildlife Conservation Society branch in Ecuador. The striking exotic animals are highly prized as pets by collectors around the world.

Like Costa Rica, Ecuador is another country targeted by frog smugglers. The nation is home to 578 known frog species, about half of which are found only in Ecuador. To curb *wildlife trafficking*, scientists there have come up with a unique idea. They're breeding native frogs in a lab and selling them lawfully. They aim to outsmart smugglers

LIFE IN THE TREES: The splendid leaf frog lives in treetops, descending only to breed.

CAPTIVE TRAVELERS A smuggler transports frogs from Panama to Belgium in film canisters.

by reducing the demand for illegally traded frogs. That would allow more of the animals to remain in the wild—where they belong.

STRIPED BEAUTY: The phantasmal poison frog, seen here carrying tadpoles on its back, is native to Ecuador.

KEY SPECIES

The exotic frogs targeted by smugglers come mainly from tropical countries in Central and South America. These warm, wet regions have a greater diversity of frogs than anywhere else in the world.

Each frog species plays an important role in its native *ecosystem*. Frogs eat insects, spiders, and other bugs, and they're also prey for birds or other animals. Removing a frog species from the wild can affect the community of organisms in its environment, says Rudolf von May, a biologist at the University of Michigan Museum of Zoology.

Wildlife trafficking isn't the only danger to frog populations (*see Frogs at Risk, p. 22*). In recent years, a variety of threats have caused frog numbers around the world to plummet—leaving many species facing extinction (*see Threatened Species, right*). According to Ecuador's environment ministry, about 30 percent of the country's frog species are at risk of disappearing.

PRIZED AS PETS

Frogs come in all colors, shapes, and sizes: They can be electric blue or nearly transparent, poisonous or harmless, as big as your hand or tiny enough to perch on your fingertip. Some people are willing to pay as much as $600 for a particularly beautiful or rare frog.

Many countries don't allow people to export wild frogs, but smugglers disregard the laws. Sometimes they offer local people money to catch a certain species that is popular among pet owners in places like the U.S., Europe, or Japan. The smuggler pays just a few dollars for a frog that will later sell for a much higher amount. He or she then packs the frogs in containers—like the smuggler described earlier did. Then the trafficker puts the frogs in a suitcase and flies off to sell them—usually over the internet or at exotic pet shows.

MAKING FROGS: The company Wikiri's lab in Ecuador

But scientists at the Jambatu Center for Research and Conservation of Amphibians are trying to outwit smugglers. At their facility in Quito, Ecuador's capital, the center studies and maintains populations of local frog species that are at risk in the wild.

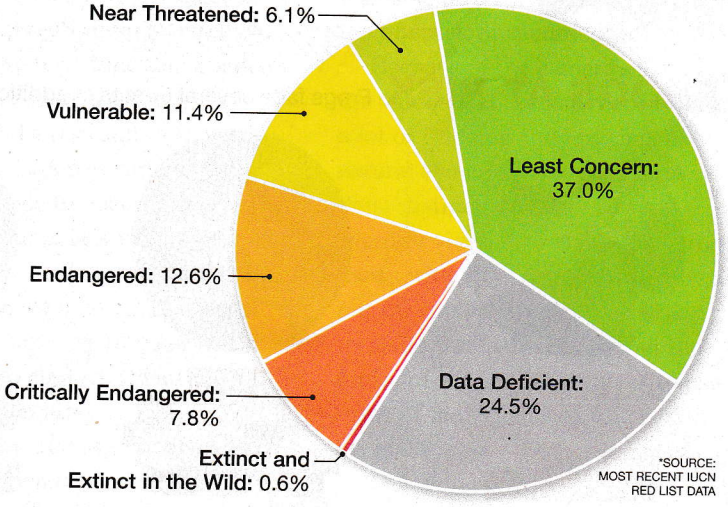
A few years ago, Jambatu founded a company called Wikiri that runs a *captive breeding* program. Wikiri raises rare, highly sought-after frogs in lab

Continued on the next page →

MOUNTAIN DWELLER: The Riobamba pouched frog, found in the Andes Mountains, is endangered.

THREATENED SPECIES

This graph shows the status of all known species of *amphibians*, including frogs, as of 2008*. These cold-blooded animals usually live in water when young and on land as adults. What percentage of these species are endangered or critically endangered?



*SOURCE: MOST RECENT IUCN RED LIST DATA

CORE QUESTION

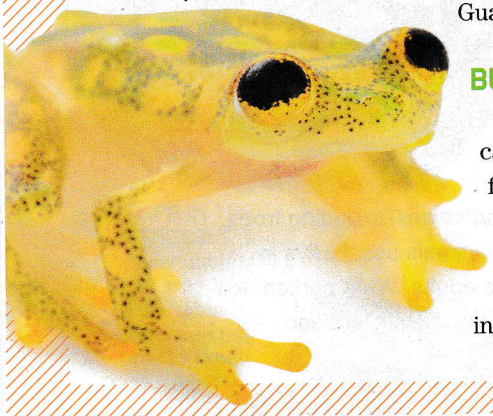
Do you think Wikiri's program will work to reduce the trafficking of wild frogs? Use evidence from the text to explain why or why not.

HELPING HAND? The Wikiri lab raises frogs for legal sale.

BREEDING GROUNDS: The company breeds frogs at sites like this one.

terrariums and outdoor gardens, as well as on a nearby farm and nature reserve. The frogs are then sold and shipped legally to people all over the world. Wikiri currently breeds and sells 16 frog species. Its scientists believe the business will make selling frogs on the black market less profitable, thwarting would-be wildlife traffickers. The money made by Wikiri also helps pay for Jambatu's conservation work.

Raising frogs in captivity requires time, patience, and expertise. Wikiri scientists spend about two years experimenting to figure out the best way to breed a species, says Lola Guarderas of Wikiri.



SEE-THROUGH: The Sun's glass frog has skin that is transparent in some places.

BUYER BEWARE

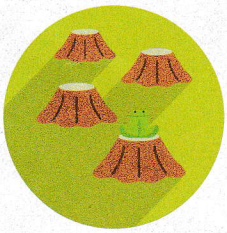
Not everyone agrees that captive breeding will reduce trafficking, though. The demand for exotic frogs could be so great that those produced by captive breeding might not put a dent in the market. Guarderas admits that's a risk. But she says groups like Wikiri help in other ways. Their presence educates frog collectors about the importance of buying animals legally versus removing them from the wild. "I can't say we're winning the battle against smuggling yet," she says. "But that's what we're fighting for."

Another potential challenge of this approach is that buyers may not be able to tell if a frog is captive-bred or taken from the wild. Experts suggest asking questions: Where was the frog bred? Does that country allow frogs to be exported? The seller should have permits showing that the frogs were bred in captivity and imported legally. Paperwork can be falsified, however, so even that is no guarantee.

Buyers should also remember that keeping rare frogs in captivity isn't the same as maintaining a healthy population in their natural habitat, says Valdivieso of the Wildlife Conservation Society in Ecuador. "If we want to take care of frogs, let's try to keep them in their own homes, not in ours." *—Barbara Fraser*

FROGS AT RISK

Frogs face several threats in addition to wildlife trafficking.



HABITAT LOSS

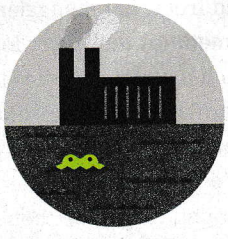
Cutting down forests for farming or ranching destroys the ecosystems where frogs live.

DISEASE

Chytridiomycosis, a deadly fungal disease, is spreading among frogs worldwide.

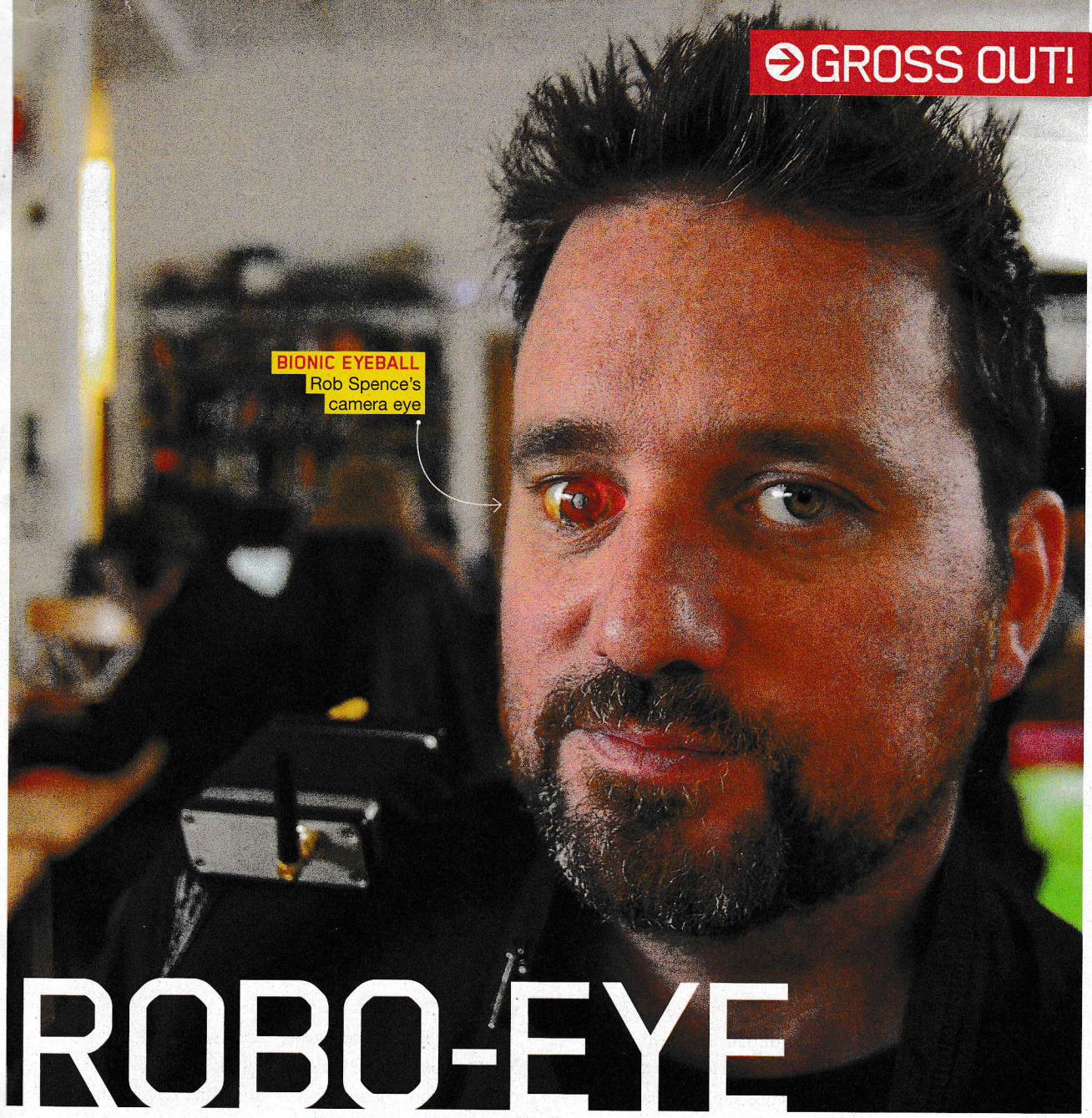
CLIMATE CHANGE

If frogs can't adapt fast enough to changes in temperature or rainfall, they may not survive.



POLLUTION

Frogs are vulnerable to pesticides and other chemicals that can pollute water.



ROBO-EYE

Meet a man who is part human and part machine. Canadian filmmaker Rob Spence lost sight in his right eye after injuring it when he was 9 years old. In 2007, doctors told him they needed to remove the damaged eye. Instead of opting for a typical glass replica eye as a replacement, Spence worked with engineers to build a *prosthetic* eye that is also a working camera.

Spence says the inspiration for his unusual eye came from comic book characters with *bionic* body parts. These electronic or mechanical devices replace body parts and can improve their function. Spence's bionic eye contains a battery, a camera, and a transmitter to send video signals. A magnetic switch allows Spence to turn the camera on and off by tapping it with a magnet.

Spence's camera isn't connected to his brain via a nerve, like a real eye, so he can't use it to see. But he is able to capture videos of the world around him.

The eye wirelessly transmits the footage, which can be watched in real time on a screen, streamed over the internet, or recorded.

Because of the camera's location, the videos that Spence records have a lot of glancing and blinking, like natural eye movements. To remove these distractions, Spence edits together video recorded by his prosthesis with other footage taken by a regular camera. He's now working on a short documentary about the future of vision, and he plans to use some of the videos he's taken with his bionic eye.

—Katie Free

EXPLAIN THIS!

Visit **scholastic.com/scienceworld** to see if your explanation is accurate.

DIRECTIONS: Follow these steps to form an explanation for what's going on in this photo.

1 INQUIRE

Closely examine the photo above. What do you notice about the image? What stands out to you? What ideas do you have that might explain what's going on in the photo?

2 EXPLAIN

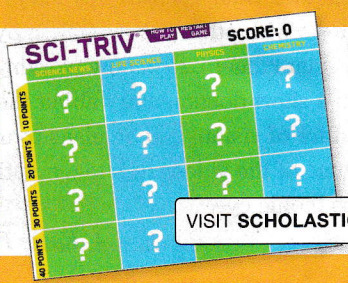
What do you already know that could help explain what you see? What evidence in the photo can you use to support your explanation? Write down ideas or draw sketches to express your thinking.

3 DISCUSS

Compare your explanation with those of your classmates. How are your ideas similar to or different from those of other students? Use information from the discussion to refine your explanation.

4 TAKE IT FURTHER

Do you think your explanation is plausible for what you're seeing in the photo? What questions do you still have? Write them down and then do research to answer them.



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