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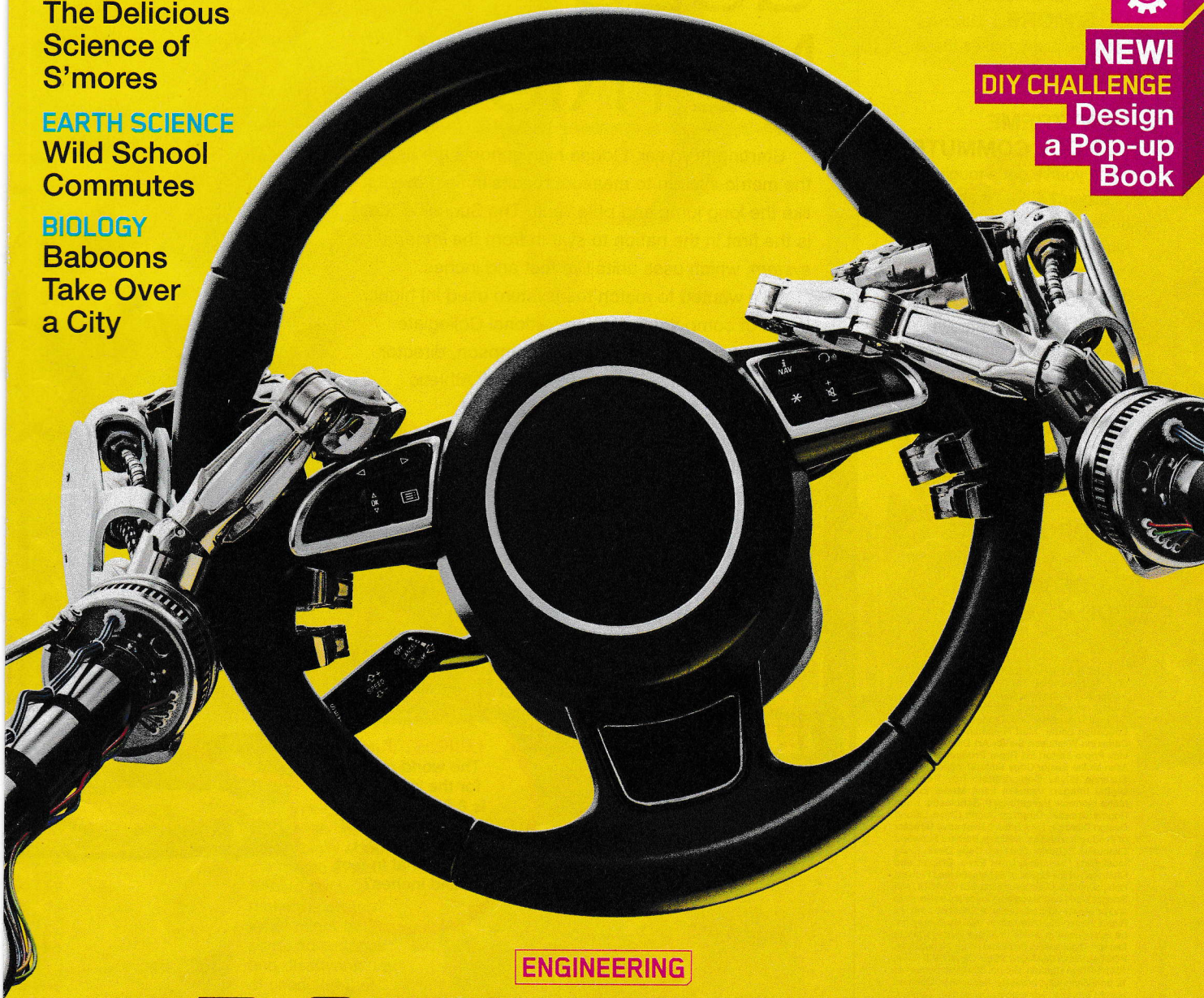
INSIDE

NEW!
DIY CHALLENGE
Design a Pop-up Book



ENGINEERING

ROBO-CARS

Could self-driving vehicles make driver's ed a thing of the past?

SCHOLASTIC
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SCIENCE WORLD SEPTEMBER 4, 2017
VOL. 74, NO. 1 **Editorial Director:** Patricia Janes **Senior Editor:** Jennifer Barone **Associate Editor:** Jacob Batchelor **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.

COVER: ISTOCKPHOTO/GETTY IMAGES

SCIENCE NEWS

PHYSICS: MEASUREMENT

FLORIDA GOES METRIC

Starting this year, Florida high schools are using the metric system to measure results in field events, like the long jump and pole vault. The Sunshine State is the first in the nation to switch from the *imperial system*, which uses units like feet and inches.

"We wanted to match the [system used in] higher levels of competition like the National Collegiate Athletic Association," says Ed Thompson, director of athletics for the Florida High School Athletic Association. "And we wanted to improve precision—centimeters are more precise than inches." Most scientists rely on the metric system as well, and precision is one reason why.

Officials will measure event results using metric units and convert them to inches and feet for spectators who are unfamiliar with metric distances.

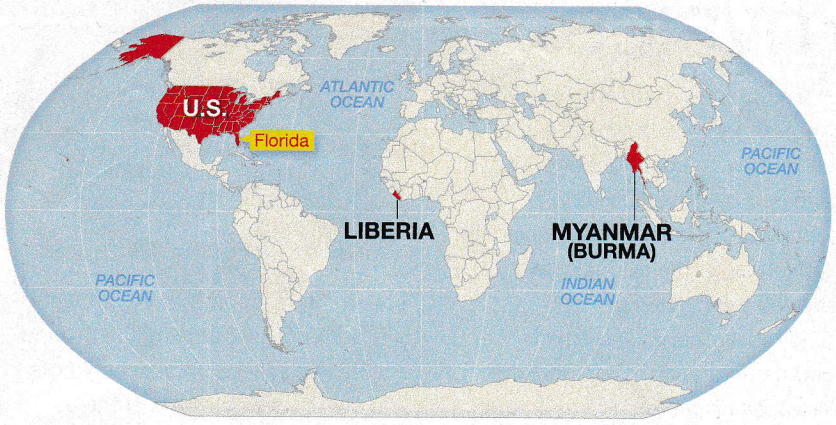
—*Jeanette Ferrara*

LONGEST JUMP: The world record for the long jump is 8.95 meters, set by Mike Powell of the U.S. in 1991. What is that in feet and inches?

GOING ALL OUT Florida student Katie Barnett competes in the long jump at the 2016 high-school state finals.

METRIC HOLDOUTS

Only three countries worldwide have not yet officially adopted the metric system. Should the U.S. make the switch? What might be some advantages and disadvantages of changing the official measurement system?



BOB THOMAS SPORTS PHOTOGRAPHY/GETTY IMAGES (POWELL); ZACK KITTMAN/ST. PETERSBURG TIMES VIA ZUMA WIRE (BARNETT); JIM MCMAHON MAPMAN ® (MAP)

KOMODO DRAGON: This large reptile is native to Indonesia.

BIOLOGY: HEALTH AND DISEASE

Healing Dragon Blood

Scientists are looking to an unusual source for new medicines: Komodo dragons. Doctors use *antibiotics* to wipe out bacteria that make people ill. But some strains of bacteria have become *resistant* to these medicines, so they're no longer effective. The dragons' blood could hold the key to creating new bacteria-fighting medications.

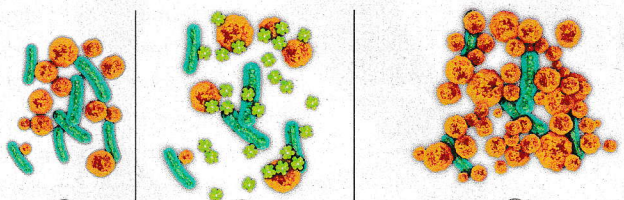
In the wild, Komodo dragons are exposed to dangerous bacteria. To learn how they survive, researchers isolated molecules called *peptides* from the dragons' blood. The scientists re-created the peptides in a lab and tested them on bacteria that are resistant to many antibiotics.

The lab-made peptides were a success. "One attacks the harmful bacteria and also helps heal wounds," says Barney Bishop, a biochemist at George Mason University in Virginia who helped lead the project. He hopes dragon peptides can be used to develop new treatments to fight antibiotic-resistant superbugs. —*Jeanette Ferrara*

ANTIBIOTIC RESISTANCE

Some bacteria have adapted to the widespread use of antibiotics. Many medicines are no longer effective against them.

KEY
= good bacteria
= bad bacteria
= antibiotics



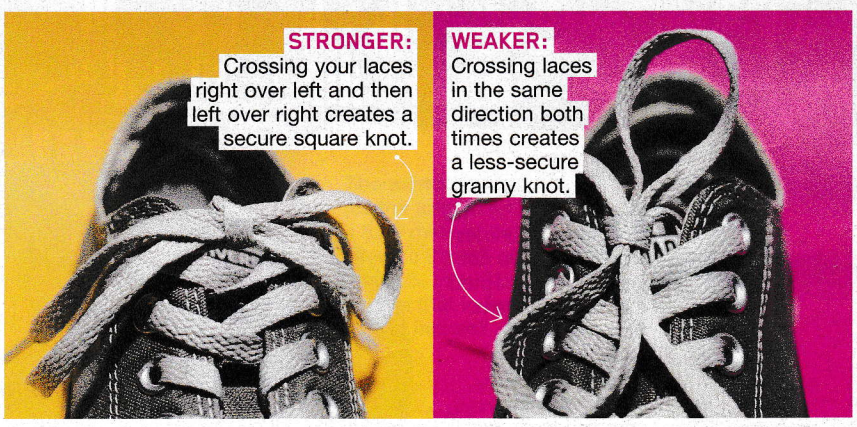
1. Our bodies contain both good and bad bacteria.
2. People take antibiotics to kill bad bacteria, but the medicines also kill good bacteria.
3. Some bad bacteria have developed resistance and survive treatment. Without good bacteria, bad bacteria have room to multiply and spread.

PHYSICS: FORCES AND MOTION

Shoelace Physics

It's a common problem: You tie your shoelaces, but before you know it, they've come undone. Why? A team led by Oliver O'Reilly, a mechanical engineer at the University of California, Berkeley, may have unraveled the mystery.

The researchers used a high-speed camera and motion sensors called *accelerometers* to study how people's movements cause laces to loosen. They found that the impact of a person's feet striking the ground gradually weakens shoelaces' knots. And swinging of the legs creates forces that tug at the laces' ends.



A stronger knot can help laces stay in place longer, says O'Reilly, but "the combination of forces means that most knots will eventually come undone." —*Hailee Romain*

CHEMISTRY: CHEMICAL REACTIONS

GLOWING MUSHROOMS

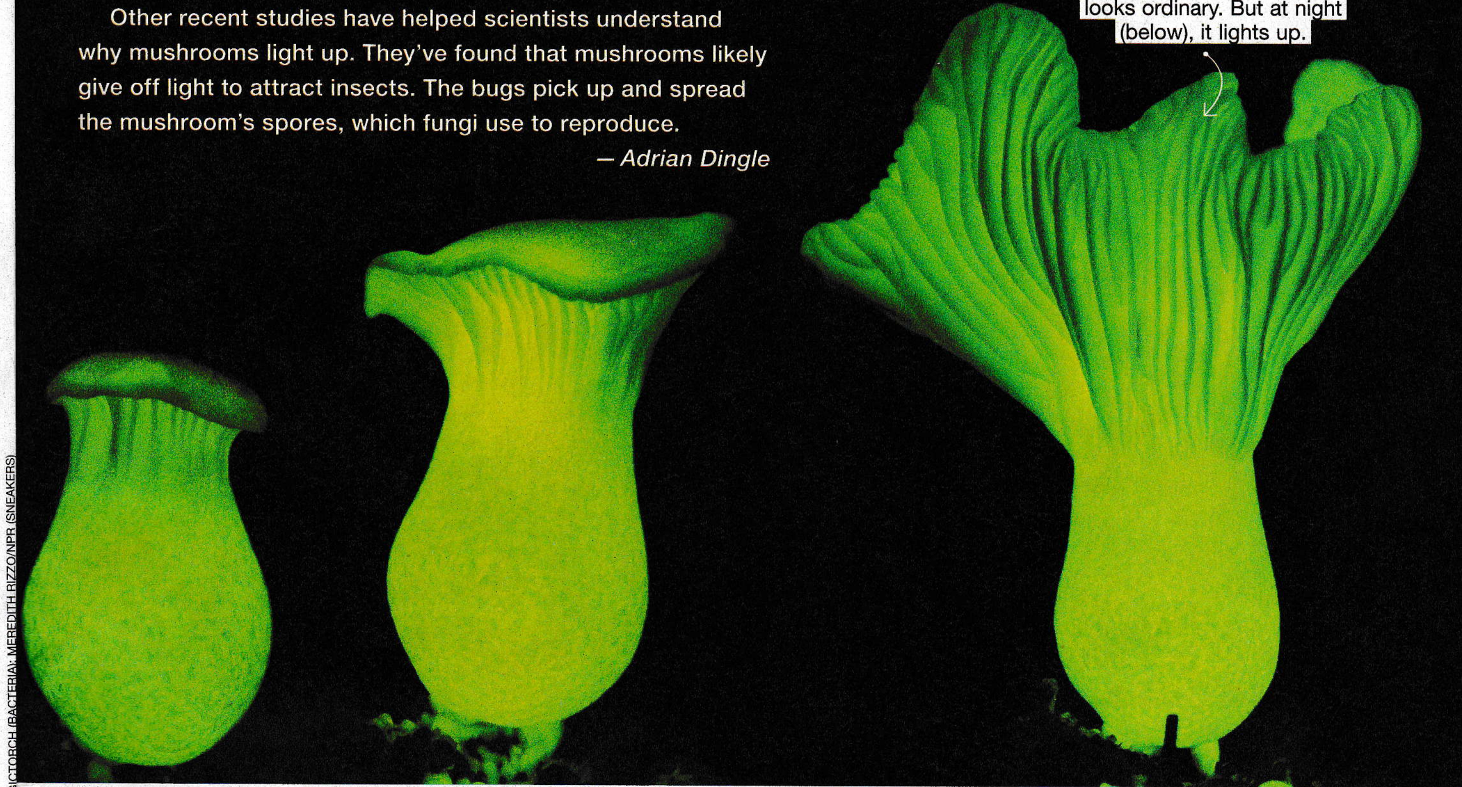
On dark nights in forests around the world, it's possible to spot mushrooms giving off an eerie green light. Recently, a team of scientists from Russia, Brazil, and Japan figured out how these mushrooms glow. They use chemical reactions similar to those that light up *bioluminescent* animals, like fireflies and squid.

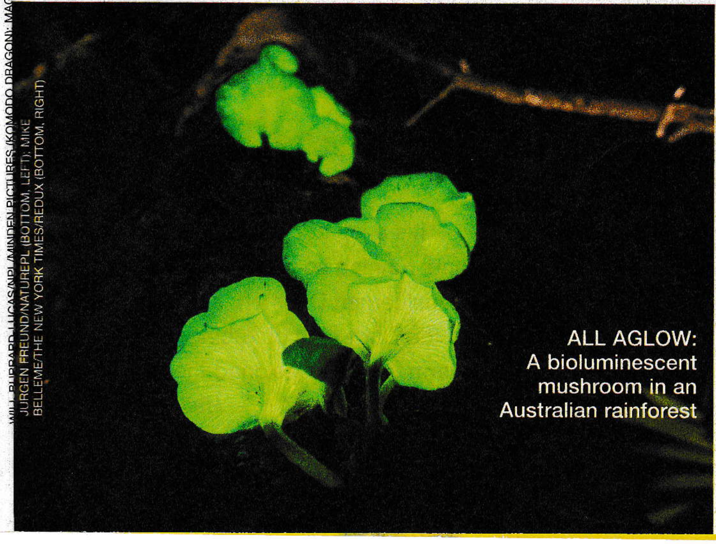
"Many creatures on Earth emit light," says Cassius Stevani, a biochemist at the University of São Paulo in Brazil. Most bioluminescent organisms, including mushrooms, create light by producing a chemical called luciferin that reacts with oxygen (O). The two bond together with the help of a chemical called luciferase. It acts as a *catalyst* to speed up the reaction.

Other recent studies have helped scientists understand why mushrooms light up. They've found that mushrooms likely give off light to attract insects. The bugs pick up and spread the mushroom's spores, which fungi use to reproduce.

— Adrian Dingle

GLOWING FUNGUS In daylight (above), this Brazilian mushroom species looks ordinary. But at night (below), it lights up.

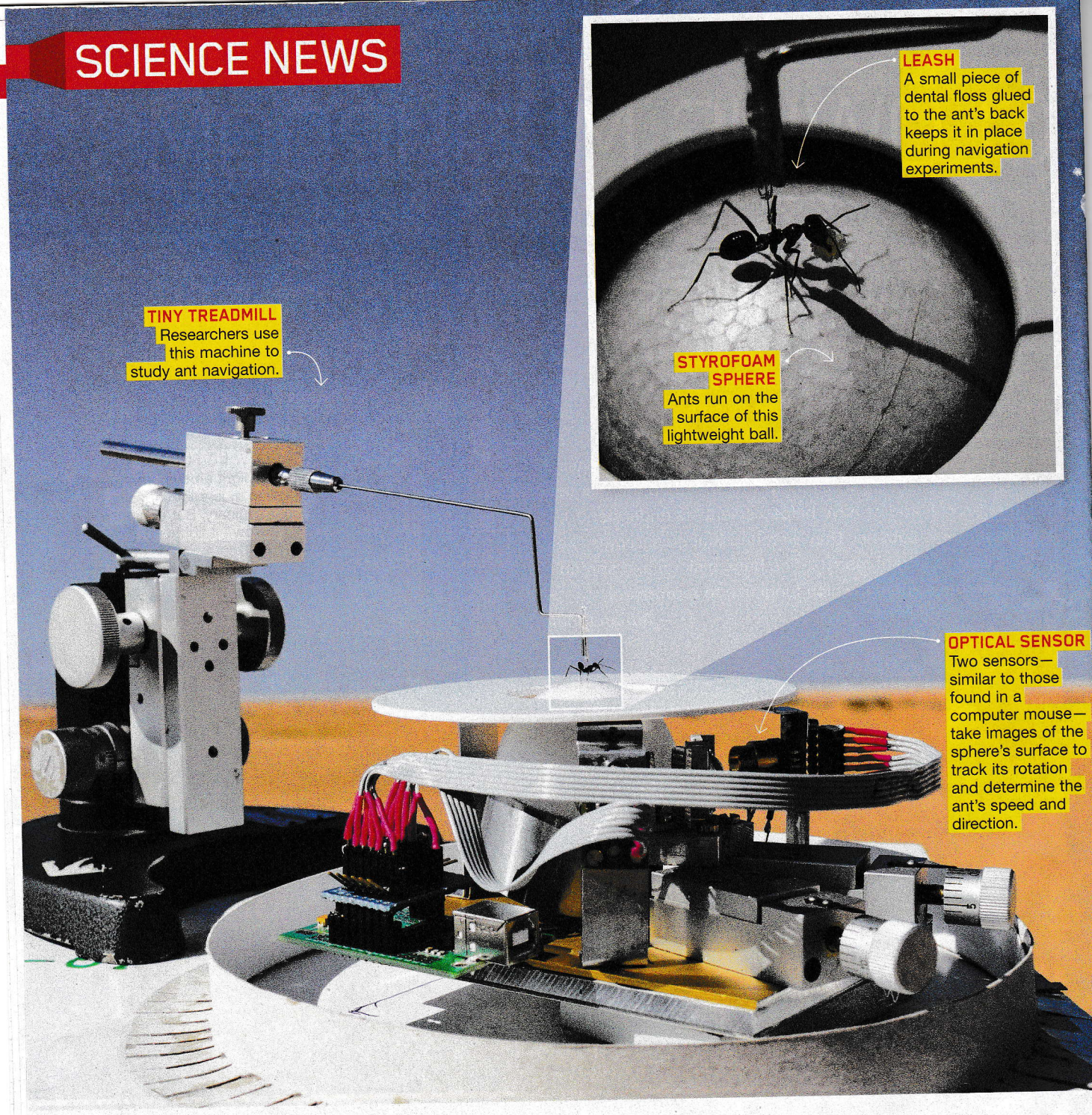




ALL AGLOW: A bioluminescent mushroom in an Australian rainforest

LIGHT SOURCE: A glowing mushroom in North Carolina

WILL BURRARD-LUCAS/NPL/MINDEN PICTURES (KOMODO DRAGON); MAGICTORCH (BACTERIA); MEREDITH RIZZO/NPR (SNEAKERS) JURGEN FREUND/NATUREPL (BOTTOM, LEFT); MIKE BELLEME/THE NEW YORK TIMES/REDUX (BOTTOM, RIGHT)



ENGINEERING: MACHINES

ANT TREADMILL

To study how ants get around, scientists have built the insects a pint-size treadmill. The treadmill is made up of a Styrofoam ball cushioned by a jet of air so it can roll freely as an ant walks on its surface. Sensors track the ball's rotation to measure the ant's speed and direction. It's the first device sensitive enough to track the tiny insects' movement and allow the animals to move just as they would in the wild.

"It's a joy to observe the ants running so naturally," says Hansjüergen Dahmen, a physicist at the University of Tübingen in Germany who designed the treadmill.

— Hailee Romain

SUN SEEKER: The smartflower tilts toward the sun.

EARTH SCIENCE: NATURAL RESOURCES

Sun Flower

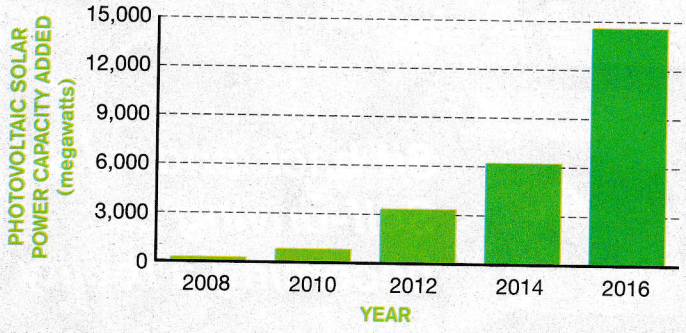
A new flower-shaped solar panel follows the sun as it moves across the sky—just like a real plant. The smartflower, created by a company of the same name based in Austria, has petal-shaped panels that open at sunrise and close at night. The panels tilt throughout the day to get maximum exposure to sunlight, which the smartflower converts into electricity.

The smartflower's manufacturers say that its sun-tracking abilities allow it to generate up to 40 percent more energy than traditional stationary solar panels. They estimate that even in cloudy places, it can produce a significant portion of the energy needs for a household.

—Adrian Dingle

SOLAR BLOOM

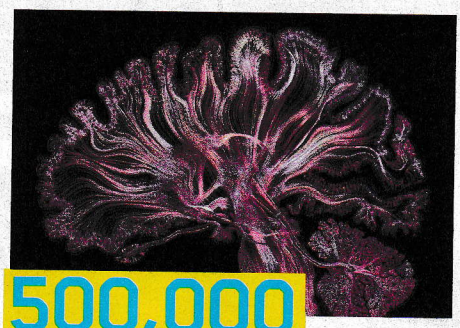
The graph below shows the amount of solar-power capacity installed in the U.S. each year since 2008. What factors might contribute to the growing popularity of solar power?



SOURCES: STATISTA, SOLAR ENERGY INDUSTRIES ASSOCIATION

NUMBERS IN THE NEWS

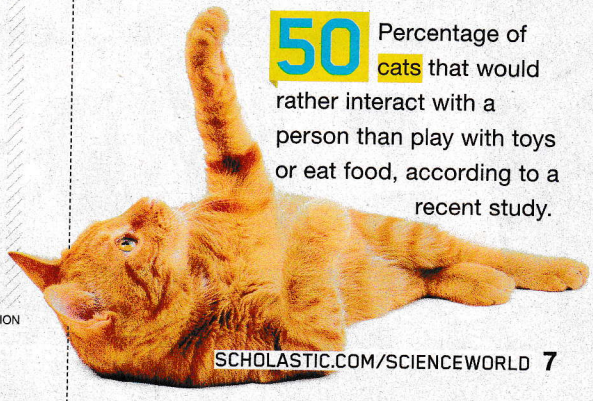
13.2 billion Age of the oldest dust in the universe ever observed. It was recently spotted in a distant galaxy.



500,000 Number of nerve cells depicted in the most detailed illustration ever made of the human brain.

1,000 Number of carved figurines discovered in an ancient tomb recently excavated along the Nile River in Egypt.

210 Speed in miles per hour reached by a battery-powered aircraft created by the German company Siemens. It set a new world record.



50 Percentage of cats that would rather interact with a person than play with toys or eat food, according to a recent study.

HANDS-FREE RIDE

Sit back and relax: Self-driving cars are becoming a reality

ESSENTIAL QUESTION: How do technological innovations change the way we live our daily lives?

Last year, Uber customers became some of the first people to try a technology straight out of science fiction: cars that drive themselves, no humans required. Until recently, the app-based transportation service always sent human drivers to pick up customers. Now it has begun testing *autonomous* vehicles in Tempe, Arizona, and Pittsburgh, Pennsylvania. The cars rely on computers and sensors to navigate their surroundings. Uber plans to eventually transition to vehicles that are completely self-driving.

"People have fantasized about self-driving cars for a long time," says Jimmy O'Dea, a vehicle technology analyst at the Union of Concerned Scientists. "Now these vehicles are actually being tested on public roads and carrying passengers."

There's fierce competition among leading automakers and technology companies to develop autonomous vehicles. Waymo, a self-driving car service started by Google's parent company, Alphabet, has even accused Uber of stealing trade secrets to gain the upper hand. "Every major auto company is thinking seriously about this," says O'Dea. A computer at the wheel could eliminate human error and make driving safer. But there's a long road ahead before driverless cars become the norm.

HIGH-TECH RIDE

Some vehicles are now equipped with sensors and extra computing power that give them the ability to operate without any input from a driver. They rely on GPS to navigate to a destination.

Radar helps a self-driving car sense its surroundings. A radar system sends out *radio signals*, which are an invisible form of light, and detects them when they bounce back off of surrounding objects. A computer on board the vehicle calculates how far away each object is. This technology provides accurate measurements of distance, so it's especially useful in situations where objects are close to the car, like in bumper-to-bumper traffic.

Cameras help by providing images of the car's surroundings. The computer uses them to identify other vehicles, pedestrians, bicyclists, traffic lights, and signs.

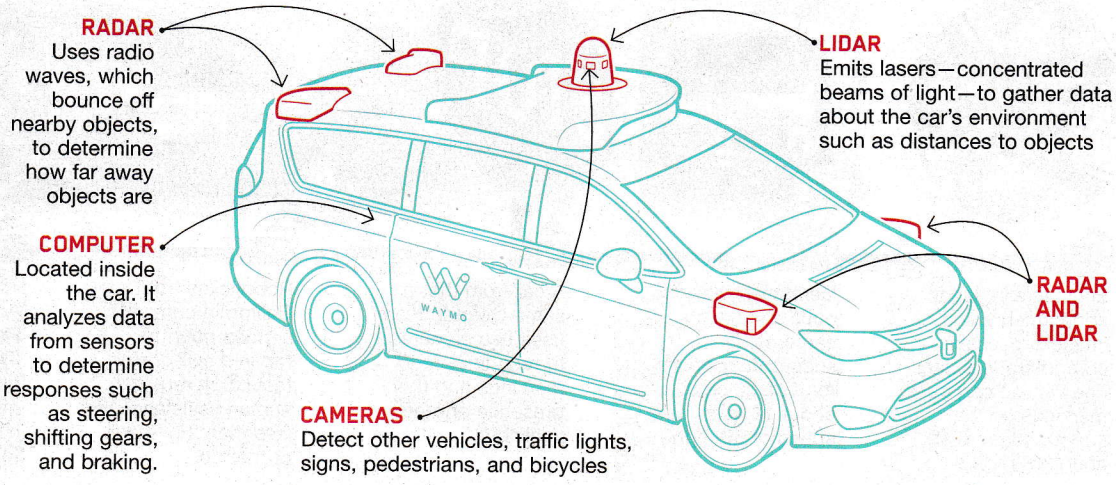
Many self-driving cars also carry a spinning *lidar* unit on top. Lidar works like radar, but instead of radio waves, it emits a laser beam, often consisting of invisible *infrared* light. Lidar combines various advantages of radar and

Continued on the next page →

TEST-DRIVE: A Waymo self-driving van in Phoenix, Arizona

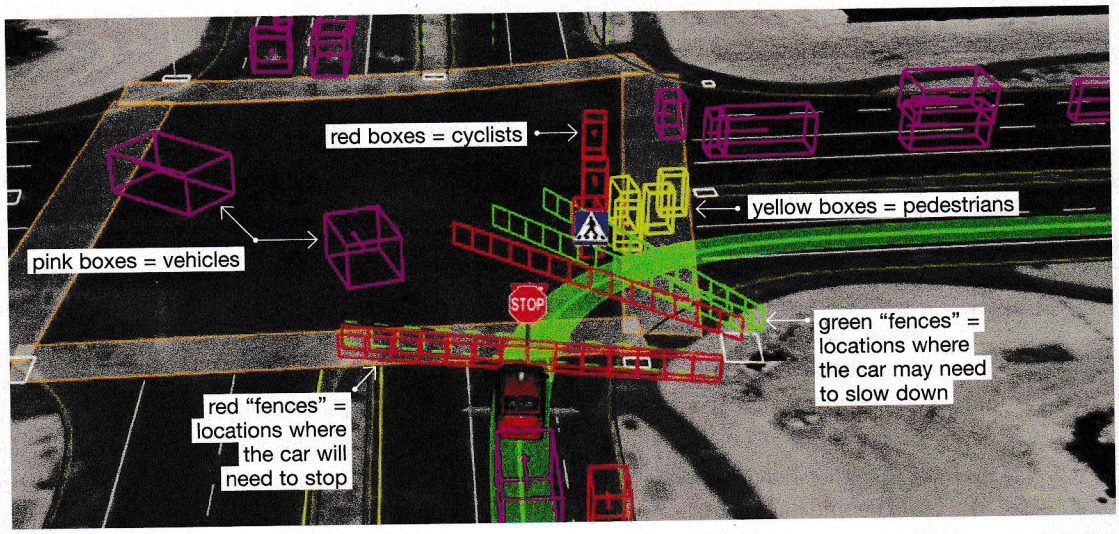
HOW CARS DRIVE THEMSELVES

These components allow self-driving vehicles like the Waymo van (*right*) to operate.



WHAT THE CAR SEES

Software combines data from cameras and sensors to build a picture of the environment.



cameras: It provides distance measurements and also reveals the shape of objects.

Software in the vehicle's computer uses these inputs to identify objects based on their appearance and speed. Engineers have programmed the software to make decisions about how to proceed based on the inputs the car receives. Computer code tells the vehicle to obey traffic laws such as stopping at red lights and yielding appropriately. But it allows the car to ignore traffic laws when safety is at stake. For example, if highway traffic is going faster than the speed limit, a self-driving car might keep up with surrounding vehicles rather than slowing down and potentially causing an accident.

The computer also sends commands to robotic moving parts called *actuators*. These components control acceleration, braking, and steering (*see How Cars Drive Themselves, p. 9*).

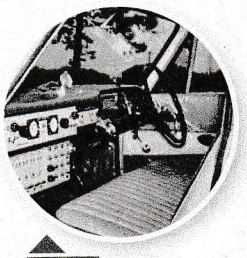
GETTING READY TO ROLL

One of the biggest roadblocks to getting driverless cars up and running is ensuring that the technology is safe for the streets. During Uber's testing phase for its self-driving cars, an engineer from the company rides along in the driver's seat. He or she can take control of the car if needed. The same goes for Waymo. It recently launched the first public tests of its autonomous vans—with an employee in the driver's seat—in Phoenix, Arizona.

The carmaker Tesla, while not yet programming its electric cars to be fully autonomous, has "Autopilot" capabilities on all its vehicles. The software can steer, change lanes, speed up and slow down, apply the brakes, and park on its own. However, the company advises drivers to keep their hands on the wheel and monitor the vehicle's operation.

TSUKUBA (1977): TENTIMOOK (1987); SHUTTERSTOCK.COM (STOP SIGN); CARNEGIE

MILESTONES IN AUTONOMOUS CARS



1977

Engineers in Japan add cameras and image-processing computers to a car. The vehicle can track markings on the street and drive at about 18 mph.

1987

German engineers outfit a van with cameras. It successfully drives for a distance of about 12 miles at a speed of 55 mph.

1994

A car from the same German team uses two cameras to recognize road markings and the presence of other vehicles.

1995

Roboticists from California complete a cross-country trip in a self-driving test car. It requires human assistance for less than 2 percent of the trip.

2004-2007

The Defense Advanced Research Projects Agency (DARPA), which develops U.S. military technology, hosts competitions for autonomous cars.

Since driverless technology is so new, many states don't have rules about it. Currently, only 13 states have enacted laws or regulations relating to whether and how autonomous vehicles can operate.

A SAFER DRIVE?

Self-driving cars still have a long way to go to prove their reliability. Some have run red lights or been in minor collisions, most of which were the fault of other drivers.

But many experts hope that once driverless technology is fully developed, it could make roads safer than ever. Of all the potential benefits of self-driving cars, "the big one is safety," says O'Dea. Computer-driven cars don't get sleepy, drunk, angry, or distracted.

Talking or texting, checking navigation systems, or adjusting music while driving can lead to deadly crashes. More than 30,000 people die in auto accidents in the U.S. every year, according to the National Highway Traffic Safety Administration. Millions more are injured or disabled. Human error contributes to more than 90 percent of crashes.

Some experts suggest that human drivers might someday be banned from public roads for safety reasons, just as horse-drawn carriages are no longer allowed on most expressways.

WARNING: CHANGES AHEAD

Self-driving vehicles could have other effects on our lives. "We're looking at changing one of the most fundamental daily experiences that many people have," says Bryan Reimer, an engineer at the Massachusetts Institute of Technology who studies driver behavior.

CRASH! A human driver in another car caused this collision with a self-driving Uber SUV in Arizona in March.

If cars can drive themselves, cities and towns may not need as many parking lots. Many people might get around with shared vehicles that never have to park. The cars could just move on to the next customer after a drop-off.

People's jobs could change too. "There are a lot of people employed today as drivers," O'Dea points out. Self-driving vehicles could reduce demand for those jobs. But "the field will create new jobs in software and robotics, so there will be opportunities opening up," he says.

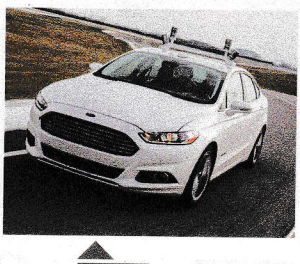
Reimer and O'Dea both believe that for the next several years, most people will still drive the old-fashioned way—so those turning 16 soon shouldn't skip out on licenses. But many will get to ride in self-driving vehicles in the not-too-distant future. "Autonomous vehicles could change so much about how people get around, where they live, and what cities and towns look like," says O'Dea.

—Jennifer Barone

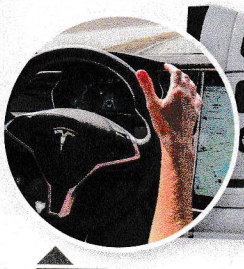
CORE QUESTION

Do you think the benefits of self-driving cars support their use over traditional vehicles? Cite evidence from the text to support your answer.

2008 Engineers in San Francisco modify a Toyota Prius to drive itself across the Bay Bridge to pick up a pizza and then return.



2013 Major automakers, including Ford, Toyota, and Volvo, test autonomous technology.



2015 A software update to Tesla vehicles delivers the first Autopilot features.

2016 A self-driving truck makes the first autonomous cargo delivery in Colorado. Uber begins testing self-driving vehicles with its customers in Pittsburgh.

2017 Waymo begins testing autonomous cars in Phoenix. Cadillac begins selling models with a self-driving feature called SuperCruise.

(CAR): DAVID PAUL MORRIS/BLOOMBERG VIA GETTY IMAGES (STEERING WHEEL): TONY AVELAR/AP PHOTO (TRUCK): WAYMO (WAYMO)

THE SCIENCE OF S'MORES

Discover how chemistry makes these tasty treats possible

ESSENTIAL QUESTION: How does chemistry influence how we cook and consume food?

Did you know that August 10 was National S'mores Day? Don't worry if you missed it; it's not exactly a well-known holiday. To help you celebrate (slightly belatedly), *Science World* investigates what it takes to transform chocolate, graham crackers, and marshmallows into the sweet goodness of s'mores.

NICE 'N' TOASTY

The first step to making a s'more is to make a fire (*see On Fire, bottom right*). "Combustion is a *chemical reaction*," says Sally Mitchell, a teacher in Syracuse, New York, and an expert for the American Chemical Society. During a chemical reaction, new substances are formed. Next, toast the marshmallow.

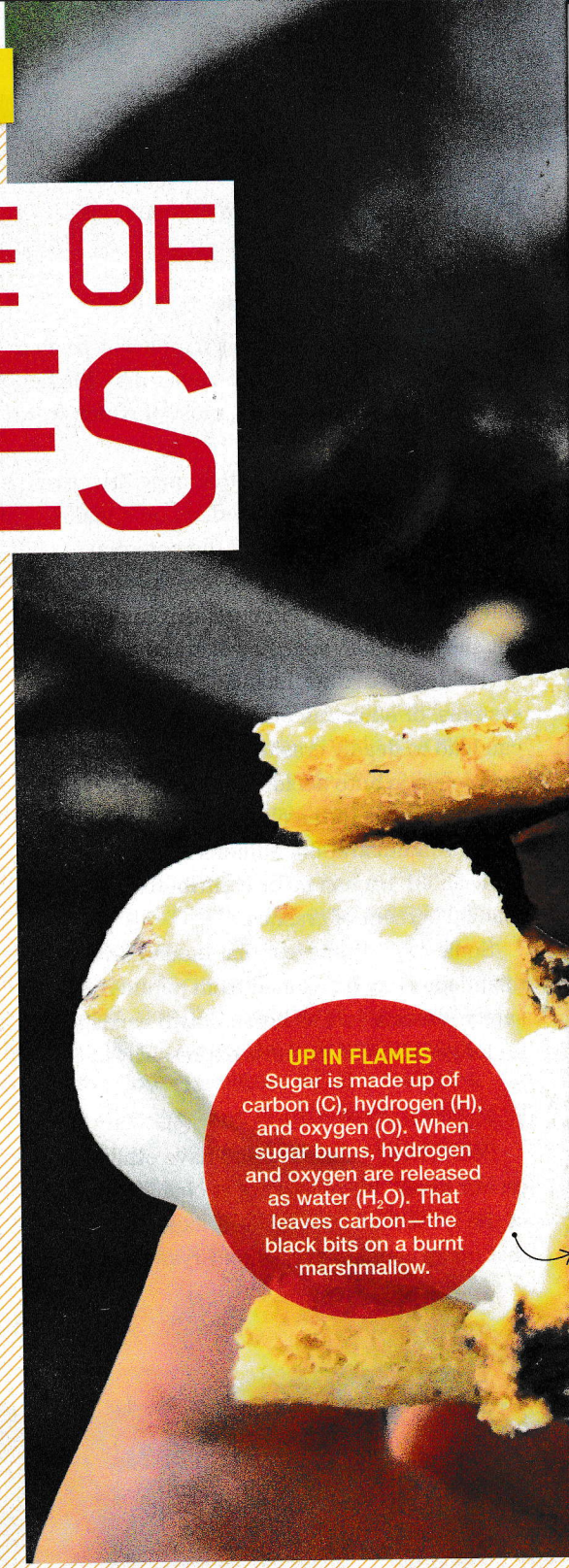
A marshmallow is mostly sugar whipped with air to make it fluffy. The treat also contains a stretchy molecule called *gelatin* that gives a marshmallow its structure. Gelatin is made up of *proteins*. These large molecules are essential to all living things. Heat from a campfire causes the sugar and proteins in a marshmallow to chemically react and form new substances—the brown crust you see on the outside of a toasted marshmallow.

STICKING TOGETHER

Once toasted, the marshmallow and a square of chocolate are sandwiched between two graham crackers. The hot marshmallow melts the chocolate. "It changes phases from a solid to a liquid," says Mitchell. "This is a *physical change* because the chocolate's components remain the same."

The sticky chocolate and marshmallow hold a s'more together. The graham crackers play an important role too—they keep your fingers from getting too messy as you munch the sweet treat.

—Cody Crane



UP IN FLAMES
Sugar is made up of carbon (C), hydrogen (H), and oxygen (O). When sugar burns, hydrogen and oxygen are released as water (H_2O). That leaves carbon—the black bits on a burnt marshmallow.

ON FIRE
Wood contains *hydrocarbons*—molecules of hydrogen (H) and carbon (C). Heat causes the hydrocarbons to break apart. Hydrogen and carbon mix with oxygen (O) in the air to form carbon dioxide gas and water in the form of steam. The reaction also releases energy as heat and light.

MAKING A S'MORE

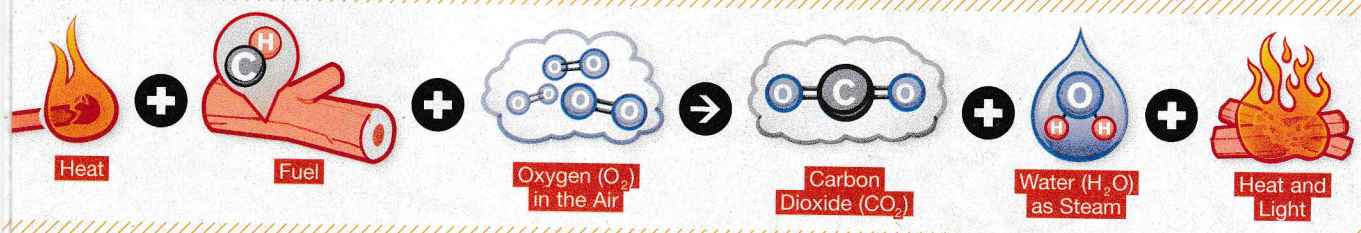
1. A graham cracker's perforations make it easy to break in half to become the top and bottom of a s'more.
2. Toasting a marshmallow over a flame causes a chemical reaction between the sugar and gelatin in the marshmallow, turning its outside brown and crispy. A marshmallow's *melting point*—the temperature at which a solid becomes a liquid—is about 45°C (113°F). So as its outside crisps, its insides become gooey.
3. A chocolate bar's indentations allow it to be broken into pieces that fit perfectly on a graham cracker half. A hot marshmallow melts the chocolate, which has a melting point of about 33°C (91°F). That physical change secures the snack together.

SCOUT SNACK
The original idea for s'mores appeared in a publication for the Girl Scouts in 1927.

TEMPTING TREAT
The word *s'more* is thought to be a contraction of "some more," because the treats are so irresistible.

MAKE IT!

It's possible to use the heat from the sun to make a s'more. Brainstorm ways you could build your own solar oven. Then cook up one of these delicious desserts—no fire needed.

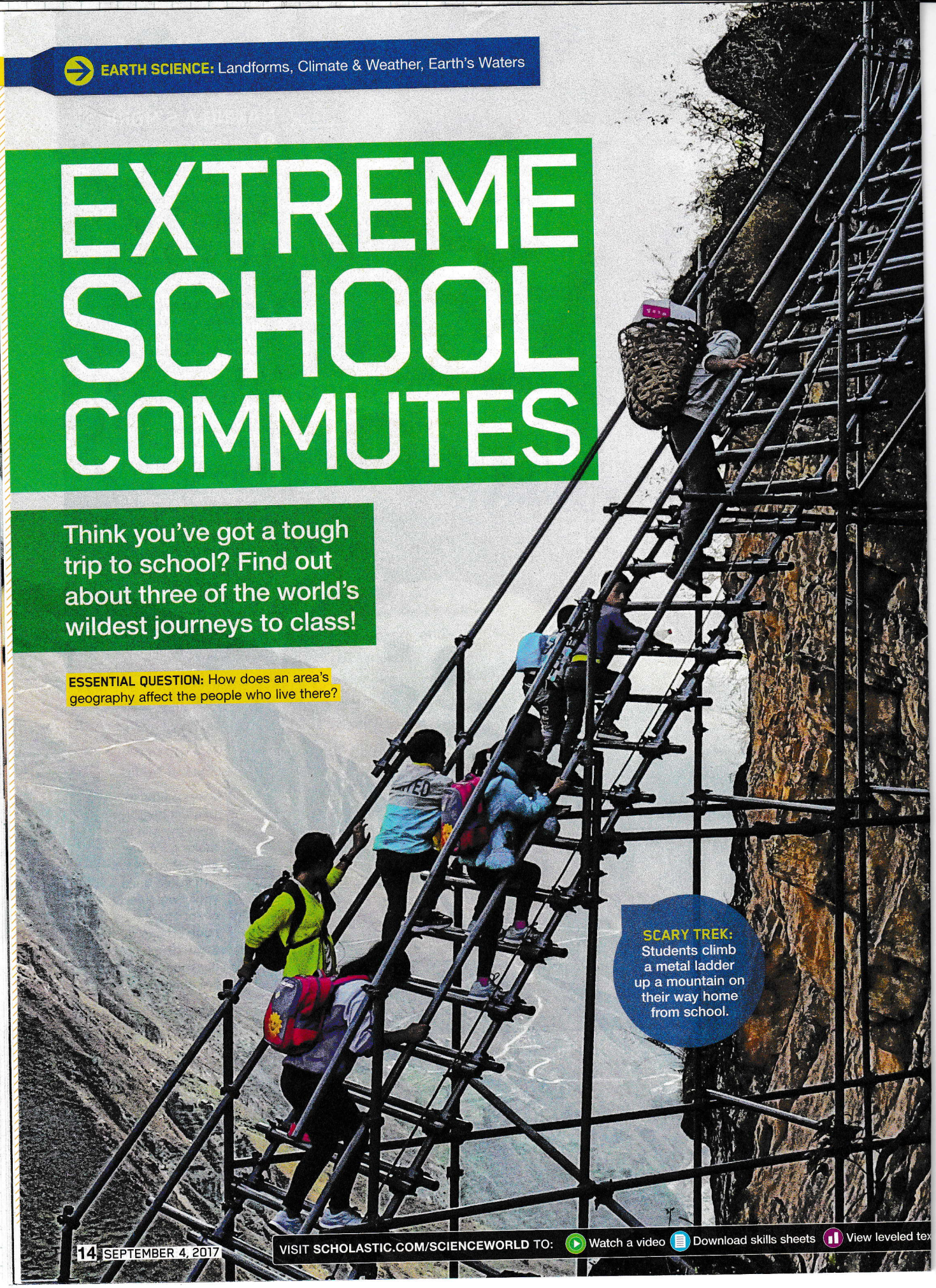


KIRA KREUTZBENDER/EYEEM/GETTY IMAGES (S'MORE); SHUTTERSTOCK.COM (GEARS); DAMEN SCOGIN (ICONS)

EXTREME SCHOOL COMMUTES

Think you've got a tough trip to school? Find out about three of the world's wildest journeys to class!

ESSENTIAL QUESTION: How does an area's geography affect the people who live there?



SCARY TREK: Students climb a metal ladder up a mountain on their way home from school.

ARE WE THERE YET? It takes about 90 minutes to climb down to school and two hours to climb home.

1 CLIFF CLIMBERS ATULE'ER, CHINA

If you have a fear of heights, then you wouldn't want to live in the small village of Atule'er in southern China. Students there make a dangerous trek down ladders from their homes at the top of a 763 meter (2,500 foot)-tall mountain to their school in the river valley below.

Atule'er is in the Himalayan mountains, which formed as two *tectonic plates* collided, says Peter Modreski, a geologist at the U.S. Geological Survey in Denver, Colorado. These slowly moving slabs of rock make up Earth's *crust*, or surface. About 50 million years ago, the Indian and Eurasian plates, which make up most of Europe and Asia, struck one another to form the Himalayas (*see Building Mountains, below*).

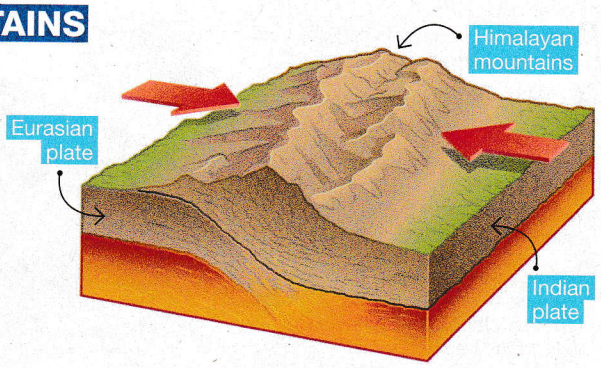
About 15 students, ages 6 to 15, spend two weeks living and studying at the school in the valley before making the climb back up the cliff to spend the weekend at home. Then they make the hike back down the mountain to school.

Once they're there, the kids stay in simple dorms, sleep on metal bunk beds, and go to class in a small, two-story concrete building. In other regions like this, the Chinese government has tried to move mountain dwellers to lower-lying villages. But the small valley below Atule'er is already overcrowded, so there's no space for additional families.

Modreski says that the river will continue to shape the valley's walls and make the slope less steep. But since this *erosion* will take millions of years, the kids of Atule'er will continue making their extreme journey up and down the mountain for a long time to come.

BUILDING MOUNTAINS

The region where tectonic plates collide is called a *convergent plate boundary*. As the giant slabs of rock smash together, rock is pushed upward to form massive mountain belts, like the Himalayan mountains.



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BOAT STOP: The floating school drops off students in Bangladesh.

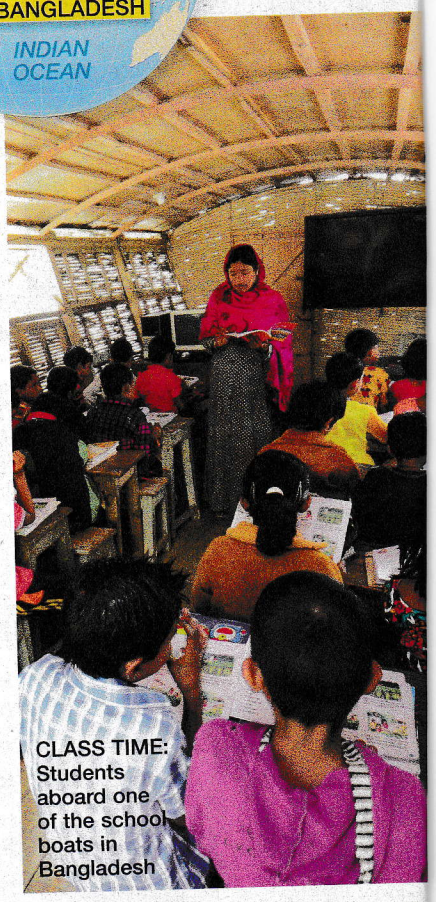
2 FLOATING SCHOOLS BANGLADESH

The South Asian country of Bangladesh receives heavy rainfall during its *monsoon season*, which lasts from June through October (*see How Monsoons Form, below*). The rains lead to massive flooding, and many students can't get to school. But some kids avoid wading through high waters to get to class. How? Their schools are on boats, which float around and pick them up.

Bangladesh is especially vulnerable to flooding because of its location. The country lies on a *delta* where the mouth of the Ganges River splits into many small branches before flowing into the Indian Ocean. During heavy rainfall, all these smaller waterways easily overflow.

The nonprofit organization Shidhulai Swanirvar Sangstha began constructing boat schools in 2002. About 2,000 students, ages 6 to 10, attend the schools, which are staffed by more than 60 teachers. Each boat is about 17 m (55 ft) long and 3.5 m (11 ft) wide and holds about 30 students. A multilayered roof protects the students from heavy rains. Each of the 22 boats is solar powered and has computers with internet access.

"Our family owned a small boat that ensured my travel to school during the monsoons," says Mohammed Rezwan, a Bangladeshi architect who developed the floating schools and founded the organization. "But I saw many of my friends could not. I thought that if the children cannot come to the school, then the school should go to them by boat."

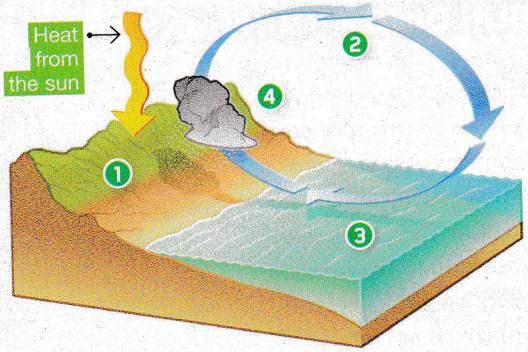


CLASS TIME: Students aboard one of the school boats in Bangladesh

HOW MONSOONS FORM

Monsoons form during summer months because of temperature differences between landmasses and ocean water.

1. During the summer, air over land becomes warmer than ocean air.
2. The hotter air rises because it's less dense than the surrounding air.
3. Cool, denser air sits over the ocean. This cool, moist air moves over the land to fill the void left behind as the warmer air rises.
4. Once over the land, the moist ocean air warms up. It rises to form monsoon clouds that release their moisture as heavy rainfall.



3 FROZEN TREK MADELINE ISLAND, WISCONSIN

Madeline Island is located in Lake Superior—the largest of the Great Lakes (*see map, right*). The small island is 3.2 kilometers (2 miles) from the mainland. During warm weather, students who live on the island ride a ferry to middle or high school in nearby Bayfield, Wisconsin. But in the winter, they commute by car. The lake usually freezes over, so vehicles can drive on top of it, making travel to the mainland a lot easier than having to take the ferry.

"We really look forward to the ice road," says 18-year-old Solomon Schuppe, a resident of Madeline Island who graduated from Bayfield High last year. "When the ice is thick enough to drive over, we're like normal kids—we can hang out with friends on the mainland whenever we want."

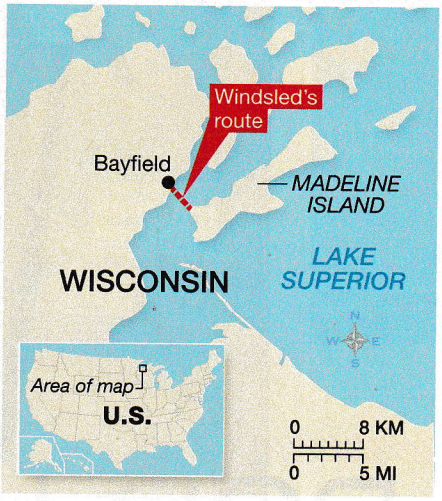
But before the lake freezes solid, chunks of ice float on the water. Cars can't drive on the lake and ferries can't travel on it. That's when students ride the windsled. This unusual vehicle is like a houseboat on a sled that's propelled over the ice by two big, noisy fans.

For the past few years, though, the lake hasn't frozen enough to require the windsled. Ferry service continued for the entire winter. Prior to 1999, that was unheard of. Scientists believe this is a sign of warming linked to *climate change*.

"Warmer air temperatures would likely reduce the potential for the lake to freeze and lead to a shorter duration when the ice is thick enough to support the windsled," explains Joshua Koch, a scientist who studies bodies of water at the U.S. Geological Survey in Alaska. He explains that many northern areas are seeing rivers and lakes thawing earlier, disrupting travel and leading to hazardous conditions.

Solomon says he hopes there's an ice road this winter to make it easier to see his friends. "For the last two years, I've been pretty bummed out."

—Andrew Klein



COOL RIDE: The windsled parked on Lake Superior

SLEDDING TO SCHOOL: It takes the windsled about 15 minutes to travel to and from Madeline Island.

CORE QUESTION

Think of a weather phenomenon or landform not mentioned in the article that might affect students' commutes or schools. What solutions could you devise so students could continue to study safely?

ABIR ABDULLAH/SHIDHULAI SWANIRVAR SANGSTHA (BOAT, CLASSROOM); JEREMY OSWALD (WINDSLED); T.C. WORLEY/THE NEW YORK TIMES/REDUX (SLEDDING TO SCHOOL); JIM MCMAHON MAPMAN ® (GLOBE AND MAP); EYEWASH (DIAGRAM)

POP-UP BOOK DESIGNER

Matthew Reinhart makes art that leaps from the pages of books

Matthew Reinhart works at a table covered with scraps of paper in his studio in New York City. He cuts, folds, glues, and tapes paper together to create a flat shape. Then he pulls a tab. The flat shape suddenly springs to life, unfolding into a 3-D sculpture of a monster that waves its claws and gnashes its teeth.

Reinhart creates pop-up books. He helps bring stories to life with dinosaurs that roar and fairy-tale princesses that spin. Reinhart combines science, engineering, and art to make his amazing paper creations. He spoke with *Science World* about how he designs and constructs pop-up books.

PAPER ENGINEER: Matthew Reinhart designs paper masterpieces that move.

How did you become a pop-up book artist?

At first, I decided to become an *industrial designer*—someone who designs products—focusing on toy design. I went to graduate school to study industrial design, and I loved it. Then I started working for a pop-up artist to make extra money after class. That's where I learned that I was good at making pop-ups. For the next three years, I helped

This *T. rex*'s mouth opens and closes.

Reinhart's huge LEGO book tower

MAKE IT!

Check out our **DIY Challenge (p. 24)** to help you design and test your own pop-up book.

him with his projects. I learned a lot. Eventually, I got good enough to create my own designs.

What is your design process when making a pop-up book?

First, I decide what will go on the page. For example, a dinosaur book might include a *T. rex*. Then I think about what the *T. rex* is going to do. What's the coolest way for readers to encounter the dinosaur? Maybe it pops up and tries to bite them!

Then it's time for the engineering stage. That's when I'm cutting and folding paper to figure out my design. I have learned all these different pop-up mechanisms over the years. One is a *v-fold*—a triangle-shaped piece of paper folded in half and placed in the center of a book. When the book is closed, the v-fold stays folded in half and flat. When the book is opened, it unfolds and makes a pop-up piece move across the page as you open it. Changing the angle of the v-fold changes how far and fast it moves.

Because every pop-up is unique, there is still a lot of trial and error involved. I go through a lot of paper! But failing is OK. That's how I discover ways to make a piece move in a really new and cool way or build a bigger pop-up than I've ever made before.

Did you always know you wanted to do something creative for a living?

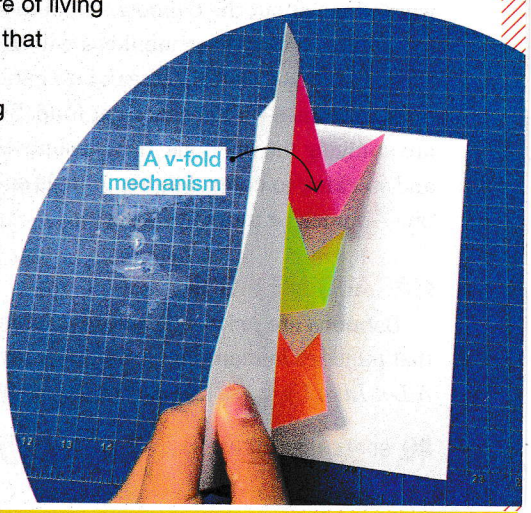
Yes! As a kid, I loved to draw. I also loved to build things out of cardboard or whatever else I could find. If my parents wouldn't get me a toy I wanted, I would just make it myself.

But I always loved science too. I studied biology in college. I loved learning about animals, insects, and plants. I took *anatomy* classes. I learned about the structure of living things. Now I use that knowledge every day when creating my sculptures.

Which of your pop-ups are your favorites?

My two favorites are in a LEGO® book I recently designed. One unfolds into this huge tower so tall it could poke you in the eye! Then there's another one that's a triple-changing pop-up. The sculpture starts out as a car. Then you lift a flap and it becomes a plane. Finally, you can pull the bottom down and it becomes a dinosaur. Those types of pop-ups really amaze people.

—Stephanie Warren Drimmer



MARTIN ADOLFSSON (REINHART); VIVIAN MOY (HOLDING BOOK); MATTHEW REINHART (ALL OTHER PHOTOS)

MONKEY TROUBLE

Baboons are wreaking havoc in South Africa—as *Science World* editor Jacob Batchelor witnessed firsthand

ESSENTIAL QUESTION: What issues arise when humans and animals are forced to share the same habitat?

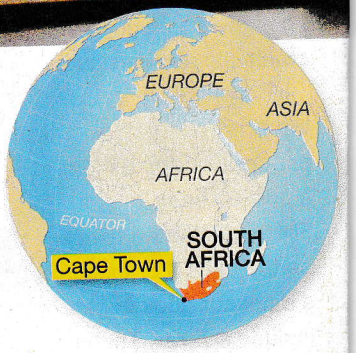
One day, I was sitting in a park in Cape Town, South Africa, when someone—or something—grabbed my backpack. To my surprise, it was a small baboon! I laughed at the little monkey's attempted thievery . . . until I saw a group of its bigger, meaner-looking friends coming toward me. Suddenly, the situation wasn't so funny.

"Leave your bag, back away slowly, and don't make eye contact," a friend I was with told me. After I carefully followed his instructions, the little monkey snatched my backpack and disappeared with its friends. I had just been robbed—by a baboon.

Before I moved to Cape Town, nobody warned me about the baboons. I had to learn the hard way that these monkeys will steal from people in broad daylight, break into cars, and ransack homes—all in search of food. Scientists are studying the baboons' troublesome behavior and working to control these animals so that no one—human or monkey—gets hurt.

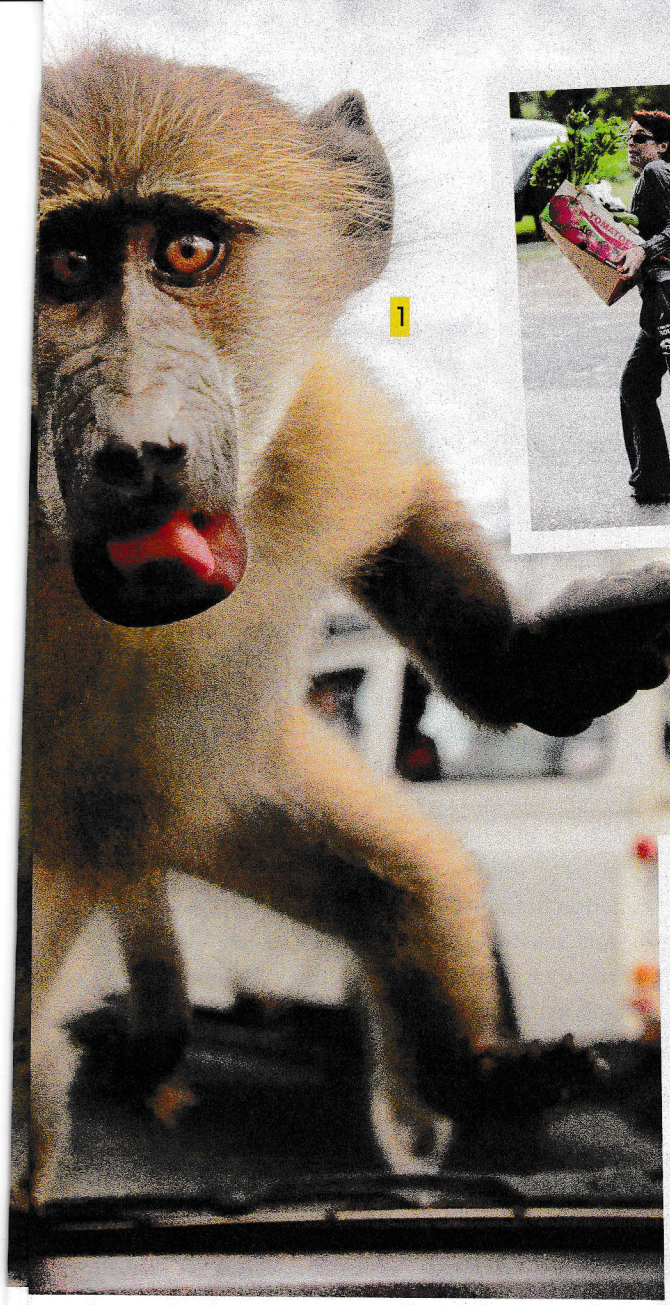
MARAUDING MONKEYS

Baboons are *primates*, an order of animals that includes humans, apes, and monkeys (*see A Lot Like Us, p. 22*). Primates are known for their intelligence. But baboons have more than just smarts. They're strong and have hands like those of humans, allowing them to grasp and manipulate objects. That unusual combination of traits makes baboons excellent thieves.



Baboons are relatively common throughout Africa. But they are usually too afraid of humans to give people much trouble. Cape Town's baboons are different. They have become *habituated* to the presence of humans. And that has made them fearless.

Baboons in Cape Town have been known to scale apartment buildings, jump over walls, and unlock windows and doors. Several years ago,



it wasn't uncommon to find a baboon in your kitchen. These monkeys rarely injure people, but a few serious attacks have been reported.

"I don't think there was any more challenging example of human-wildlife conflict in the world," says Justin O'Riain, the director of the Institute for Communities and Wildlife in Africa at the University of Cape Town.

SEARCHING FOR A SOLUTION

In 2010, Cape Town officials asked O'Riain and his team to gather data about the local baboon populations. They hoped to use the information to figure out how to rein in Cape Town's out-of-control monkeys. After months of work, O'Riain and his team found about 300 baboons organized into 11 social groups, called *troops*, living on the outskirts of the city.

The scientists learned that raids by baboons were a serious problem for people. But they also discovered that raids were bad for the monkeys too. Raiding monkeys were more likely to develop rotting teeth and become ill. People were also killing the animals in revenge.

Armed with O'Riain's research, the city of Cape Town initiated a program that aimed to control—and help—the baboon population. The city launched a massive education campaign that taught people baboon-proofing methods for their homes and warned locals not to feed the monkeys. It hired teams to track the baboons

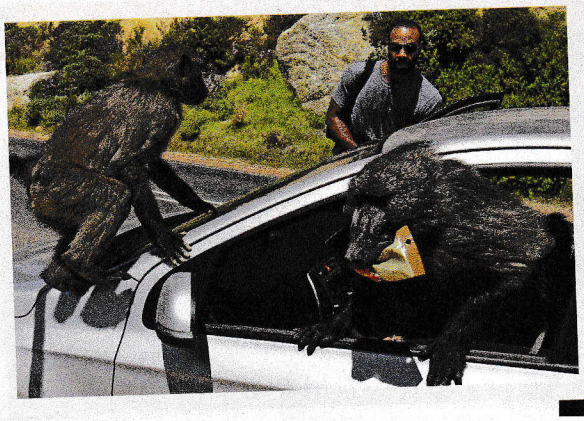
Continued on the next page →

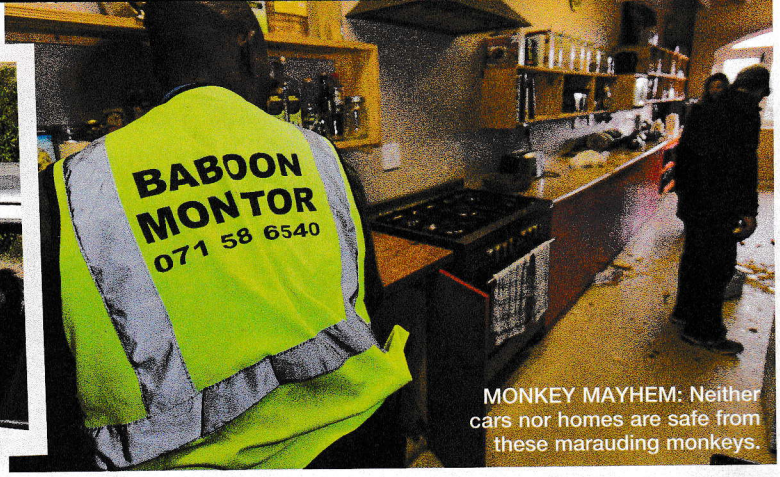
1 A young baboon peers through a car windshield.

2 Grocery shoppers are a favorite target of baboons.

3 The monkeys love sweet human food.

4 A baboon kidnaps a teddy bear.





MONKEY MAYHEM: Neither cars nor homes are safe from these marauding monkeys.

CORE QUESTION

Do you think the strategies used to control Cape Town's baboons are the best solution for the city's animals and people? Why or why not?

and scare them off using nonlethal methods—a technique called *hazing*. The city also instituted a more controversial program to selectively *cull*, or kill, the worst-offending baboons.

THE RIGHT WAY TO HELP?

Hazing involves the use of paintball guns and noisemakers, which are approved by a local chapter of the Society for the Prevention of Cruelty to Animals and have been used elsewhere. But not everyone agrees it's a good idea.

Kathy Kelly, a member of the animal rights group Baboon Matters in Cape Town, believes hazing is too harsh. "It also sends the wrong message to residents," she says. "They think it's OK to haul out their paintball guns and shoot." Baboon Matters also says the culling program destabilizes baboon troops. It argues that killing off dominant monkeys within a group disrupts that troop's social structure, leading to stress.

O'Riain and city officials say the program has been a success. Raids by problem monkeys are at an all-time low even though the baboon population in Cape Town has risen to more than 500. And scientists have recently installed high-tech collars to better track the monkeys' movements and learn more about their habits.

AN UNCERTAIN FUTURE

The baboons of Cape Town may be nuisances, but they were there long before people. They also have nowhere else to go. That's because the monkeys' traditional migration routes have been cut off by sprawling urban growth. The baboons have few options but to try to survive.

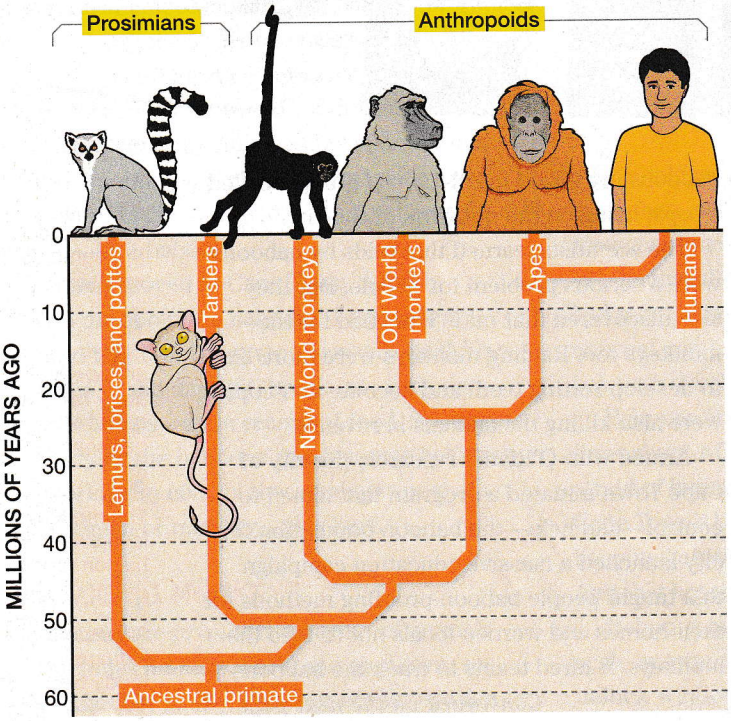
City officials currently have the baboon population under control, but Cape Town keeps expanding. If the baboons' numbers continue to grow—or their territory continues to shrink—there's a chance they will increase their raiding. "Space is finite," says O'Riain. "Down the line, there will be two options: culling or fertility control." Fertility control would involve capturing some monkeys and making them temporarily unable to reproduce.

Whatever happens, Kelly and her colleagues at Baboon Matters hope the people of Cape Town can learn to live with the monkeys—raids and all. "Cape Townians love their baboons," says Kelly. "We can't just let our need for expansion wipe them out."

—Jacob Batchelor

A LOT LIKE US

Baboons are Old World monkeys native to Africa and Asia. All monkeys, apes, and humans are primates. The *cladogram*, or family tree, below shows how the world's primates are related.



BUGGY BURGER

When you order a burger at a restaurant, you expect to be offered toppings like cheese or bacon. What you don't expect is to be asked, "Would you like some fried crickets and mealworms with that?" But food made with insects, like the bug-covered burger shown here, is exactly what's on the menu at pop-up "Pestaurants" around the U.S.

The exterminator company Ehrlich came up with the idea of mixing creepy-crawlies and gourmet food to promote its pest-control business. Ehrlich has been hosting Pestaurant events in major cities around the country, like Boston and Washington, D.C., since 2014.

The idea of eating bugs might make some people queasy. But *entomophagy* is common around the world. For thousands of years, people have sautéed, fried, boiled, and baked more than 2,000 species of bugs. An insect's flavor can range from nutty to shrimp-like. "Their flavor also depends on the spices used in their preparation," says Louis Sorkin, an *entomologist* at the American Museum of Natural History in New York City.

Bugs are highly nutritious. That's led some chefs in the U.S. to begin cooking up insects as a healthy food option. Pound for pound, bugs contain more protein than typical meats, like beef, chicken, or pork. Raising insects is also better for the environment. Doing so requires fewer resources and less space than livestock and poultry farming.

Still, biting into a burger topped with a pile of crunchy bugs might be hard for some people to swallow. Sorkin says that many people are more open to the idea of eating foods created with insect flour made from dried, ground-up bugs. Cricket cake, anyone?

—*Jeanette Ferrara*

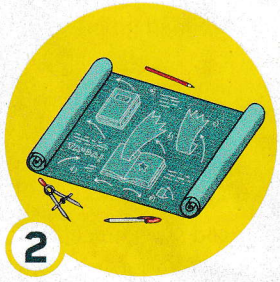
DIY CHALLENGE

DESIGN a POP-UP BOOK

In "Pop-up Book Designer" (p.18), you read about a pop-up book artist. Now try engineering a science-themed pop-up by following the design process below.

1 PICTURE THE PROBLEM

Think about the type of pop-up page you want to create. What parts of it will move? Will the reader need tabs or flaps to slide or open the pop-up? Clearly describe your pop-up idea. (Think about what you will need to make it work and any limitations you might face.)



2 GET CREATIVE

How will you turn the idea you came up with in step 1 into reality? Think of several different solutions. To determine which solutions will work best, write out a step-by-step plan, draw diagrams, or make small models of the mechanisms you'll need.

Go to **scholastic.com/scienceworld** to download a pop-up designed by Matthew Reinhart to use as inspiration for your design.

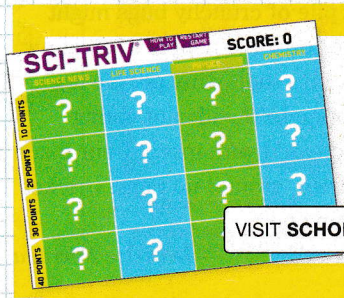
3 CONSTRUCT IT AND TEST IT

Pick a solution from step 2. Use it to make your pop-up. Test your design. Write down observations, noting any features that work well, and others that aren't needed or could be improved. If parts of your design aren't working, brainstorm why.

4 REFINE YOUR DESIGN

Use the observations you made in step 3 to improve your design. Make adjustments to your original plans. Test the design again. Did your changes make your pop-up work better? If not, keep going back to the drawing board until you're satisfied. Then use what you learned to make a whole pop-up book!

ANALYZE IT Compare your pop-up with that of a classmate. Evaluate the designs and discuss the engineering-design process you followed. Offer ideas on how to improve your partner's design and vice versa.



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