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# ScienceWorld

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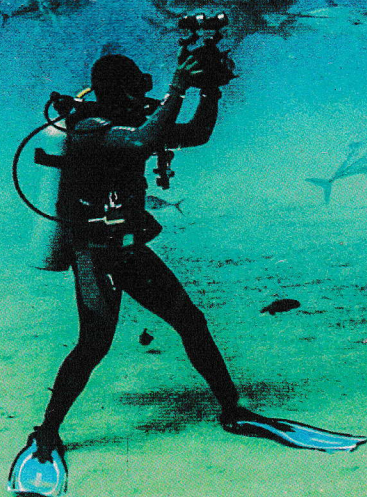
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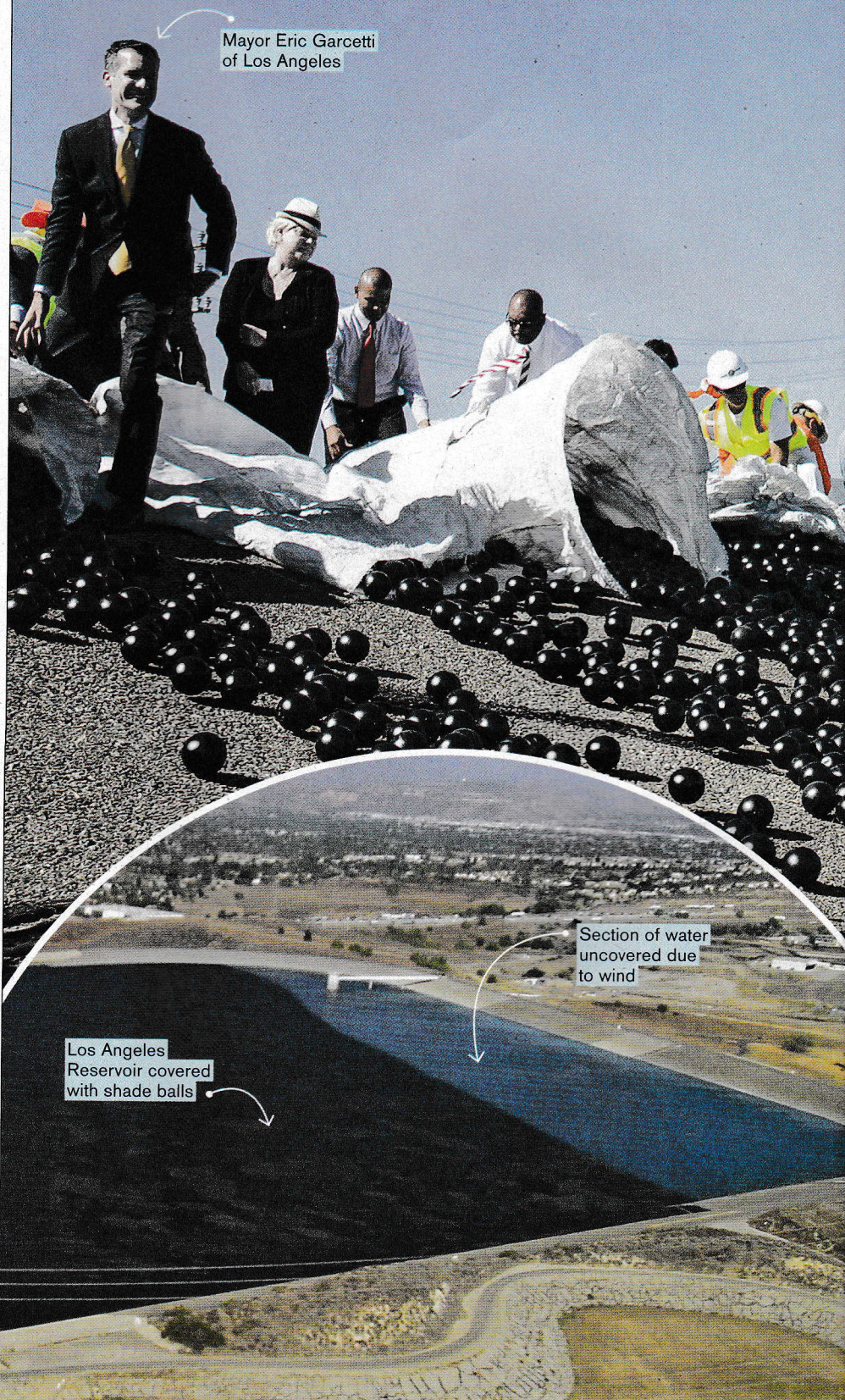
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# SCIENCE NEWS





# GIANT BALL PIT?

Last August, Mayor Eric Garcetti of Los Angeles helped dump 96 million plastic balls into the Los Angeles Reservoir. It was a strange sight, but the balls could play an important role in protecting the city's drinking water, especially during California's severe, years-long drought. Covering the 175-acre surface of the reservoir with the so-called "shade balls" is expected to help save 300 million gallons of water each year—enough to serve 2,760 homes.

The balls are made from a special material that reflects ultraviolet rays from the sun. Sunshine causes water to evaporate quickly because it heats the water, causing the water to change from liquid to gas. The shade balls slow this process.

Some people expressed concern that the balls might break down, contaminating the drinking water. Fortunately, they're safe, says Theresa Bellish, who works for an independent organization that tested the shade balls. "The material used to make the balls does not get into the water," she says.

—Jennifer Abbasi

## ABOUT THE SHADE BALLS

### BUOYANT

Hollow inside so they float; contain water to keep them from blowing away

### NON TOXIC

Made from polyethylene plastic, a material used to mold milk jugs

### BLOCK SUN

Black surface reflects ultraviolet rays from the sun, limiting evaporation of water

### COMPACT

About 4 inches in diameter

### STORM-PROOF

Withstand bad weather like rainstorms; may break down after 10 years, at which point they would be removed and recycled



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## SCIENCE NEWS

PHYSICS: ENGINEERING

# DRONES CATCH CHEATERS

**S**chools in Luoyang, China, have started using drones to catch students who cheat on the country's National College Entrance Exam, known as the *gaokao*. The two-day test, one of the most difficult in the world, is the main basis for university acceptance. Si Chen, who grew up in China and took the test in 2012, says it is "the most important exam in a student's life."

That kind of pressure pushes some test takers to use high-tech cheating methods, including camera pens that transmit questions to an outsider who can provide answers. The drones are able to detect the radio signals emitted by devices like these, and then send the gadget's location to a staff member. If caught, cheaters may be banned from taking the test for up to three years.

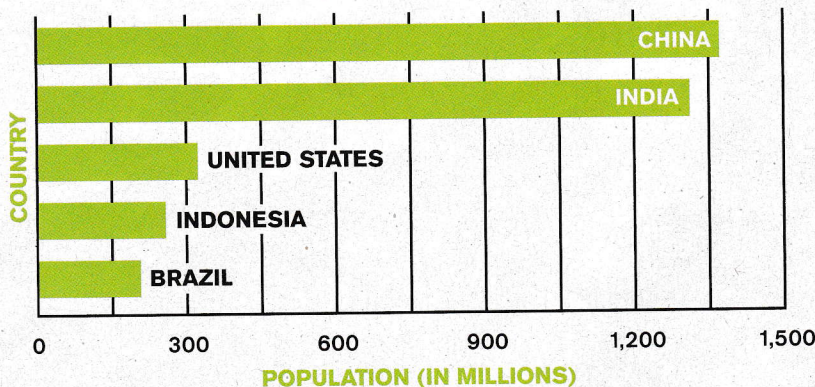
—Hailee Romain

### DRONE DETECTOR

A remote-controlled drone, like the one above, is used to find cheating test takers in China. At left, more than 1,700 students participate in an exam in China's Shaanxi province.

## POPULATIONS BY COUNTRY

One reason testing is so competitive in China is that there are many more students than universities have space for. China is the most populous country in the world. About how many more people live in China than in the U.S.?



SOURCE: STATISTA



**SWEET DREAMS:** This rat may be dreaming about a tasty treat.

BIOLOGY: ANIMAL BEHAVIOR

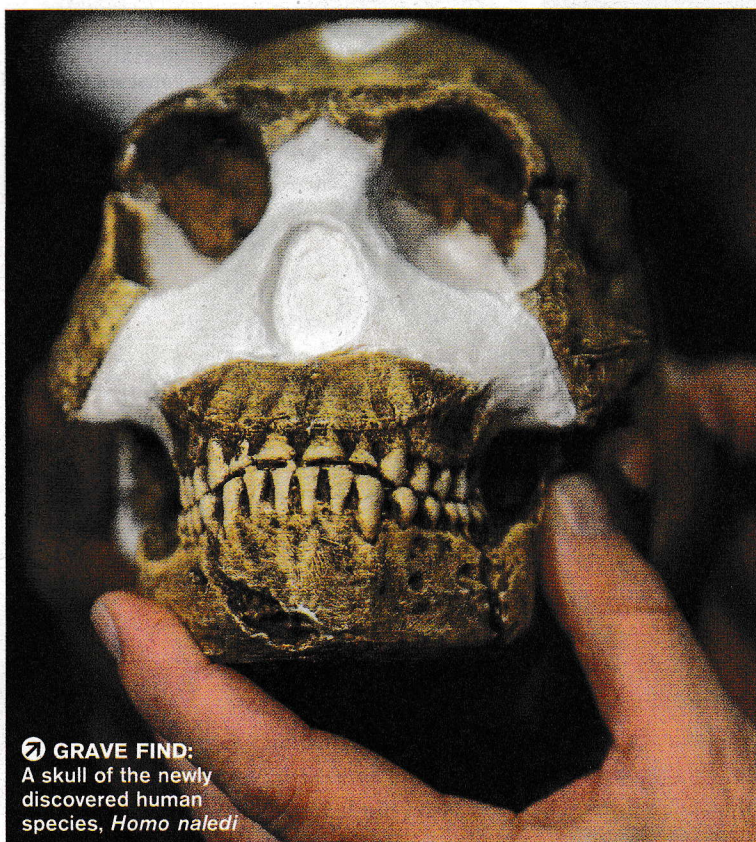
# RAT DREAMS

**S**cientists have long known that rats dream when they sleep. New research suggests that while the rodents snooze, they imagine places they hope to explore.

Freyja Olafsdottir, a neuroscientist at University College London, put rats on a track where they could see a treat through a window but couldn't get to it. Later, as the rats slept, their brain cells fired in patterns that showed they were imagining being in the same place as the tasty treat.

Olafsdottir says that the study teaches us about rats as well as people: It suggests that sleep can help prepare us for the future. —Kathryn Free





**GRAVE FIND:**  
 A skull of the newly  
 discovered human  
 species, *Homo naledi*

#### EARTH SCIENCE: FOSSILS

## NEW HUMAN SPECIES

**D**eep inside an underground cave in South Africa, scientists discovered a previously unknown species of human. Archaeologists squeezed through

the cave's narrow opening and gathered about 1,600 bones belonging to at least 15 individuals.

The species, *Homo naledi*, revealed major surprises:

While its torso resembled that of early human ancestors that lived 3 million years ago, its legs and feet appear more modern. *H. naledi* also had the small brain of early humans, yet its hands resemble those of more recent, sophisticated toolmakers. Today's humans are known as *Homo sapiens* and evolved about 200,000 years ago.

The location of the remains is just as fascinating as the fossils. "Either these people found their way into this cavern or they died at the surface and were dragged down into this deep and very narrow series of passageways," says Rick Potts, a paleoanthropologist at the Smithsonian Institution in Washington, D.C. "That's one of the great mysteries: how they got there."

—Hanneke Weiering



## NUMBERS IN THE NEWS



**600,000** The number of dahlias, a kind of flower, covering this float depicting the artist Vincent van Gogh. The parade celebrates the Netherlands' many types of dahlias.

**32,000** Number of years ago that Stone Age people were making porridge. Scientists in Italy made the discovery after analyzing grains on an ancient grinding tool.

**3,527** Estimated weight, in pounds, of a dinosaur named Sophie—the most complete *Stegosaurus* known.

The rare fossil was found in Wyoming.

**\$7,200** Approximate amount paid at auction for microbiologist Alexander Fleming's original 1928 culture of penicillin, the first antibiotic drug.

**20** Pounds of food thrown away in the U.S. per person each month, on average.

**12** Age of Lydia Sebastian, who got a perfect score on Britain's IQ test. She beat the scores of Albert Einstein and Stephen Hawking by two points.





**ROBO PAL:** Research shows that we behave similarly toward robots, like this Sony AIBO, as we do toward living pets.

# YOUR NEW BEST FRIEND

*Move over, Rover. Could robotic pets one day replace the real thing?*

What makes a good pet? Everyone has an opinion. Maybe it's an animal that happily greets you at the door, or one that shows affection when you pet it, or comes when you call. But it's a given that a good pet is alive, right? Maybe not. New research suggests that people respond to robotic pets in much the same way as we do to our living animal companions.

"People like pets because we get pleasure from taking care of another creature—walking it, feeding it, giving it water," says Katherine Houpt, a veterinarian who studied

animal behavior at Cornell University in New York. Research has shown that "we even get a drop in blood pressure from petting a dog—it's a relaxation response," she says.

Despite the psychological and physiological benefits, not everyone is prepared to take on the responsibility that comes with owning a living, breathing pet. That's prompted some scientists to question whether robotic pets could have the same effect.

## ROBO RESEARCH

Alan Beck is the director of the Center for the Human-Animal Bond at Purdue University in Indiana. He and his colleagues

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**4 BONUS  
SKILLS  
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Gail Melson and Tracy Roberts study the health benefits of owning pets. To learn more about how we interact with robotic ones, he turned to AIBO, a robotic dog made by Sony.

Engineers programmed AIBO to mimic behaviors seen in real dogs, like fetching balls and looking at you when you call. The upside: Its owners don't have to buy food, pick up poop, or take it to the vet (see *Sony AIBO*, right).

To see how people's behavior compares when we interact with living pets versus robotic ones, Beck studied more than 70 kids ages 7 to 15 as they interacted with an AIBO and a female Australian sheep dog named Canis. He also asked the kids questions about how they felt about the robot and the dog.

When it came to petting and spending time with either Canis or the robot, everyone preferred Canis. And although kids showed more affection toward the real dog, most kids showed affection for AIBO too.

For instance, the kids were asked: "If you were alone at home, would you feel better with Canis?" Almost everyone said they would feel better. When asked the same question about AIBO, 74 percent said they

would feel better with AIBO. Similarly, when asked if it's wrong to hit a dog, 79 percent of kids said yes. Seventy-three percent said it was wrong to hit the robot.

### A TRUE BOND?

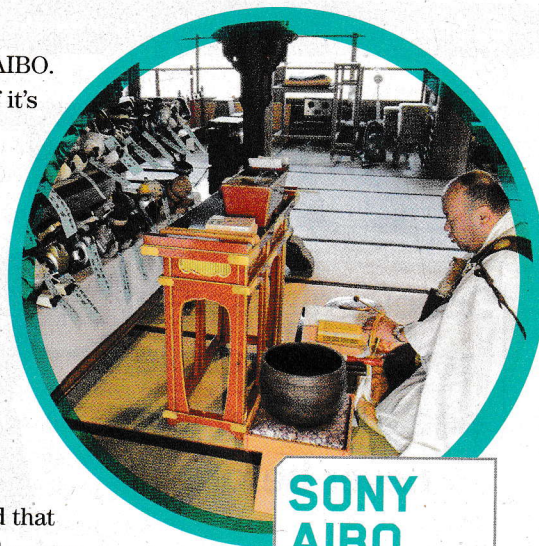
Although Beck's study suggests that people act similarly toward real and robotic dogs, a 2005 study found that AIBO doesn't generate the same physiological response.

When we spend time with live pets, our brain releases a chemical called *oxytocin*, says Houpt. We release this same hormone when we feel affection for people. Oxytocin is believed to strengthen emotional bonds between family and friends. Recent research shows that dogs release oxytocin when they're around us too.

"It's a true interaction," says Beck. "The dog really wants to be with you—it recognizes you and gets pleasure from your voice, facial expressions, and glance." Being around AIBO, however, doesn't cause the same release of oxytocin in our brains.

Even though this suggests that we may never see a robotic pet as equal to an animal, Beck says his findings show that we still see them differently from an ordinary machine like a toaster. "I've never convinced anyone to hit the AIBO," he says. "I wouldn't do it either." ❀

—Andrew Klein



## SONY AIBO

From 1999 to 2006, Sony sold about 150,000 AIBO robotic dogs. Most were sold in Japan, for a cost of about \$2,000 each. Sony was willing to fix broken AIBOs until this past March, when they discontinued repairs. Without tech support, some owners have been forced to say goodbye to their robotic four-legged friends—sometimes with traditional Japanese funerals (above).



**🐾 COPYCAT BOTS:** Robotic pets are programmed to mimic the behaviors of real ones.



## CORE QUESTION

Do you think that a robotic pet could replace a living pet? Support your opinion.



# WHAT DO YOU SEE?

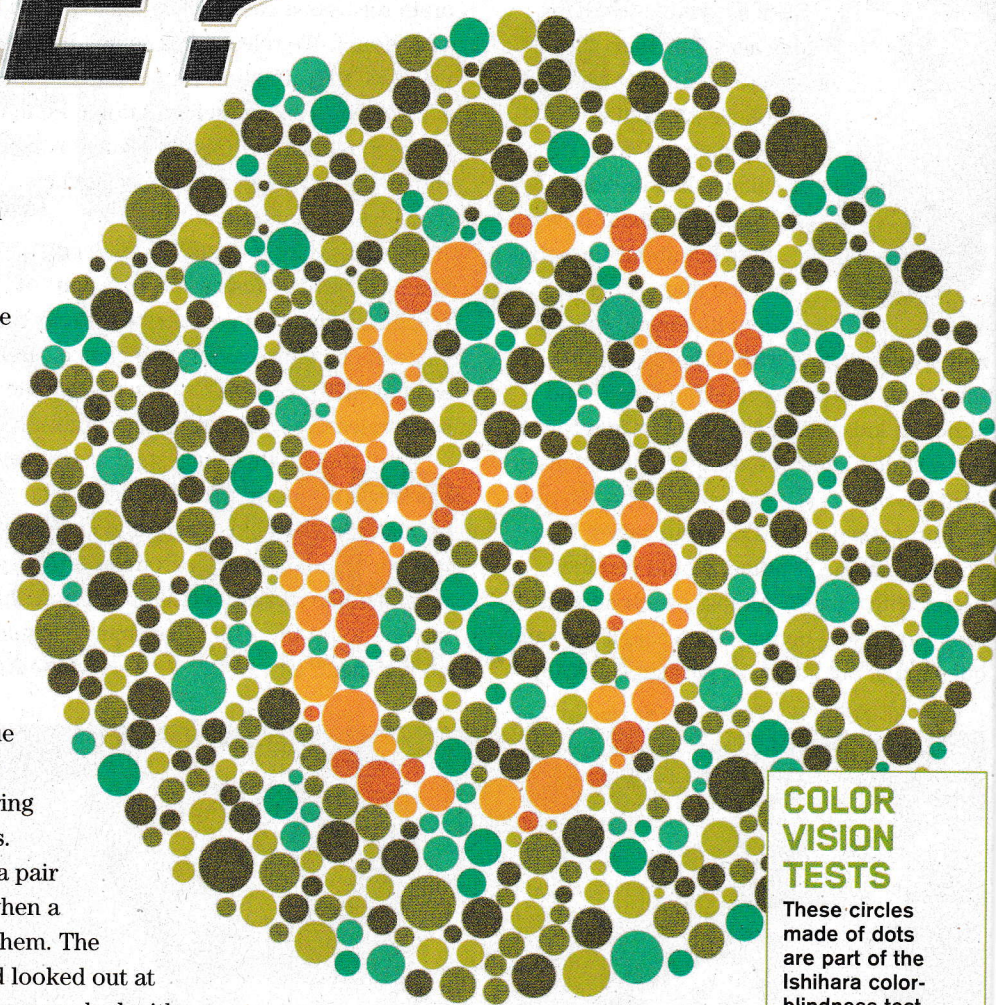
Special glasses let colorblind people see the world like never before

About 10 years ago, glass scientist Don McPherson was playing in an Ultimate Frisbee tournament in California. At the time, McPherson specialized in making glasses to protect surgeons' eyes from lasers that they use to perform operations. Some of the doctors reported an unexpected effect of the safety glasses: The lenses seemed to make certain colors—like the deep red hue of blood—more vivid. A few surgeons even enjoyed wearing them outdoors as sunglasses.

McPherson was wearing a pair at the Frisbee tournament when a teammate asked to borrow them. The friend put the glasses on and looked out at the field, scanning the end zone marked with bright orange cones. "Dude," he exclaimed suddenly, "I can see the cones!"

At first McPherson didn't understand what his teammate was talking about. The friend, a talented player, explained that he

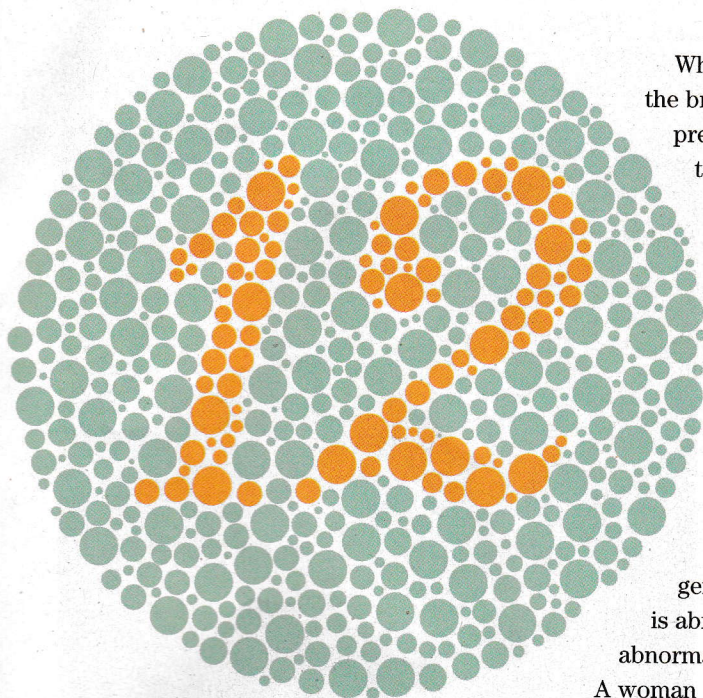
was colorblind. He'd always had trouble distinguishing the orange cones from the green grass surrounding them—until he put on McPherson's glasses and the colors popped like never before.



## COLOR VISION TESTS

These circles made of dots are part of the Ishihara color-blindness test. Everyone should be able to see the number 12 (top right). Colorblind people may be unable to see the number 6 (above).





## COLORBLINDNESS 101

*Colorblindness* can refer to a variety of *color vision deficiencies* ranging from difficulty in distinguishing certain colors to complete absence of color vision (which is very rare). Around 15 million Americans—more than 4 percent of the population—have some form of colorblindness. The most common is red-green colorblindness, which involves trouble telling apart colors containing red, yellow, or green. Most types of colorblindness don't affect *visual acuity*, the sharpness of vision.

Colorblindness is usually inherited. It's caused by problems with light-detecting cells in the eye called *cones* (see *Inside the Human Eye*, right). The eye normally has three types of cones, each containing a different light-sensitive molecule called a *pigment*. Each pigment is most sensitive to a different *wavelength* of light. Wavelength is the distance between the peaks of a wave of light energy. Wavelength is related to light's color, but most light is a mix of wavelengths.

When light hits the back of the eye, the brain rapidly combines and interprets signals from the cones to create the perception of color. If any of the three cone pigments is missing or abnormal, a person will have some form of colorblindness.

The genes for two of the pigments are located on the *X chromosome*, which plays a role in determining a person's sex. Typically men have one X chromosome in each of their cells and women have two.

If one of the cone pigment genes on a man's X chromosome is abnormal, he'll be colorblind: The abnormal gene is the only copy he has. A woman may have an abnormal gene on one X chromosome, but as long as she has a normal version of the gene on the other one, she'll have full color vision. As a result, colorblindness is far more common in men than in women.

*Continued on the next page*

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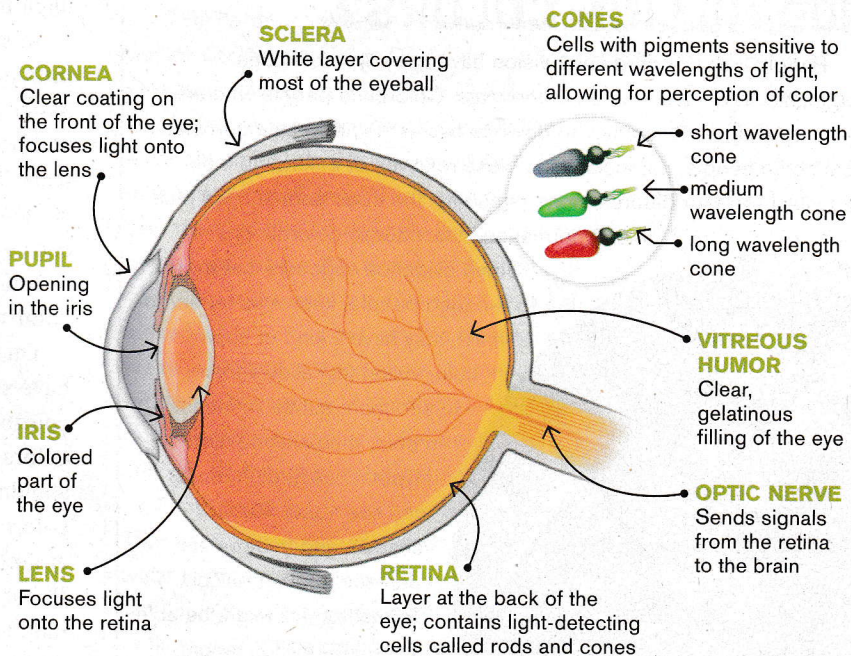
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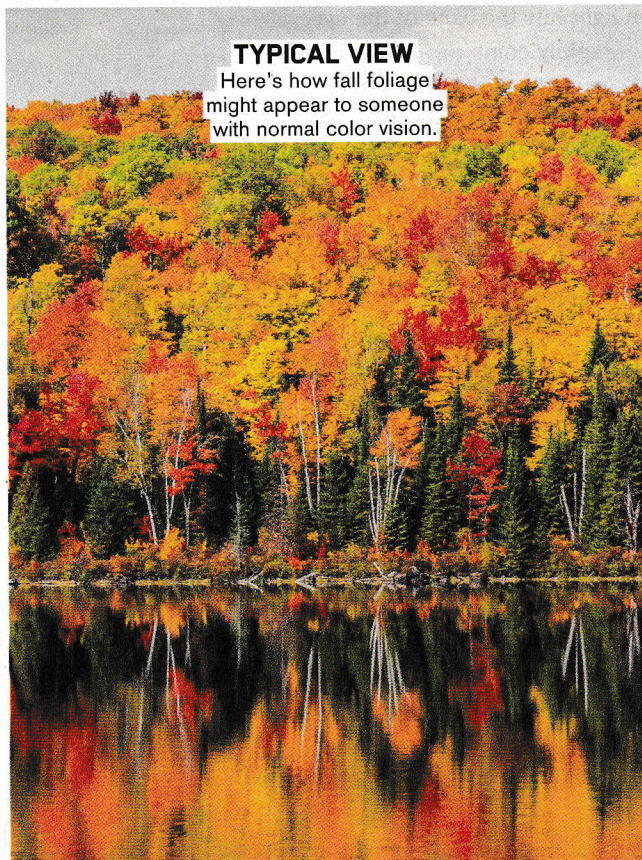
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## INSIDE THE HUMAN EYE

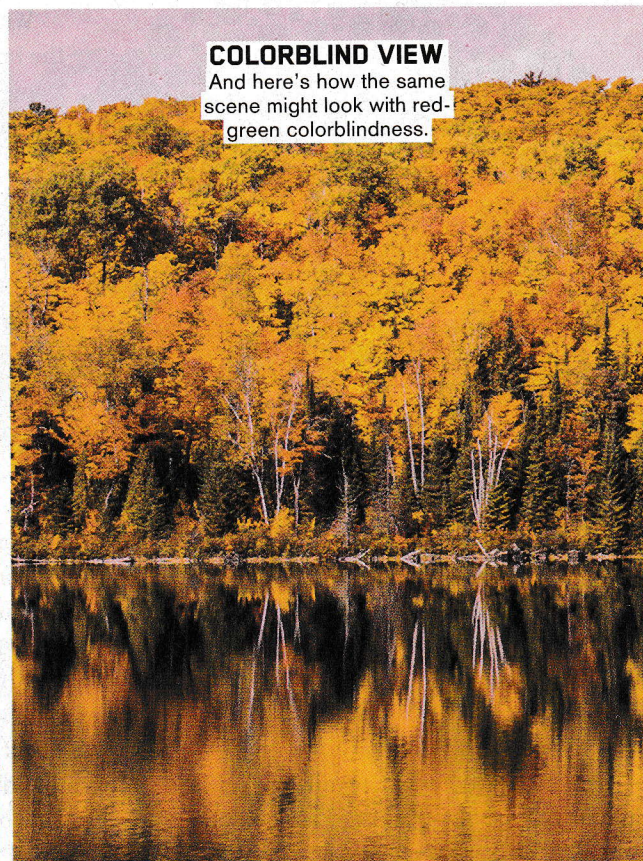
This diagram shows a cross section of the human eye and some anatomical structures that play a role in our sense of sight. Cone cells contain three different light-sensitive pigments. If any of the pigments is missing or abnormal, a person will be colorblind.







**TYPICAL VIEW**  
Here's how fall foliage might appear to someone with normal color vision.



**COLORBLIND VIEW**  
And here's how the same scene might look with red-green colorblindness.

## SEEING DIFFERENTLY

Colorblind people do just fine most of the time but can run into problems in certain situations. Some may have trouble telling

whether produce is ripe, seeing whether meat is properly cooked, and noticing skin rashes or sunburn. They also may be unable to distinguish the colors of traffic lights. In daylight they can often tell the lights apart by their positions on the traffic signal, but at night it may be impossible to see.

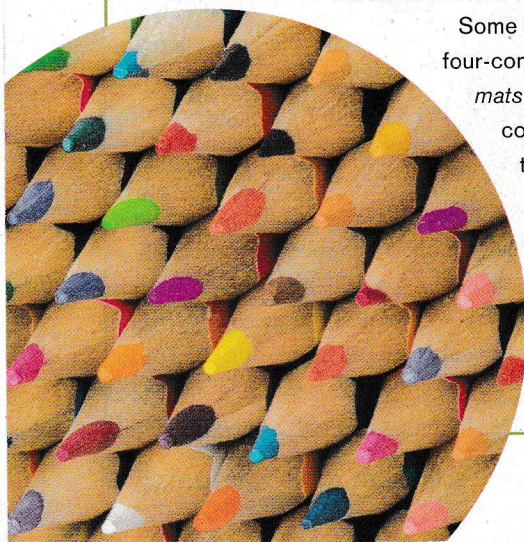
In schools, "students sometimes have difficulties, since a lot of information on assignments may be color-coded," says McPherson. The issue may even come up on tests. Teachers may not realize that certain students are colorblind—and students themselves may not know if they haven't been tested. Currently, most states don't require color vision testing in schools.

On the other hand, colorblindness may have some upsides. Research suggests that colorblind people can distinguish certain colors that look identical to viewers with standard color vision. And some types of colorblindness may give people an advantage at detecting camouflage. During World War II, colorblind servicemen reportedly spotted hidden enemy soldiers, ships, and weaponry that others couldn't see.

## 100 MILLION COLORS?

People with standard color vision have three types of cone pigments. They're known as *trichromats*. Colorblind people who are missing a pigment—so they're down to two—are known as *dichromats*. But some people, particularly the close relatives of colorblind individuals, have four different cone pigments: the three normal ones plus the abnormal one that causes colorblindness.

Some evidence suggests that these four-coned people, known as *tetrachromats*, may have a kind of super color vision that allows them to see more subtle variations in color than anyone else. Hypothetically, dichromats can see about 10,000 shades, and trichromats can see about 1 million. Tetrachromats might be able to see 100 million colors!





## HOW THE GLASSES WORK

After McPherson saw his Frisbee teammate's reaction, he decided to focus on creating lenses for colorblind people. His glasses can compensate for certain types of red-green colorblindness by filtering out yellow light. Yellow falls between red and green on the *electromagnetic spectrum*, which includes all types of light arranged by wavelength.

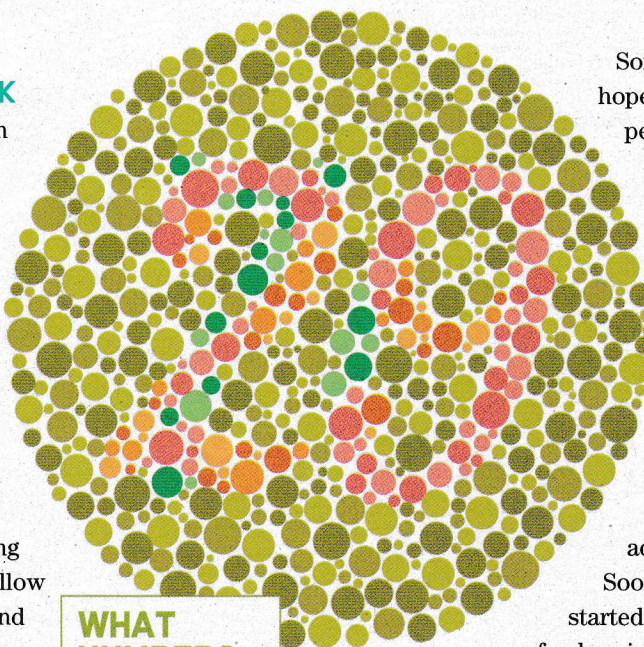
Blocking some of that yellow light helps to more clearly separate the red and green light that hits the cones in the eye. That can help the wearer distinguish red from green when the signals from the cones are combined in the brain. "Color perception isn't a simple reflex," says Bevil Conway, a neuroscientist at Wellesley College in Massachusetts who studies visual perception. "It depends on heavy computation that the brain performs on the information it gets from the eye."

## RESTORING THE RAINBOW?

McPherson conducted experiments to find out how well the glasses worked. Some people with red-green colorblindness become much better at identifying colors with the glasses on, and some improve their performance on certain tests of color vision.

The glasses don't work for everyone. People who have an abnormal pigment may notice a big difference in their color vision, but people who are missing a pigment usually don't see much improvement.

McPherson cofounded a company, EnChroma, that sells the glasses. Anyone can take a test at the company website to see how likely it is that the glasses will help (see *Our Results*, right).



### WHAT NUMBER?

Most viewers will see 29. Colorblind people may see 70 or no number.

Some researchers hope to develop a permanent cure for colorblindness. In 2009, University of Washington scientist Jay Neitz injected a pigment gene into the eyes of two colorblind adult monkeys. Soon, the monkeys started passing tests of color vision that they had consistently failed before.

Someday, a gene-based fix could open people's eyes to a colorful new world. ❀

—Jennifer Barone



## OUR RESULTS

*Science World* asked colorblind friends and colleagues to test out the EnChroma glasses (working with a partner to confirm colors). One tester noticed a big difference in greens. He reported that street and highway signs had always appeared muddy colored but popped as bright green with the lenses on. Another tester said, "The trees are different colors of green! I've never been able to see that before." He also reported that he was able to tell apart the colors of the red and green lights on a traffic signal for the first time.

A third tester said the green light on a traffic signal had always looked white to him, but with the glasses, it took on a new color. He also noticed that red shirts seemed gray without the glasses but reddish with them on. A fourth tester found that some objects that originally appeared blue to her became purple with the glasses. Yellows, on the other hand, became less bright.

A fifth tester saw no difference in his color vision with the glasses. That wasn't a big surprise, since the online vision test at the EnChroma website predicted only a 30% chance that the glasses would help him.

Our testers loved wearing the glasses, but none of them were ready to buy a pair at current prices (starting at \$330).



## CORE QUESTION

What are some possible advantages and disadvantages of colorblindness? Cite evidence from the text.



# SWARM SCIENTIST

Simon Garnier studies the science behind group behavior

**B**iologist Simon Garnier is fascinated by *swarms*—many animals that move together. Swarms can often accomplish more complicated goals than an individual can on its own. From herds of sheep to schools of fish and colonies of ants, there's a lot humans can learn from swarms.

Garnier heads the Swarm Lab at the New Jersey Institute of Technology. He spoke with *Science World* about the science behind swarms, what it's like to study them, and how learning to mimic their behavior could allow people to work better together.

## How did you become interested in swarms?

In college I wanted to coach sports. I liked the idea of helping a group of individuals organize themselves in a way that was efficient and would score goals. I told my physics professor it was hard to coordinate

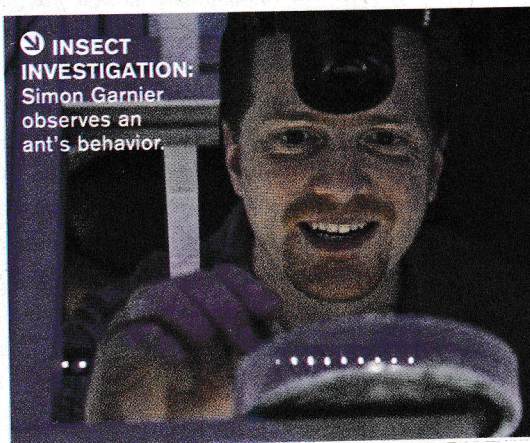
a team of six or seven players: If they do things wrong, your strategy goes out the window. He suggested that I look at schools of fish and colonies of ants. None of those animals have a brain nearly as powerful as a human's, but they do what they're supposed to do when they're part of a group. I did what he suggested, and that's how I became completely fascinated by swarms.

## Why do animals swarm?

Fish usually school together for protection. If a fish is in a large crowd, it's less likely to be eaten by a predator than when it's on its own. The fish are



**INSECT INVESTIGATION:** Simon Garnier observes an ant's behavior.







**POWER IN NUMBERS:** Pacific mackerel swarm to protect themselves from a nearby Bryde's whale.



**FLOCKING TOGETHER:** Starlings fly in a tight swarm. Each bird makes sure to stay the same distance from its neighbors.



**CHEMICAL TALK:** Ants, like these leafcutters, communicate by emitting different chemical scents called *pheromones*. These scents tell the larger group things like where food is located.

basically hiding behind each other. Scientists call it a “selfish herd”—it’s not very brave.

The school also distracts predators. Imagine you have to catch a tennis ball. If I send you a thousand tennis balls, it’s going to be hard for you to process which one to catch. Similarly, it’s hard for a predator to focus on one target inside a swarm. Some birds, like starlings, fly in large flocks for this reason.

**What kinds of animals are you studying?** My team and I are studying leafcutter ants in Panama. We’re trying to understand how the insects cut, transport, and process leaves for their food and nests. Ants in a colony look like they’re acting

randomly, but they’re actually well organized.

We’re also looking at vocalization among herds of goats and troops of baboons in southwest Africa. We’ve attached microphones and tracking collars to them. While they’re on the move, they vocalize a lot, but it’s not clear why. We’re trying to figure out if they’re saying “I’m here!” or signaling that they want to change direction, like “I’m going this way!” We’re looking into how their movement changes based on the sounds they make.

**Why is it important to study swarms?** Swarms can teach us how to save time and energy. For example, about \$120 billion of gas

is wasted in the U.S. every year in traffic jams. Ants don’t have traffic jams even though their colony can consist of 20 million individuals. One reason is that their “roads” aren’t fixed like ours. If we have a three-lane highway, we can’t easily open a fourth. If people find ways to mimic ant behavior, traffic jams could be avoided.

Swarms are also helping engineers build better robots. Rather than create one complex robot that’s expensive to build and develop, engineers are making a lot of cheap, simple robots that work together so they’re smart collectively. That way, even if some of the robots break, there are a lot left that can do the job. ✨

—Amy Barth



# FIRES

*Wildfires are raging in record numbers.  
What's fueling the flames?*



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**D**uring a single weekend in June this year, a stunning 152 wildfires ignited in Alaska. Flames crackled and spread through brush and fallen branches, dried out by warm conditions and turned into perfect fuel. More than 5 million acres of Alaskan forest have burned so far this year—an area larger than Connecticut. This year may end up with the most extensive wildfires in the state's history.

Alaska wasn't the only state on fire. Blazes raged across California, Washington, and much of the rest of the West. Thousands of people were evacuated as flames threatened homes. Extreme fire seasons like this are becoming more common. Before 2000, more than 8 million acres had never burned in a year in the U.S. Since 2000, there have been six years when that happened. This trend could be the new normal.



# TORM



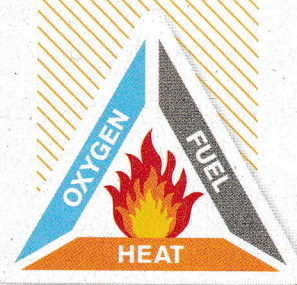
**FIGHTING BACK:**  
Firefighters battle  
a wildfire near  
Clearlake, California,  
in August.

## FIRESTARTER

Wildfires happen when three factors come together, says Matt Jolly of the U.S. Forest Service. Jolly is an *ecologist*, a scientist who studies the connection between living things and their environment.

The first factor is the weather. Hot, dry, and windy conditions dry out pine needles, branches, and other dead plant material on the forest floor. That material becomes the

second factor: fuel. Once weather conditions and fuel are in place, all that's needed is a source of *ignition*: something that starts the fire. In the western U.S., that's usually lightning, says Jolly. In the eastern U.S., it's often people igniting fires. Sometimes they do it by accident, like when a campfire isn't put out properly. Other times, people maliciously start fires—that's called *arson*. And fireworks are a common cause of fires. "We see a peak



## CHEMISTRY BEHIND A BLAZE

### FUEL

Anything that burns can be fuel for a fire. The drier the material, the more easily it will burn. Firefighters stop wildfires by lighting small, controlled fires to burn up dry, dead plants that could fuel a fire.

### OXYGEN

Fire needs oxygen from the air to keep burning. Wind supplies fires with more oxygen, helping them spread. Firefighters sometimes use foam to act like a blanket between the fire and the air, smothering the fire until it goes out.

### HEAT

A fire needs a heat source, like a match, to ignite, or start. When firefighters spray a fire with water, the water turns to steam. This removes the fire's heat.



around the Fourth of July,” says Jolly.

People tend to view fire as a catastrophe. It's true that human-caused wildfires are never a good idea. But naturally occurring wildfires aren't always bad, Jolly says. Forests rely on fires to stay healthy: Blazes clear the forest floor so that new trees can grow. “Fire has always been a part of nature,” says Jolly. It's when fires threaten people's lives and property that we see them as disasters.

### MAPPING THE FLAMES

Lately, it seems like every time you check the news during *fire season*—the time of year when wildfires are most likely to ignite and spread—you see photos of flames raging out of control. The timing varies widely depending on local conditions, but summer and fall tend to bring many fires in the West. Are there really more fires than there used to be, or does it just seem that way? Jolly wanted to find out.

Jolly and his colleagues studied weather data from around the



### CORE QUESTION

How have fire seasons changed over the past 35 years? Cite evidence from the text to support your answer.

world that scientists had gathered over the past 35 years. He and his team looked for four factors that increase the chance of wildfires: high temperatures, low humidity, many rain-free days, and high wind speeds. They pinpointed places that had experienced all these conditions at once, and how

long they had experienced them. That told them how long the fire seasons around the world had been. From 1979 to 2013. “Being able to combine information about each day for every place on the planet is really powerful,” says Jolly.

Jolly and his team found that across one quarter of the parts of Earth's surface where plants grow, fire season has lengthened. Globally, they found that fire season has gotten more than 18 percent longer, from 18 days to 22 days on average. They also found that the total area at risk of fires has

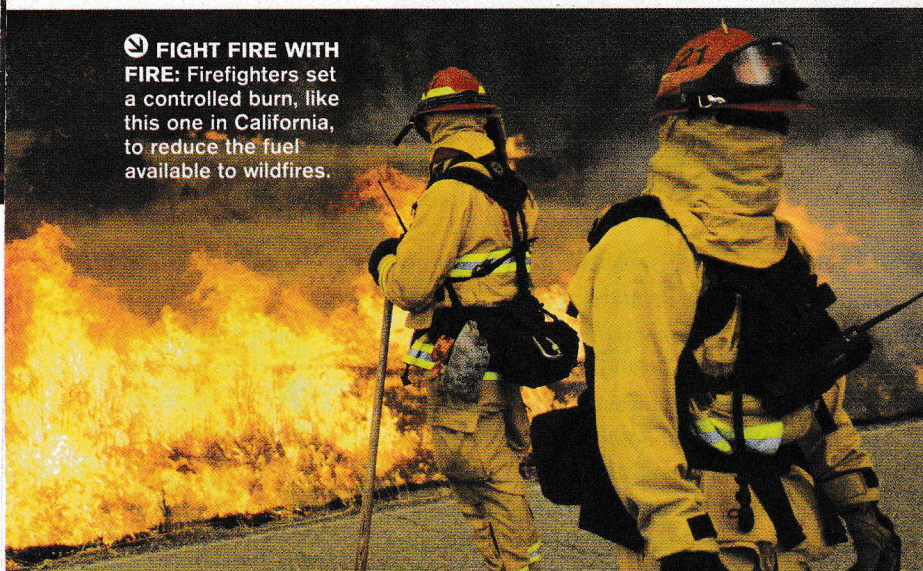
doubled, increasing from 4.4 million to 9.1 million square miles. “It's clear that something has changed over the last 35 years,” says Jolly. But what?

### HEATING UP

The world is gradually heating up. Earth's climate has always varied over time, but over the past 100 years, average temperatures have risen unusually quickly. Alaska, for example, has warmed by more than 1.7°C (3°F) in the past 50 years.

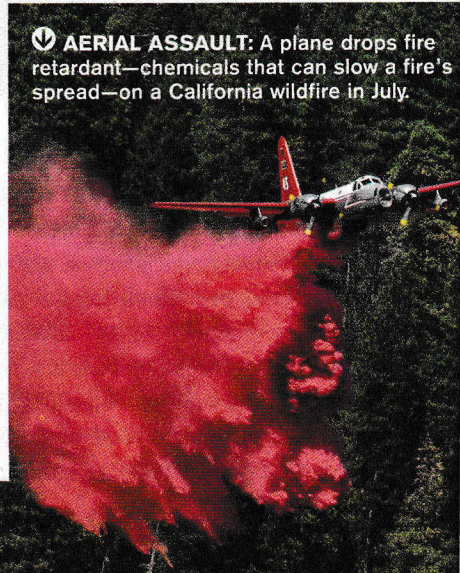
This warming trend, called *climate change*, also creates the hot, dry conditions that are ideal for fires. Not all scientists agree on exactly how climate change affects fire season or how big its role is. But overall, research suggests that climate change has contributed to longer and more severe fire seasons.

**FIGHT FIRE WITH FIRE:** Firefighters set a controlled burn, like this one in California, to reduce the fuel available to wildfires.



**DESTROYED BY FLAMES:** A burned-out car near the remains of a home destroyed in California in September

**AERIAL ASSAULT:** A plane drops fire retardant—chemicals that can slow a fire's spread—on a California wildfire in July.





says climate scientist Gregg Garfin of the University of Arizona.

## FIGHTING BACK

Wildfires may be getting bigger and lasting longer, but people are fighting back to protect homes and property. Improvements in firefighting technology have given firefighters a host of new weapons.

The U.S. Forest Service uses the same weather measures Jolly studied to judge current conditions. The agency uses the data to create a *fire danger rating* that indicates how likely it is that fire will strike any given area in the near future.

The Forest Service also uses the data to create computer simulations of the landscape, mapping where a fire is likely to spread. The simulation tool can make predictions as far as two weeks ahead of time. Firefighters can even virtually test out a fire prevention method, such as a *controlled burn*—a carefully managed fire set intentionally by firefighters to reduce the amount of fuel available and help prevent bigger wildfires. “It’s almost like playing a video game,” Jolly says of the simulations.

When it comes time to fight a real fire, firefighters can fly over the burning area in airplanes equipped with *infrared scanners*. The scanners allow them to find out exactly where the fire is burning—even when it’s too smoky or cloudy for them to see well. That precise, up-to-the-minute information helps them devise a plan of attack.

With these new tools, firefighters can use smarter strategies than ever before to battle blazes. And if scientists are correct, they’re going to need all the help they can get. If climate change continues as predicted, says Garfin, “the kinds of fires that we’re seeing now are a hint of what the future might hold.” ❁

—Stephanie Warren Drimmer

# SUIT UP!

This isn’t an Iron Man costume—it’s an idea for a suit that could someday give firefighters super strength. Traditional firefighting equipment—a helmet, coat, pants, gloves, boots, and an air tank—weighs as much as 25 kilograms (55 pounds). That’s a heavy load to maneuver through a burning building or challenging terrain. But someday, future firefighters could strap on this exoskeleton, dreamed up by industrial designer Ken Chen, a graduate student at Monash University in Melbourne, Australia. The exoskeleton would take some of the load off firefighters’ bodies, allowing them to easily carry up to 91 kg (200 lbs).

### FLASHLIGHTS

Flashlights would be mounted on each shoulder for hands-free illumination.

### BATTERIES

Lithium batteries would power the suit for up to two hours.

### TOOL-HOLDER

This would holster a tool, such as the Jaws of Life, used to free victims trapped in rubble.

### WATER GUN

A gun would blast water at high speed to provide extreme extinguishing power.

### EMERGENCY RELEASE SYSTEM

Pulling on one of the rings on either side of the thigh would make all the suit’s joints disassemble, freeing the firefighter inside.

### FOOT-WEIGHT TRANSFER SYSTEM

The weight carried by the firefighter would be transferred down the suit to this foot pad and directly into the ground.



# QUESTIONS ABOUT DRUGS- ANSWERS FROM SCIENTISTS

Every year since 2007, scientists at the National Institute on Drug Abuse (NIDA) in Washington, D.C., dedicate a day to answering student questions about drugs. In this annual online chat—Drugs and Alcohol Chat Day\*—teens across the country can ask the questions they most want answered, and scientists answer them. No judgment. Just the facts.

To read the actual questions and answers—more than 2,500—visit [teens.drugabuse.gov/chatday2015](http://teens.drugabuse.gov/chatday2015). Here are a few Q&As inspired by Chat Day to give you some important facts now.

**Q: SOME PEOPLE SAY MARIJUANA IS DANGEROUS AND OTHERS SAY IT'S NOT. WHAT'S THE TRUTH?**

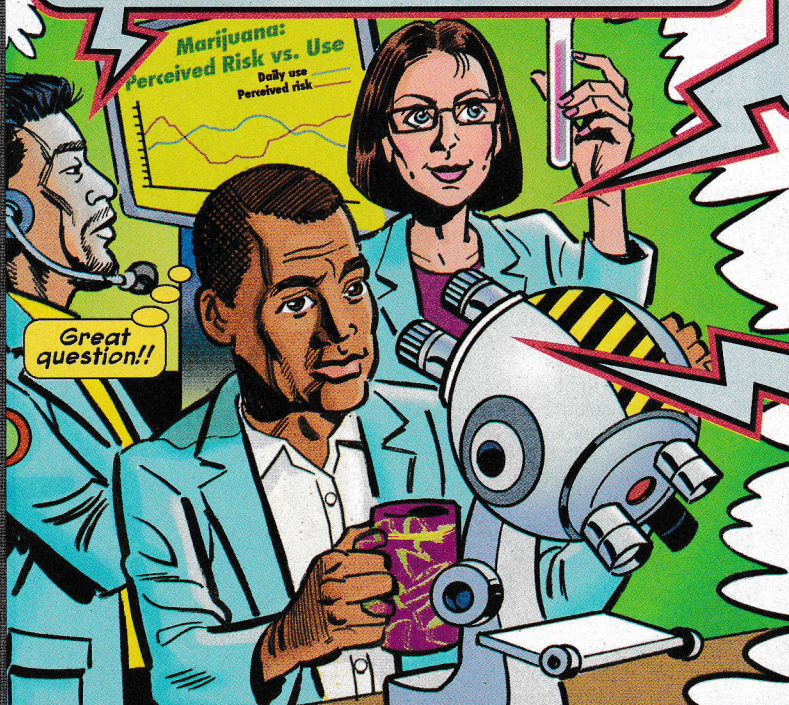
**A:** Scientific research has shown that marijuana can be dangerous for teens because their brains are still developing. Regular marijuana use may impact teens' ability to learn and even lower their IQs. It can also impair driving ability, especially when combined with alcohol. More recently, a lot of people have landed in the emergency room having psychotic episodes after eating food or candy containing marijuana. Not knowing that THC (the mind-altering chemical in marijuana) digests more slowly when eaten than when smoked, they mistakenly eat multiple servings looking to increase or speed up the mind-altering effects.

**Q: WHY DO PEOPLE USE TOBACCO WHEN THEY KNOW IT'S SO BAD FOR THEM?**

**A:** It is bad for them! More than 480,000 people die every year from smoking-related illnesses. But people smoke because the nicotine in cigarettes is highly addictive. Young people are especially sensitive to nicotine's addictive effects, which is why most smokers get addicted before age 18. Some people mistakenly think that using a hookah (water pipe) will let them use tobacco but avoid the dangers of it. Not true. Hookah smoke contains the same chemicals as cigarette smoke and is also linked to heart disease and lung cancer. In fact, a typical hookah session can equal as many as 100 cigarettes.

**Q: CAN COFFEE KILL YOU?**

**A:** Caffeine is generally safe at levels found in beverages such as coffee, soda, or energy drinks—though drinking too much can make you feel sick. However, there have been overdoses from consuming caffeine powder. Just a teaspoon of it is equal to 25 cups of coffee—enough to kill you! Too much caffeine powder can cause fast and erratic heartbeat, seizures, vomiting, diarrhea, disorientation, and even death.



**More Info:** For additional facts about drugs, visit [scholastic.com/headsup](http://scholastic.com/headsup) and [teens.drugabuse.gov](http://teens.drugabuse.gov).



**Q: HOW IS MARIJUANA ADDICTIVE?**

**A:** Marijuana is addictive for some people, with the risk increasing for those who start using it as a teen. It affects certain receptors in the brain, called cannabinoid receptors, which influence many functions, including the brain's reward system. Over time, this can make it difficult for some people to stop using marijuana even when it's having negative effects on their lives—this means they have become addicted. Also, because marijuana withdrawal can cause irritability and restlessness and “looks” different from withdrawal symptoms from drugs such as heroin, some people might not realize they are experiencing withdrawal.



**Q: WHAT ARE MOLLY AND SPICE AND WHY ARE THEY IN THE NEWS?**

**A:** Both Molly and Spice have led to hospitalizations and death, which makes headlines. Molly is another name for a drug called MDMA (also known as Ecstasy or X). MDMA affects areas of your brain that help you control your body temperature. It can cause the body to overheat to such an extreme that serious heart and kidney problems can result. MDMA is sometimes passed out at concerts and parties, but more and more, what is being presented as MDMA actually contains additional dangerous chemicals or other drugs (and sometimes has no MDMA at all). Spice, sometimes called K2 or “fake marijuana,” is a drug that is made by spraying plant material with dangerous chemicals. These chemicals can cause extreme reactions like hallucinations, paranoia, and heart problems.

**Q: HOW CAN I GET A FRIEND TO STOP TAKING DRUGS?**

**A:** Talking about drug use can be uncomfortable, so we suggest you ask a trusted teacher or coach to help you figure out how best to help your friend. Without being judgmental, you can let your friend know that you care and are concerned, and that he or she can talk to a trusted adult or a medical professional in confidence. Also, the anonymous national call line at 1-800-273-TALK is not just for emergencies, but can also connect your friend with a nearby professional. There is also a helpful fact sheet at [drugabuse.gov/helpforteens](http://drugabuse.gov/helpforteens).

### From the Nation's Leading Expert on Drugs

→ “Any potentially addictive drug can be the ‘worst’ drug. We are all different, and some of us might be more sensitive to one drug versus another. You often won’t know until it’s too late what your reaction will be. No one ever chooses to be addicted.”

—Dr. Nora D. Volkow, Director, NIDA

**All Q&As:**  
[www.teens.drugabuse.gov/chatday2015](http://www.teens.drugabuse.gov/chatday2015)



# Name That Element!

Which element is used to repair bones, build planes, and protect cell phones? Use these five clues and the periodic table on the next page to find out.

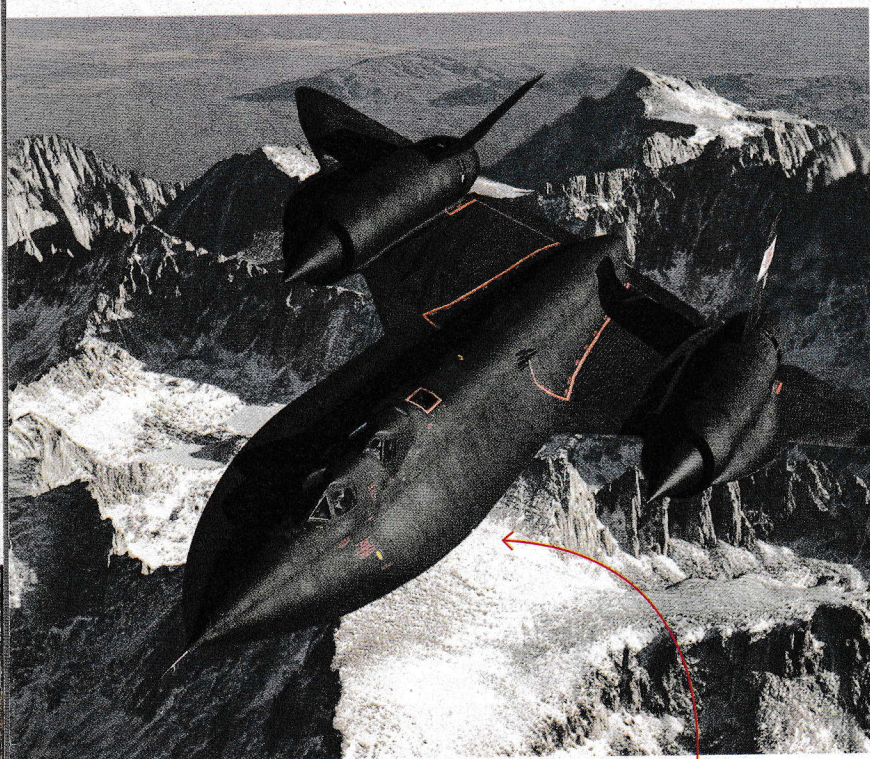
—Lydia Chain

## ANATOMY OF AN ELEMENT

|        |                |
|--------|----------------|
| X      | Atomic Number  |
| ??     | Element Symbol |
| NAME   | Element Name   |
| X.XXXX | Atomic Mass    |

**ATOMIC NUMBER** equals the number of *protons* (positively charged particles) in an atom's *nucleus*, or center. Each element consists of atoms that all have the same number of protons, and so each has a unique atomic number. In a neutral atom, the number of protons and the number of *electrons* (negatively charged particles) are equal.

**ATOMIC MASS** is the average mass of the naturally occurring *isotopes* of an element. Isotopes are atoms of an element with the same number of protons but with different numbers of neutrons.



## 1 STRONG SUBSTANCE

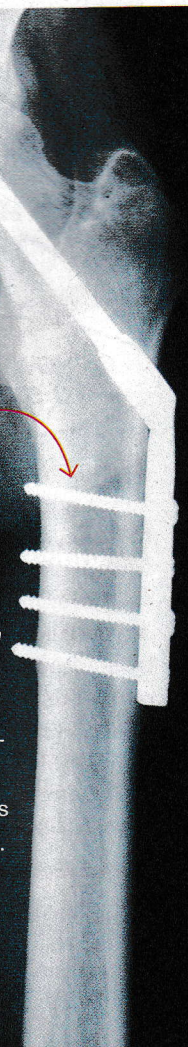
The mystery element is a metal found in an *ore* (a rock that contains minerals or metals). It's often mixed with other elements to create *alloys*. Alloys made from the mystery element are stronger than steel but much lighter. They're also resistant to *corrosion*, a process in which chemicals in air or salt water slowly degrade metal. Because of these qualities, alloys of the mystery element are often used in ships, airplanes, and even some cell phone cases. **Got it already? Score 100 points. Otherwise, read clue 2.**

# 2

## MEDICAL INNOVATION

The mystery element helps mend broken bones because it is *biocompatible*. That means it doesn't react with body tissue or cause infection. The element, a *transition metal*, integrates with bone so the two can fuse together. Many artificial hips and bone-fracture pins are made from this nonmagnetic element. It's even found in artificial hearts.

**Know the element? Score 80 points. Still guessing? See clue 3.**





3

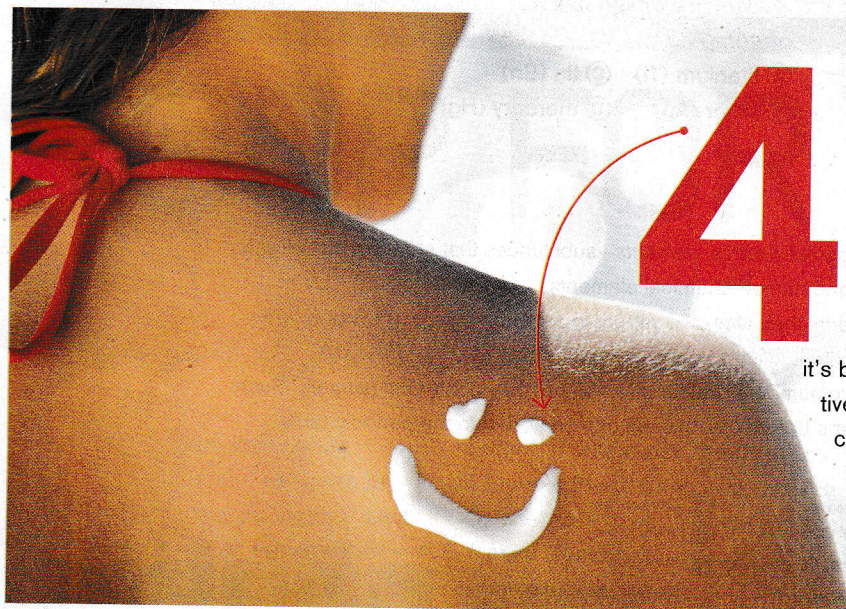
## BRACE YOURSELF

Orthodontists sometimes use a high-tech “memory wire” called *nitinol* in braces. Nitinol is an alloy of the mystery element and nickel (Ni), which

are members of the same *period*, or row. Your dentist molds the wire to the current shape of your teeth. When it's exposed to the heat of your mouth, the wire slowly re-forms into its original, straighter shape. This process pulls on your teeth, gradually moving them into proper alignment. **Got it yet? Score 60 points. No luck? Check out clue 4.**



4 BONUS  
SKILLS  
SHEETS  
scholastic.com  
/scienceworld



4

## SKIN SAVER

White paint and many plastics owe their whiteness to the mystery element. When the element and oxygen (O) are chemically bonded, they form a powdery *compound* that scatters most of the light that hits it.

That makes the powder—and anything it's been added to—appear white. This reflective property also makes the compound a common ingredient in sunscreens, since harmful *ultraviolet rays* bounce off it.

**Cracked the case? Score 40 points. If not, try the last clue.**

5

## SPARKLY SILVER SHOW

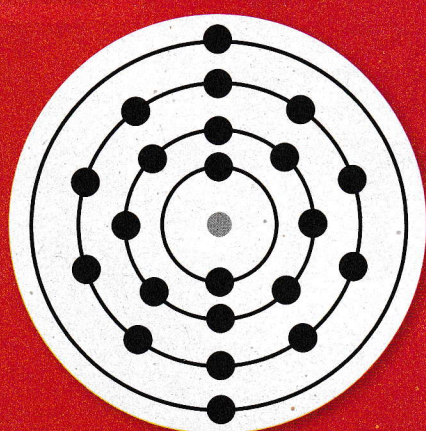
If you've ever watched fireworks, you've witnessed the *combustion*, or burning, of the mystery element. People who make fireworks mix the mystery element with vanadium (V) and aluminum (Al) to create a gray powder that burns silvery white. It makes spectacular fireworks because the mystery element has a very high melting point of  $1,668^{\circ}\text{C}$  ( $3,034^{\circ}\text{F}$ ) and ignites easily in the air. Vanadium's atomic number is one higher than that of the mystery element. **Figured out the mystery element? Score 20 points. Then turn the page.**



WHAT'S THE ELEMENT?



# TEST YOUR CHEMISTRY IQ



## ATOMIC STRUCTURE

The mystery element is found in meteorites and rocks brought back to Earth from the moon.

Use the periodic table below and what you learned about the mystery element on the previous pages to answer the following questions.

- Which of the following shares a period with aluminum (Al)?  
 (A) lead (Pb) (C) sulfur (S)  
 (B) boron (B) (D) zinc (Zn)
- Which of the following is NOT true of the mystery element?  
 (A) It has a high melting point.  
 (B) It ignites easily in air.  
 (C) It is found in an ore.  
 (D) It's magnetic.
- Which element has 47 protons?  
 (A) titanium (Ti) (C) tin (Sn)  
 (B) silver (Ag) (D) mercury (Hg)
- The mystery element is a(n) \_\_\_\_\_ metal.  
 (A) inner transition  
 (B) alkali  
 (C) alkaline earth  
 (D) transition
- Which of the following is a noble gas?  
 (A) argon (Ar)  
 (B) francium (Fr)  
 (C) chlorine (Cl)  
 (D) radium (Ra)

## PERIODIC TABLE

The periodic table is a systematic way to organize Earth's *elements*—substances that each consist of only one kind of atom. Today, there are 114 known and named chemical elements.

Elements on the periodic table are arranged by their atomic numbers in ascending order. Hydrogen (H), for example, has an atomic number of 1 and is the lightest known natural element.

Scientists have created elements with atomic numbers greater than 92, but they don't exist naturally. Such elements must be confirmed by two different labs before their names can be added to the periodic table.

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|  |  |  |  |  |  |  |  |  |  |  | Group 17 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Group 18 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div><div>C</div><div>Solid</div></div> <div><div>Br</div><div>Liquid</div></div> <div><div>He</div><div>Gas</div></div> <div><div>Tc</div><div>Synthetic</div></div> <div><div>Uus</div><div>Unconfirmed</div></div> <div><div>H</div><div>Hydrogen</div></div> <div><div>Li</div><div>Lithium</div></div> <div><div>Na</div><div>Sodium</div></div> <div><div>K</div><div>Potassium</div></div> <div><div>Rb</div><div>Rubidium</div></div> <div><div>Cs</div><div>Cesium</div></div> <div><div>Fr</div><div>Francium</div></div> <div><div>Al</div><div>Aluminum</div></div> <div><div>Sc</div><div>Scandium</div></div> <div><div>Y</div><div>Yttrium</div></div> <div><div>57-71</div><div></div></div> <div><div>89-103</div><div></div></div> <div><div>La</div><div>Lanthanum</div></div> <div><div>Ce</div><div>Cerium</div></div> <div><div>Pr</div><div>Praseodymium</div></div> <div><div>Nd</div><div>Neodymium</div></div> <div><div>Pm</div><div>Promethium</div></div> <div><div>Sm</div><div>Samarium</div></div> <div><div>Eu</div><div>Europium</div></div> <div><div>Gd</div><div>Gadolinium</div></div> <div><div>Tb</div><div>Terbium</div></div> <div><div>Dy</div><div>Dysprosium</div></div> <div><div>Ho</div><div>Holmium</div></div> <div><div>Er</div><div>Erbium</div></div> <div><div>Tm</div><div>Thulium</div></div> <div><div>Yb</div><div>Ytterbium</div></div> <div><div>Lu</div><div>Lutetium</div></div> <div><div>Ac</div><div>Actinium</div></div> <div><div>Th</div><div>Thorium</div></div> <div><div>Pa</div><div>Protactinium</div></div> <div><div>U</div><div>Uranium</div></div> <div><div>Np</div><div>Neptunium</div></div> <div><div>Pu</div><div>Plutonium</div></div> <div><div>Am</div><div>Americium</div></div> <div><div>Cm</div><div>Curium</div></div> <div><div>Bk</div><div>Berkelium</div></div> <div><div>Cf</div><div>Californium</div></div> <div><div>Es</div><div>Einsteinium</div></div> <div><div>Fm</div><div>Fermium</div></div> <div><div>Md</div><div>Mendelevium</div></div> <div><div>No</div><div>Nobelium</div></div> <div><div>Lr</div><div>Lawrencium</div></div> <div><div>Other metals</div></div> <div><div>Alkali metals</div></div> <div><div>Alkaline earth metals</div></div> <div><div>Transition metals</div></div> <div><div>Noble gases</div></div> <div><div>Nonmetals</div></div> <div><div>Inner transition metals</div></div> <div><div>Unknown properties</div></div> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | <div><div>2</div><div>He</div><div>Helium</div><div>4.003</div></div> <div><div>3</div><div>Li</div><div>Lithium</div><div>6.938, 6.997</div></div> <div><div>4</div><div>Be</div><div>Beryllium</div><div>9.012</div></div> <div><div>5</div><div>B</div><div>Boron</div><div>10.80, 10.83</div></div> <div><div>6</div><div>C</div><div>Carbon</div><div>12.00, 12.02</div></div> <div><div>7</div><div>N</div><div>Nitrogen</div><div>14.00, 14.01</div></div> <div><div>8</div><div>O</div><div>Oxygen</div><div>16.00, 16.00</div></div> <div><div>9</div><div>F</div><div>Fluorine</div><div>18.99</div></div> <div><div>10</div><div>Ne</div><div>Neon</div><div>20.18</div></div> <div><div>11</div><div>Na</div><div>Sodium</div><div>22.98</div></div> <div><div>12</div><div>Mg</div><div>Magnesium</div><div>24.30, 24.31</div></div> <div><div>13</div><div>Al</div><div>Aluminum</div><div>26.98</div></div> <div><div>14</div><div>Si</div><div>Silicon</div><div>28.08, 28.09</div></div> <div><div>15</div><div>P</div><div>Phosphorus</div><div>30.97</div></div> <div><div>16</div><div>S</div><div>Sulfur</div><div>32.05, 32.08</div></div> <div><div>17</div><div>Cl</div><div>Chlorine</div><div>35.44, 35.46</div></div> <div><div>18</div><div>Ar</div><div>Argon</div><div>39.95</div></div> <div><div>19</div><div>K</div><div>Potassium</div><div>39.10</div></div> <div><div>20</div><div>Ca</div><div>Calcium</div><div>40.08</div></div> <div><div>21</div><div>Sc</div><div>Scandium</div><div>44.96</div></div> <div><div>22</div><div>Ti</div><div>Titanium</div><div>47.87</div></div> <div><div>23</div><div>V</div><div>Vanadium</div><div>50.94</div></div> <div><div>24</div><div>Cr</div><div>Chromium</div><div>52.00</div></div> <div><div>25</div><div>Mn</div><div>Manganese</div><div>54.94</div></div> <div><div>26</div><div>Fe</div><div>Iron</div><div>55.85</div></div> <div><div>27</div><div>Co</div><div>Cobalt</div><div>58.93</div></div> <div><div>28</div><div>Ni</div><div>Nickel</div><div>58.69</div></div> <div><div>29</div><div>Cu</div><div>Copper</div><div>63.55</div></div> <div><div>30</div><div>Zn</div><div>Zinc</div><div>65.38</div></div> <div><div>31</div><div>Ga</div><div>Gallium</div><div>69.72</div></div> <div><div>32</div><div>Ge</div><div>Germanium</div><div>72.63</div></div> <div><div>33</div><div>As</div><div>Arsenic</div><div>74.92</div></div> <div><div>34</div><div>Se</div><div>Selenium</div><div>78.97</div></div> <div><div>35</div><div>Br</div><div>Bromine</div><div>79.90, 79.93</div></div> <div><div>36</div><div>Kr</div><div>Krypton</div><div>83.80</div></div> <div><div>37</div><div>Rb</div><div>Rubidium</div><div>85.47</div></div> <div><div>38</div><div>Sr</div><div>Strontium</div><div>87.62</div></div> <div><div>39</div><div>Y</div><div>Yttrium</div><div>88.91</div></div> <div><div>40</div><div>Zr</div><div>Zirconium</div><div>91.22</div></div> <div><div>41</div><div>Nb</div><div>Niobium</div><div>92.91</div></div> <div><div>42</div><div>Mo</div><div>Molybdenum</div><div>95.96</div></div> <div><div>43</div><div>Tc</div><div>Technetium</div><div>(98)</div></div> <div><div>44</div><div>Ru</div><div>Ruthenium</div><div>101.1</div></div> <div><div>45</div><div>Rh</div><div>Rhodium</div><div>102.9</div></div> <div><div>46</div><div>Pd</div><div>Palladium</div><div>106.4</div></div> <div><div>47</div><div>Ag</div><div>Silver</div><div>107.9</div></div> <div><div>48</div><div>Cd</div><div>Cadmium</div><div>112.4</div></div> <div><div>49</div><div>In</div><div>Indium</div><div>114.8</div></div> <div><div>50</div><div>Sn</div><div>Tin</div><div>118.7</div></div> <div><div>51</div><div>Sb</div><div>Antimony</div><div>121.8</div></div> <div><div>52</div><div>Te</div><div>Tellurium</div><div>127.6</div></div> <div><div>53</div><div>I</div><div>Iodine</div><div>126.9</div></div> <div><div>54</div><div>Xe</div><div>Xenon</div><div>131.3</div></div> <div><div>55</div><div>Cs</div><div>Cesium</div><div>132.9</div></div> <div><div>56</div><div>Ba</div><div>Barium</div><div>137.3</div></div> <div><div>57-71</div><div></div><div></div></div> <div><div>58</div><div>Hf</div><div>Hafnium</div><div>178.5</div></div> <div><div>59</div><div>Ta</div><div>Tantalum</div><div>180.9</div></div> <div><div>60</div><div>W</div><div>Tungsten</div><div>183.8</div></div> <div><div>61</div><div>Re</div><div>Rhenium</div><div>186.2</div></div> <div><div>62</div><div>Os</div><div>Osmium</div><div>190.2</div></div> <div><div>63</div><div>Ir</div><div>Iridium</div><div>192.2</div></div> <div><div>64</div><div>Pt</div><div>Platinum</div><div>195.1</div></div> <div><div>65</div><div>Au</div><div>Gold</div><div>197.0</div></div> <div><div>66</div><div>Hg</div><div>Mercury</div><div>200.6</div></div> <div><div>67</div><div>Tl</div><div>Thallium</div><div>(204.3, 204.4)</div></div> <div><div>68</div><div>Pb</div><div>Lead</div><div>207.2</div></div> <div><div>69</div><div>Bi</div><div>Bismuth</div><div>209.0</div></div> <div><div>70</div><div>Po</div><div>Polonium</div><div>(209)</div></div> <div><div>71</div><div>At</div><div>Astatine</div><div>(210)</div></div> <div><div>72</div><div>Rn</div><div>Radon</div><div>(222)</div></div> <div><div>73</div><div>Fr</div><div>Francium</div><div>(223)</div></div> <div><div>74</div><div>Ra</div><div>Radium</div><div>(226)</div></div> <div><div>75-103</div><div></div><div></div></div> <div><div>76</div><div>Rf</div><div>Rutherfordium</div><div>(261)</div></div> <div><div>77</div><div>Db</div><div>Dubnium</div><div>(268)</div></div> <div><div>78</div><div>Sg</div><div>Seaborgium</div><div>(271)</div></div> <div><div>79</div><div>Bh</div><div>Bohrium</div><div>(270)</div></div> <div><div>80</div><div>Hs</div><div>Hassium</div><div>(277)</div></div> <div><div>81</div><div>Mt</div><div>Meitnerium</div><div>(276)</div></div> <div><div>82</div><div>Ds</div><div>Darmstadtium</div><div>(281)</div></div> <div><div>83</div><div>Rg</div><div>Roentgenium</div><div>(280)</div></div> <div><div>84</div><div>Cn</div><div>Copernicium</div><div>(285)</div></div> <div><div>85</div><div>Uut</div><div>Ununtrium</div><div>(284)</div></div> <div><div>86</div><div>Fl</div><div>Flerovium</div><div>(289)</div></div> <div><div>87</div><div>Uup</div><div>Ununpentium</div><div>(288)</div></div> <div><div>88</div><div>Lv</div><div>Livermorium</div><div>(293)</div></div> <div><div>89</div><div>Uus</div><div>Ununseptium</div><div>(294)</div></div> <div><div>90</div><div>Uuo</div><div>Ununoctium</div><div>(294)</div></div> <div><div>91</div><div>La</div><div>Lanthanum</div><div>138.9</div></div> <div><div>92</div><div>Ce</div><div>Cerium</div><div>140.1</div></div> <div><div>93</div><div>Pr</div><div>Praseodymium</div><div>140.9</div></div> <div><div>94</div><div>Nd</div><div>Neodymium</div><div>144.2</div></div> <div><div>95</div><div>Pm</div><div>Promethium</div><div>(145)</div></div> <div><div>96</div><div>Sm</div><div>Samarium</div><div>150.4</div></div> <div><div>97</div><div>Eu</div><div>Europium</div><div>152.0</div></div> <div><div>98</div><div>Gd</div><div>Gadolinium</div><div>157.3</div></div> <div><div>99</div><div>Tb</div><div>Terbium</div><div>158.9</div></div> <div><div>100</div><div>Dy</div><div>Dysprosium</div><div>162.5</div></div> <div><div>101</div><div>Ho</div><div>Holmium</div><div>164.9</div></div> <div><div>102</div><div>Er</div><div>Erbium</div><div>167.3</div></div> <div><div>103</div><div>Tm</div><div>Thulium</div><div>168.9</div></div> <div><div>104</div><div>Yb</div><div>Ytterbium</div><div>173.1</div></div> <div><div>105</div><div>Lu</div><div>Lutetium</div><div>175.0</div></div> <div><div>106</div><div>Ac</div><div>Actinium</div><div>(227)</div></div> <div><div>107</div><div>Th</div><div>Thorium</div><div>232.0</div></div> <div><div>108</div><div>Pa</div><div>Protactinium</div><div>231.0</div></div> <div><div>109</div><div>U</div><div>Uranium</div><div>238.0</div></div> <div><div>110</div><div>Np</div><div>Neptunium</div><div>(237)</div></div> <div><div>111</div><div>Pu</div><div>Plutonium</div><div>(244)</div></div> <div><div>112</div><div>Am</div><div>Americium</div><div>(243)</div></div> <div><div>113</div><div>Cm</div><div>Curium</div><div>(247)</div></div> <div><div>114</div><div>Bk</div><div>Berkelium</div><div>(247)</div></div> <div><div>115</div><div>Cf</div><div>Californium</div><div>(251)</div></div> <div><div>116</div><div>Es</div><div>Einsteinium</div><div>(252)</div></div> <div><div>117</div><div>Fm</div><div>Fermium</div><div>(257)</div></div> <div><div>118</div><div>Md</div><div>Mendelevium</div><div>(258)</div></div> <div><div>119</div><div>No</div><div>Nobelium</div><div>(259)</div></div> <div><div>120</div><div>Lr</div><div>Lawrencium</div><div>(262)</div></div> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |          |  |  |  | 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**FOSSILIZED TURTLE DUNG?** These specimens were auctioned off for \$3,250, but scientists aren't so sure they're really droppings.

**GROSS OUT!**



# POOP FOR SALE!

Dino dung?



**W**ho knew poop could be worth its weight in gold? Last year, buyers paid \$3,250 for what was advertised as fossilized turtle poop, and \$8,500 for a long, thin dinosaur *coprolite* (fossilized dung). But scientists are questioning whether these 6-million-year-old specimens (above), found in Washington State, were ever actually poop.

Unlike fresh poop, coprolites aren't squishy and smelly—they became fossils millions of years ago. "When you tell someone that these are fossil feces, you see them wrinkle up their noses," says Karen Chin, a paleontologist at the University of Colorado in Boulder. "But they're rocks."

Coprolites can tell scientists a

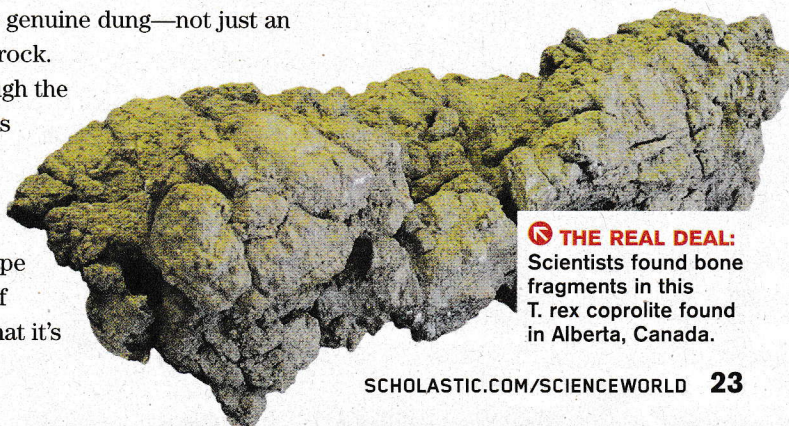
lot about an extinct animal's diet. Chin has found fragments of bone in fossilized dung that was probably from a *Tyrannosaurus rex*. The bone fragments suggest the dinos gobbled down their food without much chewing. Coprolites also preserve things that are rarely found in the *fossil record*, like eggs from a tapeworm. Finds like these not only add to our understanding of ancient species, they also prove that a fossil is genuine dung—not just an ordinary rock.

Although the specimens pictured above look like dung, shape isn't proof enough that it's

a coprolite. Chin says that rocks can form turd-like shapes. For example, if mud squeezes through a hole, it can harden to look like a coprolite.

Chin also points out that since dung is more delicate than bone, it's less likely to fossilize. That means it's harder to find a coprolite than a fossilized bone. A quick burial of the poop increases the odds that it will transform into coprolite treasure.

—Kathryn Free



**THE REAL DEAL:** Scientists found bone fragments in this *T. rex* coprolite found in Alberta, Canada.

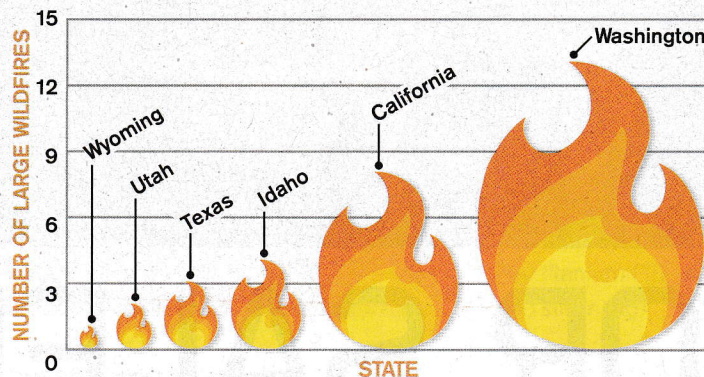
COURTESY OF THE ROYAL SASKATCHEWAN MUSEUM (BOTTOM); I.M. CHAIT (ALL OTHER PHOTOS)



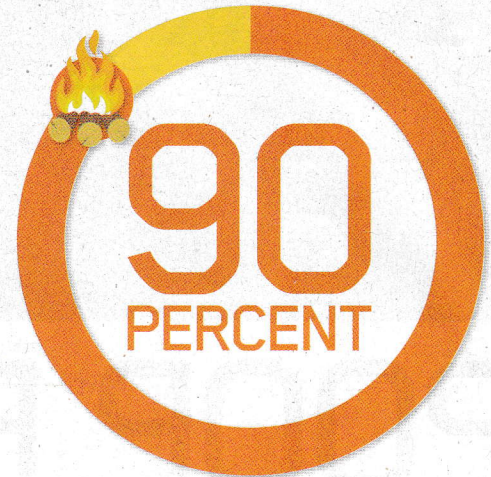
# BURNING UP

"Firestorm" (p.14) discusses evidence that wildfires may be on the rise in the West. Check out the information below to learn more about U.S. wildfires.

## NUMBER OF LARGE\* WILDFIRES THAT BURNED IN SEPTEMBER 2015 BY STATE



\*100 ACRES OR MORE IN FORESTED LAND, OR 300 ACRES OR MORE IN GRASSLAND OR BRUSH  
SOURCE: NATIONAL INTERAGENCY FIRE CENTER



Estimated percentage of U.S. wildfires caused by people, mostly by accident (for example, by not extinguishing campfires or cigarettes). The rest are the result of lightning or lava flows.

**6.7**  
RATE (IN MILES PER HOUR) AT WHICH WILDFIRES CAN SPREAD THROUGH FOREST. THEY CAN SPREAD TWICE AS FAST THROUGH GRASSLANDS.

**2,700**  
Approximate number of buildings in the U.S. that wildfires destroy per year. Many are homes.



**6.4 MILLION:** Average number of acres burned annually in the U.S., 2005-2014



**9.1 MILLION:** Number of acres burned in the U.S. this year as of late September 2015

**THINK ABOUT IT:** Which state had the most large wildfires in September 2015? What weather conditions might have made parts of that state susceptible to wildfires?

**SCI-TRIV**

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TEAM2: 20

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|-----------|--------------|-------------|-----------|---------|
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| 20 POINTS | ?            | CORRECT     | ?         | ?       |
| 30 POINTS | INCORRECT    | ?           | INCORRECT | ?       |
| 40 POINTS | ?            | CORRECT     | ?         | ?       |

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