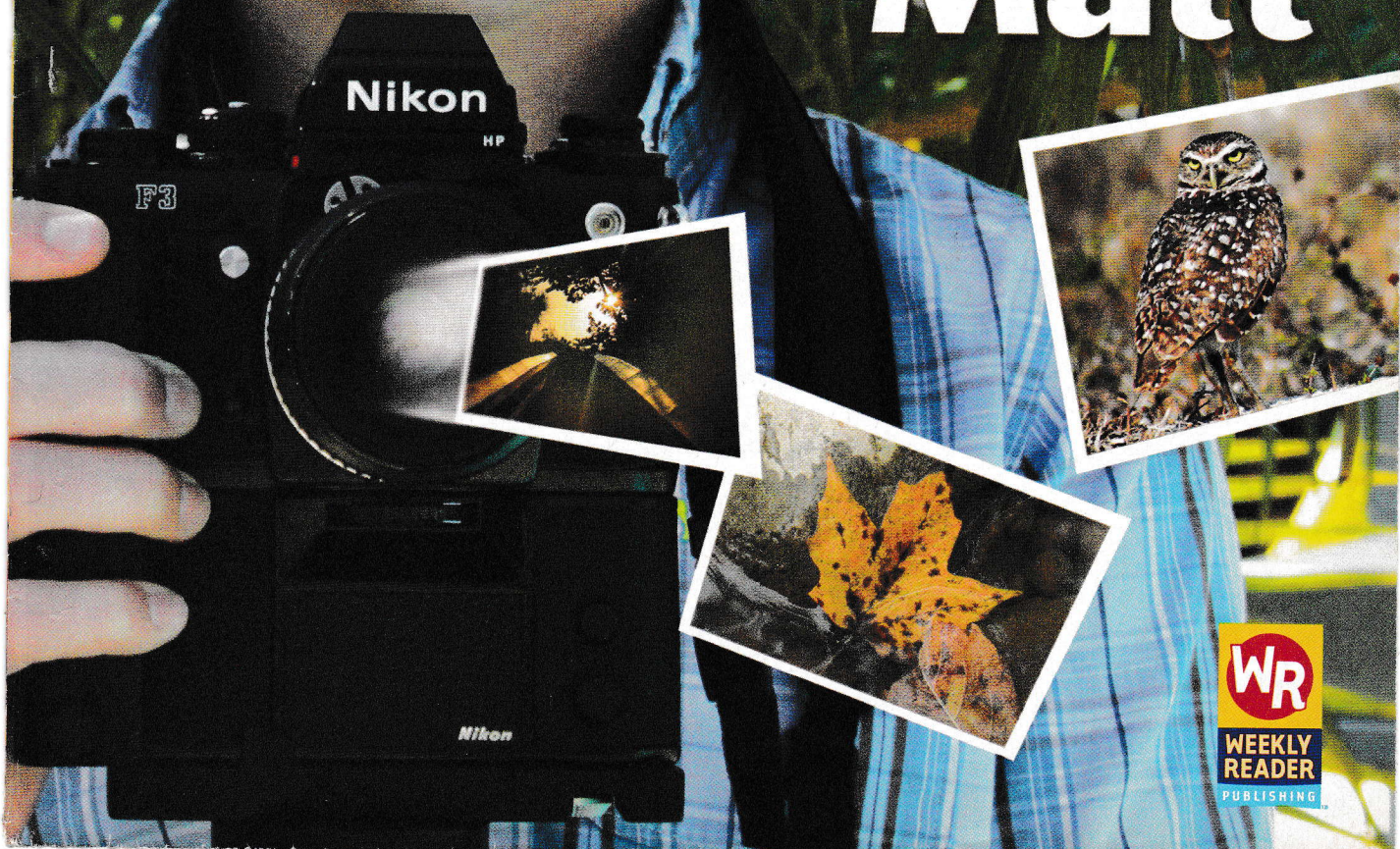


# CURRENT SCIENCE

October 2, 2009 • Vol. 95 • Issue 3 [www.weeklyreader.com](http://www.weeklyreader.com)

Matt Milligan's striking pictures show no traces of his disability.

## Photo Matt



**WR**  
WEEKLY  
READER  
PUBLISHING

# SCI-TRIVY GAME

Want to play a game of science trivia? See how many points you can win by correctly answering the questions below. To find your score, give yourself 10 points each time you get a first-row question right, 20 points for each second-row question, and so on. The **red bonus square** is worth double. Good luck!



Have fun  
learning  
about science!

	HEALTH SCIENCE	EARTH SCIENCE	MATHEMATICS	LIFE SCIENCE	PHYSICAL SCIENCE
10 POINTS	<p><i>True or False</i> Color-blind people see the world in black and white.</p>	<p><i>True or False</i> Moonrise is the time of day when the moon begins to rise over the horizon.</p>	<p><i>True or False</i> Addition and subtraction are inverse operations.</p>	<p><i>True or False</i> Some caterpillars vomit to gross out their enemies.</p>	<p><i>True or False</i> The element uranium was named after the planet Uranus.</p>
20 POINTS	<p>Which U.S. president was a paraplegic? (A) Thomas Jefferson (B) Abraham Lincoln (C) Franklin D. Roosevelt</p>	<p>Pea soup is a (A) pond bordered by pea plants. (B) polluted stream. (C) thick fog.</p>	<p>Which is a real number? (A) a bajillion (B) a nonillion (C) a zillion</p>	<p>Which bird is a wader? (A) bananaquit (B) robin (C) sandpiper</p>	<p>An atom of calcium has how many protons? (A) 10 (B) 20 (C) 40</p>
30 POINTS	<p>What medical condition is marked by a lack of red blood cells?</p>	<p>Which <i>Wizard of Oz</i> character shares a name with a very strong wind?</p>	<p>90 is what percent of 45?</p>	<p>What is an allomother?</p>	<p>A ramp is an example of which type of simple machine?</p>
40 POINTS	<p>A person who has pediculosis is infested with _____.</p>	<p>Coal, oil, and natural gas are all _____ fuels.</p>	<p>A _____ number contains a whole number and a fraction.</p>	<p>A _____ organism walks on two feet.</p>	<p>Hydraulics is the movement of a _____ under pressure.</p>
50 POINTS	<p>What is a plantar wart?</p>	<p>What is an aquifer?</p>	<p>What is an incircle?</p>	<p>What is a feral animal?</p>	<p>What is sugar glass?</p>

# ANIMAL SPOTS

**TACOLNESTON, England**—Gas-powered lawn mowers may soon be a thing of the past in Great Britain. Home owners are turning to a quieter, pollution-free substitute: *wallabies*.

Native to Australia and New Zealand, wallabies are marsupials (pouched mammals) that eat leaves, roots, and grass. International travelers first brought the animals to Great Britain in the 1800s, and several populations inhabit the wilds of England and Scotland. The lawn-mowing wallabies are raised in captivity and sold by local breeders, however.

Captive wallabies grow to between 2 and 3 feet tall and have a life expectancy of 12 to 15 years, says breeder Quintin Spratt. The animals are usually sold in pairs and require a living area of about half an acre of lawn. "They are amiable creatures, they don't make any noise, and they're really quite hearty," Spratt told *The Mail Online*.

One of Great Britain's biggest wallaby colonies—40 in total—roams Leonardslee Gardens, a privately owned park in southern England. "We have a number of very steep, grassy banks and areas where it is impossible for a lawn mower to reach, but which the wallabies keep trim and in good order," says park owner Robin Loder.

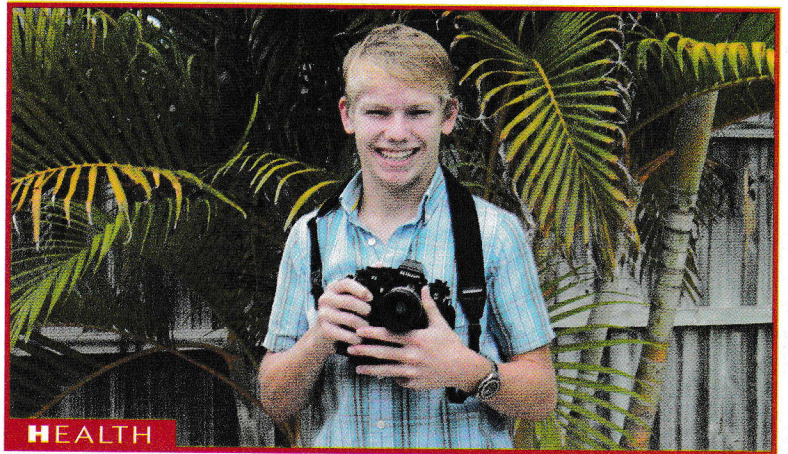


The latest model in lawn mowers, a wallaby nibbles on a patch of grass.

tbkmedia.de/Alamy

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Matt Milligan's photography reveals no sign of his unsteady hands.

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- Therapy helps immune system target cancer.
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- African volcano spews world's weirdest lava.
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COVER: Courtesy of Matthew Milligan. From top: Courtesy of Matthew Milligan; Gustavo Gilabert/Corbis Saba; Julie Alissi/Weekly Reader; AP Images

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By Stephen Fraser



A bee sucking nectar from a flower

Matt Milligan's striking pictures show no traces of his disability.

# Photo Matt

**T**wo years ago, Matt Milligan took his first photography class. Twelve years old at the time, Matt was the youngest student in a class of mostly senior citizens. But his pictures excelled compared with everyone else's. "He demonstrated amazing skills," says Garth Francis, the instructor. "I was very impressed with what he came back with just after the first class."

Matt's skills were all the more impressive because he has *cerebral palsy (CP)*, a form of brain damage that makes the muscles difficult to control. Photographers need steady hands, and Matt's hands shake. But with remarkable determination and the help of special equipment, Matt is proving that his artistic ability is secure. He has exhibited and sold photos at art shows in his hometown of Bonita Springs, Fla., and he just shot his first print magazine photos—for this issue of *Current Science*.

A steadying device called a *monopod* helps Matt Milligan compensate for his sometimes shaky hands. Matt took the three other photos shown on these pages.

All photos courtesy of Matthew Milligan



Old, abandoned trucks in rural Tennessee

## EARLY DIAGNOSIS

Matt's parents suspected that Matt might have some kind of disability when he was a toddler. "Instead of falling back on his bottom, like most babies would, he fell over like a tree!" says his mother, Lisa Milligan. "He also drooled a lot."

Matt's early diagnosis was typical. Most cases of CP are identified during infancy or early childhood because CP is usually a *congenital* condition—present at birth. Only a small number of cases result from head injuries or infectious diseases during the first months or years of life. Matt wasn't breathing when he was born, and the resulting lack of oxygen might have been what damaged his brain.

As many as 10,000 infants are born with CP in the United States every year. The symptoms vary widely from person to person. In some people, the muscles are stiff and difficult to relax. Other people have trouble maintaining their balance or controlling their voluntary movements. Still others walk on their toes or with one foot or leg dragging. In the most severe cases, CP renders a person *quadriplegic*—unable to move any of the limbs.

"There is no cure for cerebral palsy," says John Osterman, a pediatric neurologist from Fort Myers, Fla., who treats Matt. But physical therapy, speech therapy, braces, and surgery are all prescribed to lessen the symptoms and help people deal with the challenges of day-to-day living.

"Running and keeping my balance was my biggest struggle when I was little," says Matt. "Now it's speech and fine motor skills."

When Matt was a kid, his doctors predicted that he might never ride a bike or run. Were they wrong! Although it can be difficult for Matt to keep up with his brothers, he now rides a motorbike and has competed in a Special Olympics 15-mile run.

"Matt is very determined," notes his mother. She says Osterman told her that Matt has made more progress than any other CP patient he has known.

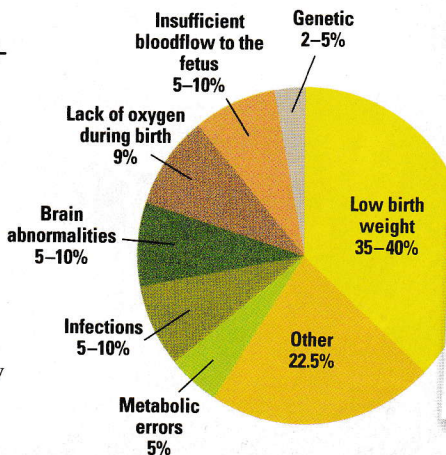
## NATURAL GIFT

Matt first tried his hand at photography when he was 9. The occasion was his brother's graduation from flight school. Matt's father, Mark Milligan, had acquired a new digital camera, and Matt asked him whether he could have his old Minolta 35mm film camera.

Matt's parents had to help him hold the Minolta. Even then, they weren't sure how well the photos would turn out. It was clear when the pictures came back from the developer, though, that Matt had a natural gift.

Today, Matt owns two cameras, a Canon EOS Rebel digital camera and a Nikon F3 film camera. "Photography is sometimes hard for me," he explains. "When I'm taking pictures, my hands shake. Sometimes, my pictures turn out real blurry." To compensate, Matt takes multiple shots of each

**Cerebral palsy, a form of brain damage that makes the muscles difficult to control, has many causes. (Metabolic errors are disorders in which the body cannot carry out certain chemical reactions.)**



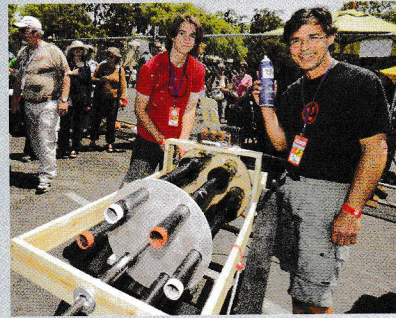
subject. He also uses a *monopod*, a steadying device that's "like a tripod but more compact and with one leg instead of three," he says. He hopes one day to own an *image stabilization lens*, which contains sensors that correct for camera movements, particularly at slow *shutter speeds*. Shutter speed is the length of time the camera's shutter is open, exposing the camera's film or image sensor to outside light. The slower the shutter speed, the longer the shutter is open.

In addition to exhibiting his work at art shows, Matt recently won first prize in a contest sponsored by *Breakaway*, an online magazine for boys. "Matt has an enthusiasm for his craft, a good eye for composition, and an aggressive way of pursuing his subjects—he just doesn't wait for something to happen," says Francis, the instructor.

Matt's long-term plan is to study photography at an art school or a college, then make his living as a news photographer. Meanwhile, he continues to hone his skills by scouting the neighboring woods and beaches, shooting pictures of wildlife and scenery. "You just have to try, try, try again until you can do it and see your dreams." **CS**



A great white egret (foreground) and a wood stork at the Corkscrew Swamp Sanctuary in Florida



All photos: Amy Snyder

By Pearl Tesler

# FAIRE PLAY

Our reporter checks out the mad science at a California geek fest.



“Here come the potatoes!”

*Thunk! Thunk! Thunk!*

*Thunk! Thunk! Thunk!* In a

rapid-fire burst, six potatoes zoom across the clear blue sky over San Mateo, Calif. A homemade potato Gatling gun that’s fueled by hair spray and ignited by spark plugs produces the onslaught.

“More potatoes!” someone yells.

Welcome to Maker Faire, a wacky, one-of-a-kind fair that brings together inventors, tinkerers, craftspeople, and people who just like to mess around with stuff. Launched in 2006 by the publishers of *Make* magazine, it’s a hybrid county fair and science fair, a place where “makers” of all kinds can show off their creations.

You can find traditional fair fare here—knitting, leatherwork, and glassblowing. More typical, though, is the atypical: cardboard surfboards, solar go-karts, a guitar-playing bicycle, and robotic warships that exchange volleys of BBs until all but one of the ships is sunk.

It’s a beautiful spring day at Maker Faire 2009. As I enter the fairgrounds, a man cruises by, driving a giant cupcake. “Have you seen the muffin?” he asks. Clearly, this fair is going to be a wild ride.

## SMALL CHANGE

Spying a crowd gathered around a small booth, I worm my way to the front in time to hear someone yell, “You’ll want to cover your ears for this part!” I do. *Boom!*

**Above:** A cupcake car and a Gatling gun being loaded with potatoes  
**Left:** Cola erupting from bottles depth-charged with Mentos candies

A guy wearing goggles—hobbyist David Pierce—opens a toaster-sized detonation chamber and removes a small metallic disk. It's a quarter. At least, it *was* a quarter. Now it's the size of a dime. How did that happen?

Pierce explains that he squashed the quarter with an insanely powerful *electromagnet*. An electromagnet is a temporary magnet created when electricity moves through a coil of wire. He volunteers to shrink another one for me.

He puts the quarter inside a coil of wire. He connects the coil to a *capacitor*, a device that stores an electric charge. Then he puts the coil into the detonation chamber, made of bulletproof plastic. He turns on a *generator*—a machine that makes electricity—and after a minute or so, the capacitor is fully charged. “Time to cover your ears,” he says.

*Boom!* A sudden discharge of electricity from the capacitor turns the coil of wire into an electromagnet. In response to the sudden, enormous burst of magnetism, the coil explodes into bits. Meanwhile, the quarter inside experiences a powerful inward force. That force is similar to the one that causes an electric motor to spin—a phenomenon called the *motor effect*. In the case of the quarter, the force is strong enough to squash the coin into a mini version of its former self.

## FRUIT LOOP

Drawn by eerie electronic music, my next stop is a booth where a woman is playing a banana peel keyboard! She touches one part of the peel and gets a musical note. She touches another part and gets a different note.

This unusual musical instrument relies on a simple electronic circuit that makes sounds of varying *frequency* (pitch), depending on the *resistance* in the circuit. Resistance is a measure of how difficult it is for electricity to flow through something.

The instrument is a homemade wad of battery-powered electronics about the size of a small pack of gum with two wires sticking out. One wire has been poked into the stem of a banana peel. The other I hold in one hand. With my free hand, I touch the banana peel to complete the circuit. Electricity passes from one wire to the other, in a loop that travels through my body—the current is too small to feel—and through the banana peel. Touching the peel in different locations **adds different resistance to the circuit, changing the note that the circuit plays.** Jay Silver, who created the simple circuit, has substituted other things for the banana and used it to “play” his own body and even a pile of macaroni and cheese.

By this point, it's getting very hot, so I go in search of a soft drink. I find it in abundance, flying through the sky at the EepyBird exhibit. EepyBird is a choreographed fountain display created by two guys in white lab coats—Fritz Grobe and Stephen Voltz. Their equipment is 600 rolls of Mentos mints and 100 two-liter bottles of Diet Coke.

Each fountain in the display is created by dropping a stack of mints into a bottle of cola. When the mints hit the drink, a jet of cola erupts from the bottle's mouth, climbing 6 meters (20 feet) into the air.

That reaction, says Grobe, is physical, not chemical. “Bubbles form

when they have a surface to stick to,” he says. The mints might seem smooth, but they're actually full of nooks and crannies at the microscopic level. Those nooks and crannies are perfect *bubble nucleation sites*—places where bubbles can form. Millions of carbon dioxide bubbles form all at once, forcing the cola out of the bottle in a spectacular geyser.

When their display is over, both Grobe and Voltz are soaked in cola. Smiling, they leave the crowd with a final message: “Try this at home!” **CS**



Music-making bananas (above) and a shrunken quarter (right)

Leaders from around the world will meet in Copenhagen, Denmark, in December to confront one of the world's most pressing problems: global warming. No doubt you've already heard a lot about it and what's causing it. You probably know that most scientists agree that the burning of *fossil fuels* (oil, coal, and natural gas) is a major contributor. It releases carbon dioxide (CO<sub>2</sub>) gas into the air, which heightens the greenhouse effect, further warming the atmosphere. Your family may even be trying to reduce its use of fossil fuels. It may be using compact fluorescent lightbulbs, riding bicycles, or perhaps even driving a fuel-saving hybrid car.

What you may not know is that the attempt to curb global warming also involves trees. Around the world, more trees

are being cut down and burned than ever before. That process, called *deforestation*, is thought to be a major cause of global warming. Deforestation may have added about 17 percent of the extra carbon that exists in the atmosphere. That's about as much carbon as industry has added (19 percent) and more than has come from transportation (14 percent).

"A lot of carbon is stored in trees, and a lot of that is changed into gas when trees are burned," says James Randerson, a climate scientist at the University of California, Irvine.

### TROPICAL ZONES

Most deforestation is taking place in the *tropics*, the areas flanking either side of the equator. The tropics receive intense sunlight, making them warm year round. Much of the tropics is also covered by ocean, which saturates the air with moisture

and makes many areas very rainy. Trees and other vegetation grow thickly in Earth's warm, wet tropical regions.

"The tropics have, on average, a very high *biomass*," says Doug Morton, a climate researcher at NASA, the U.S. space agency. Biomass is the total mass of living things, including all plants and animals, in an area. Carbon is one of the most common elements in living things. Indeed, it is so critical to living things that life on Earth is said to be "carbon-based."

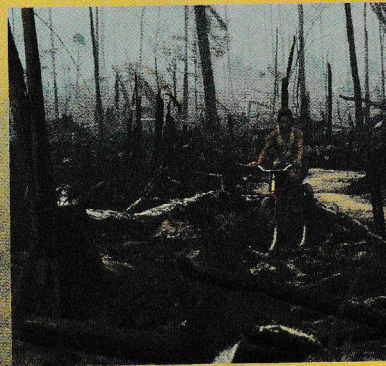
When a tree dies, it begins to decay. Small organisms, including insects, plants, fungi, and bacteria, break it down for food, a process that releases CO<sub>2</sub>. When a tree burns, the CO<sub>2</sub> is released all at once.

In many tropical regions, people are razing forests to create space for growing crops and for livestock to graze. "There's been tremendous clearing for agriculture and for pasture," says Randerson. "And it's been mechanized."

Adds Morton: "You can clear a lot more rain forest with a tractor than you can with a chain saw and an ax."

In some places, workers string heavy chains between bulldozers and then drag the chains through the trees, mowing them down. Then the stumps and felled trees are set on fire. Worldwide, an

Left: Danny Lehman/Corbis; Right & background: Jose Luis Bulcao/Corbis



By Chris Jozefowicz

# Fire Fight

Stopping the widespread burning and clearing of the world's tropical forests



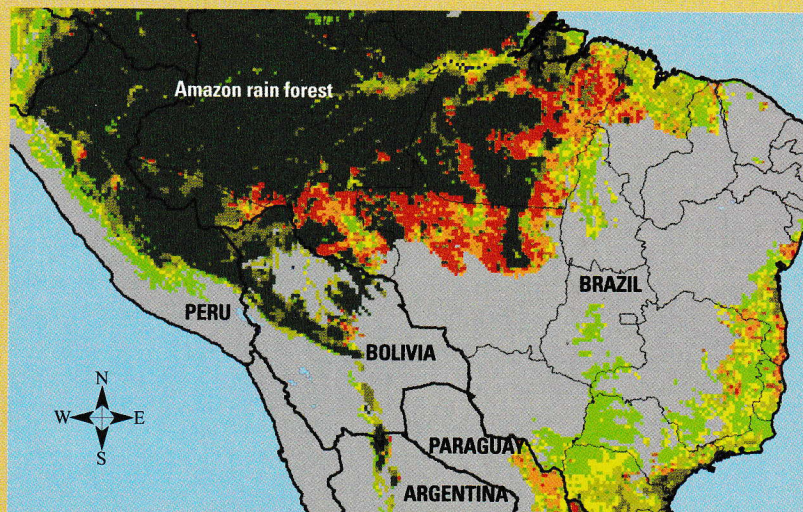
area of forest equal to a football field is razed every second, according to some sources.

### HOT SPOTS

Not all tropical forests have suffered the same degree of deforestation. "To rank them based on what we know now, Latin America and the Amazon basin is most important in terms of releasing greenhouse gases," says Morton. "Next is Southeast Asia and then Africa."

In the Amazon forest, where Morton does his research, much of the clearing is done to make space for pastureland for cattle and farmland for soybeans and other crops. The effects of deforestation are so intense there because the region is so large. The *Amazon River basin*, the area drained by the Amazon River and its tributaries, is roughly the size of the United States. There's a lot of carbon there to be released.

Many Southeast Asian forests, which Randerson has studied, are being cut down to make way for oil palm plantations. Though the forests in such places as Indonesia and Malaysia are not as big as the Amazon forests, deforestation in the region is still adding millions of tons of



The tan, orange, and red areas on this map of the Amazon rain forest show where deforestation reduced the forest cover by 5 to 25 percent (tan), 25 to 50 percent (orange), and more than 50 percent (red) between the years 2000 and 2005.

carbon to the air each year. Many forests in Southeast Asia experience regular droughts that cause fires to burn out of control and engulf more trees. In Africa, large-scale agriculture hasn't played as much of a role, so the African forests have not been affected to the same extent.

### SUSTAINABILITY

Conserving Earth's tropical forests involves helping local people find *sustainable* options—ones that don't deplete natural resources. Some countries are promoting crops that can be planted in the shade of larger trees. Those crops, such as coffee and cacao, allow farmers

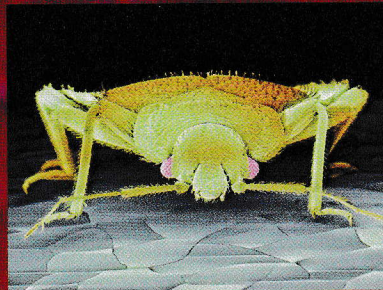
to grow food without clearing many trees. Other countries are fostering *ecotourism*—tours of regions rich in wildlife and natural beauty that don't damage the environment.

Randerson and Morton believe that real change will come only with the help of major international agreements. They hope to hear good things from the Copenhagen meeting. There, representatives may find ways to implement the Reducing Emissions from Deforestation and Forest Degradation in Developing Countries plan. That international agreement could set up a system in which tropical countries receive money to stop deforestation. "If we are willing to pay for the carbon in trees," Morton says, "then intact forests may be worth more than cleared areas for agriculture or other uses." **CS**

**Background:** A large swath of rain forest in South America is deliberately torched to make room for a farm.

**Opposite page:** An aerial view of a burning rain forest and the charred remains after a similar fire

# Sniff Test



Pasha's and Ruby's powerful noses locate bloodsucking bugs.

Left to right: Julie Alissi/Weekly Reader; Volker Steger/Photo Researchers, Inc.; Courtesy of Mike Morin; Julie Alissi/Weekly Reader

**P**asha and Ruby are off to work in New York City. The pair labor all over town—in hotels, apartment blocks, and schools. Each assignment takes about 10 minutes to complete, earning them a total of about \$300 in a five- to six-hour day.

While theirs is a job not everyone would want, there are some rewards. They're chauffeured in a private car. And they feast on treats after each assignment.

Pasha and Ruby are dogs. They make their living sniffing out bedbug infestations in city buildings. They're ideally suited for such work because dogs have one of the most acute senses of *olfaction* (smell) in nature.

## BLOODSUCKERS

Pasha is a male—part terrier, part basenji. Ruby, a female, is a beagle. Both are 18 months old and were trained at the FSI K9 Academy in Vincent, Ala. Dogs in the program are taught a single skill: to detect drugs, bombs, or bedbugs.

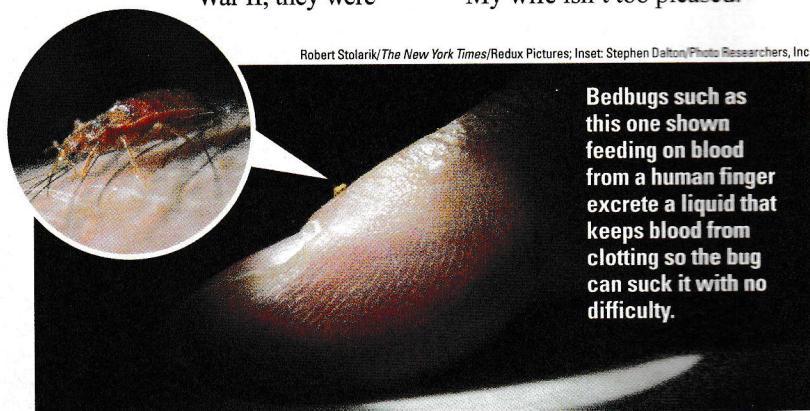
Pasha and Ruby work for Mike Morin and Don Frey of Bed Bug Finders, a Stratford, Conn.,

company that answers calls from people who are desperately trying to rid their properties of bedbugs (*Cimex lectularius*). The tiny insects are *hematophagous*—they feed on the blood of humans and other warm-blooded animals. Their bites leave behind itchy, red welts. Bedbugs are attracted by the carbon dioxide that people expel when they exhale. When a bedbug seeks out a host, usually in the middle of the night, it pricks the skin and feeds for three to 10 minutes. Then it scuttles away to a dark place—the fold of a mattress, maybe, or a crack in the floor. There, it hides, digesting its meal, almost impossible to see.

Bedbugs are making a comeback in the United States. After World War II, they were

virtually eliminated, largely through the use of DDT. But that powerful pesticide was found to be harmful to wildlife (and humans) and is now illegal in the United States. Lately, world travelers have unintentionally brought the insects back to the United States in increasing numbers. In New York City, there were 9,200 reported infestations last year.

Bedbugs have an onion-like odor, says Morin. When Pasha and Ruby pick up on the smell and locate its source, they've been trained to simply sit down. They're also retrained every day to recognize the odor. "That means we take vials with bedbugs in them and place them throughout my house for the dogs to find," says Morin. "My wife isn't too pleased."



Robert Stolarik/The New York Times/Redux Pictures; Inset: Stephen Dalton/Photo Researchers, Inc.

Bedbugs such as this one shown feeding on blood from a human finger excrete a liquid that keeps blood from clotting so the bug can suck it with no difficulty.



Opposite page: Pasha (left) and Ruby (right) sniff out bloodthirsty bedbugs such as the one shown in close-up.

## DISEASE DETECTION

Olfaction is the most highly developed sense in dogs. Like all *vertebrates* (animals with backbones), dogs have noses whose nasal cavity is partly lined with tissue called the *olfactory epithelium*. Embedded in that tissue are millions of nerve cells that are sensitive to odors in the environment. Humans have about 10 square centimeters of olfactory epithelium, but some dogs have as much as 170 square centimeters. That difference translates into a sense of smell that is far more acute in dogs than it is in humans, says Larry Myers of the Auburn University College of Veterinary Medicine in Alabama.

Myers has tested more than 4,000 dogs. Not all breeds have the same olfactory powers. The bloodhound may be the breed known for having the keenest sense of smell, but "I've tested a miniature poodle that had a sense of smell that was as good as the bloodhound's," says Myers.

Dogs may be capable of sniffing out more than bombs and bedbugs. They seem able to detect subtle odors released by chemical changes

that occur when diseases develop in the human body. In the past decade, medical researchers have conducted several experiments in which dogs demonstrated an ability to sniff out various types of cancer—skin, breast, lung, and bladder. In June, British researchers reported that dogs could be trained to warn people with *diabetes* when their blood sugar levels became dangerously low. Diabetes is a condition in which the body cannot regulate its blood sugar level.

Those results don't surprise Myers. "Physicians have always used their own senses to determine the presence or absence of disease," he says.

Pasha and Ruby's most difficult assignment so far was a bedbug infestation in a very dirty, cluttered apartment "with so many boxes, clothes on the floor, and newspapers piled high," says Morin. Jobs in cluttered homes are often a challenge for the dogs because such places frequently reek of many odors—spoiled food, dirty clothes—that distract the dogs. "Think of it," says Morin. "If you were a dog and you saw food on the floor, it would distract you too."

## What the Nose Knows

Why does an onion have such a strong odor and a piece of steel no odor at all? Onions emit millions of molecules that drift through the air. When those molecules reach your nose or the nose of a dog, they stimulate the olfactory nerve cells. The nose has millions of such cells, which differ from one another in their sensitivity to various airborne molecules.

Steel is *nonvolatile*. Nothing evaporates from it. No steel molecules drift through the air to your nose, so steel has no odor.

The sense of smell is a form of *chemoreception*. So is the sense of taste (*gustation*). Both react to chemicals in the environment.



*Cilia* (tiny filaments) inside the nose, shown here in extreme close-up, are covered with receptors that are sensitive to odor molecules in the air.

Anatomical Travelogue/Photo Researchers, Inc.

Soon enough, though, Pasha and Ruby found the bugs, nestled in a mattress in a child's bedroom. Exterminators were then called in to kill the insects.

"Our dogs have a 96 percent success rate finding bedbugs," says Morin. "That's pretty good!" **CS**

## Cannibal Sharks Endangered



Fisheries biologist Nick Otway monitors the artificial uterus that he uses to raise shark fetuses.

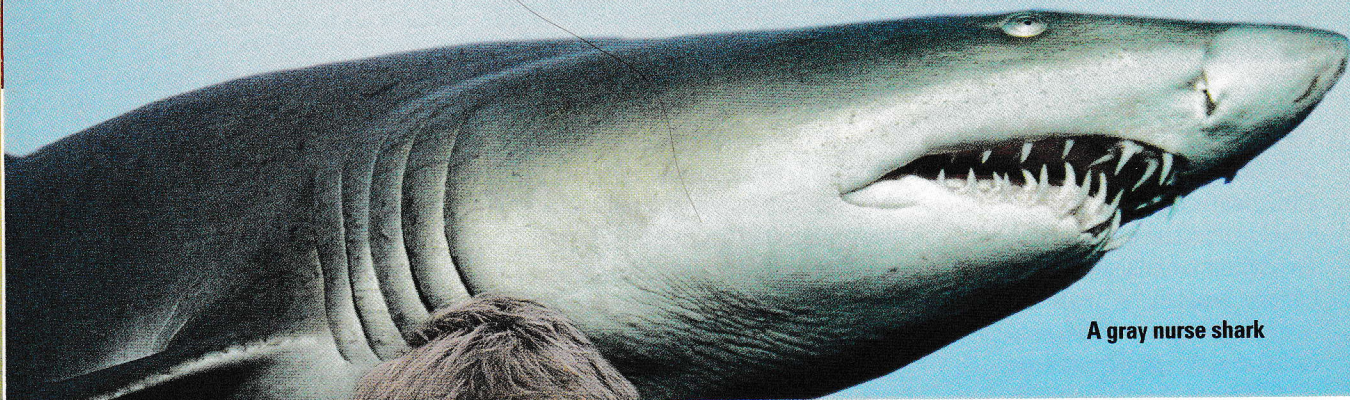
### life **PORT STEPHENS, Australia**

Many animal species practice cannibalism, but some sharks practice what may be the weirdest form. The shark fetuses attack and eat one another before they're born.

Fetal cannibalism might not worry anyone except the fetuses themselves. But its occurrence in the gray nurse shark is putting the species in peril. Overfishing has already endangered the species.

Now, fetal cannibalism could finish it off.

In an effort to rescue the gray nurse shark, an Australian fisheries biologist, Nick Otway, has developed an artificial *uterus*. A uterus is a hollow organ in which a fetus or fetuses develop. Female gray nurse sharks have two uteruses. Inside them, the fetuses prey on one another. By the time the mother gives birth, only two pups, one



A gray nurse shark

Seven years after Brian Mullin received an experimental cancer treatment, he's happy and healthy. "I've been through it, it was the past, time to move on," he says.



## Immune System Targets Cancer

### health **VALHALLA, N.Y.**

Brian Mullin was 18 months old when his parents noticed several odd bumps on his head. His doctor thought Brian had simply injured himself in a fall, but his parents pressed for a closer look. The eventual diagnosis wasn't good. Brian had *neuroblastoma*, the most common and deadliest cancer of children his age.

Neuroblastoma is a cancer of the *peripheral nervous system*. The PNS includes all the nerves that connect the limbs and the organs to the spinal cord. Like

from each uterus, have survived.

The artificial uterus that Otway built is an *acrylic* (a type of plastic) enclosure. Because gray nurse sharks are endangered, Otway experimented with wobbegong sharks, which are noncannibalistic and abundant. He put 10-month-old wobbegong fetuses into the uterus and filled it with seawater. Seventeen days later, six healthy pups were ready to be born.

Otway now plans to introduce wobbegong fetuses at much earlier stages of development into the uterus. That will mean modifying the chemicals in the uterus so that they match those in a real uterus. If those experiments are successful, he'll try to duplicate them with gray nurse shark fetuses. He'll remove the fetuses from a female gray nurse shark before they devour one another. Raising each fetus in an artificial uterus could increase the number of pups in one brood from two to 20, he says. ■

other neuroblastoma patients, Brian was treated aggressively with radiation and *chemotherapy* (cancer drugs). His doctor, M. Fevzi Ozkaynak, also offered an experimental *immunotherapy*. Ozkaynak is a cancer specialist at the Maria Fareri Children's Hospital at Westchester Medical Center.

Immunotherapy is a form of treatment that enhances the immune system's ability to fight a disease. The radiation and chemotherapy shrank the cancer to a size that Brian's immune system might deal with. Then, to lend the immune reaction a helping hand, Ozkaynak injected Brian with proteins that attached themselves to the cancer cells. Like tiny red flags, the proteins signaled to Brian's

immune system the location of the cancer cells.

Seven years later, Ozkaynak says he's confident that Brian has been cured. "I never expected to hear that word—*cure*," says Brian's father, Chris Mullin. "For a long time, Brian's doctor only said he was 'hopefully optimistic.'"

Brian is one of a number of children whose neuroblastomas have been eliminated by the treatment. Receiving immunotherapy together with radiation and chemotherapy improves a child's odds of survival by 20 percent, says Ozkaynak.

"Treating Brian was a big challenge," says Ozkaynak. "The entire treatment was very tough, but now, seven years later—it's priceless." ■



Rob Spence wants to film a documentary with the video camera in his false right eye.

## A Video Eye for an Eye

too weird

**TORONTO**—Rob Spence is a *cyborg*—or, as he calls himself, an "Eyeborg." A cyborg is a person whose body has electronic or mechanical parts. Spence has an artificial eye that's equipped with a wireless video camera.

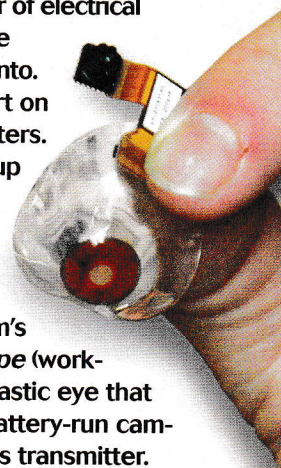
Spence, 36, lost vision in his right eye 25 years ago while visiting his granddad's farm. He was playing with a shotgun, firing at a pile of cow dung, when the gun backfired, blinding him in the eye. Spence wore a patch for years before replacing the eye with a *prosthetic* (artificial) one.

Spence is a documentary filmmaker and a science fiction buff. So the logical next step for him was to emulate his childhood hero, Steve Austin, and upgrade the false eye. Austin is the title character of the 1970s sci-fi TV series *The Six Million Dollar Man*. Austin is a bionic man: His electronic implants enhance his strength, speed, and vision far above human norms.

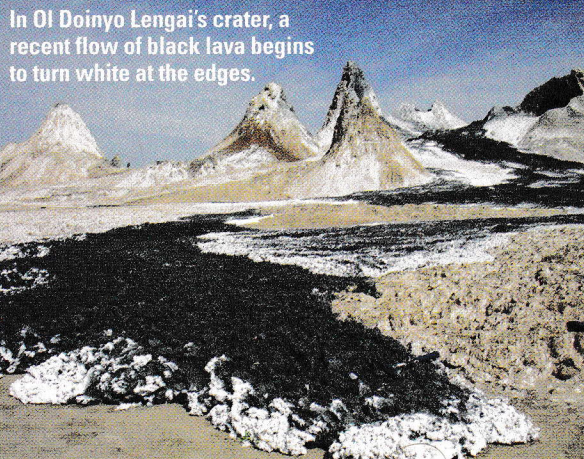
Spence teamed up with several professionals, including Steve Mann, a professor of electrical engineering at the University of Toronto. Mann is an expert on wearable computers. He also hooked up with Omnivision, a company that makes miniature cameras for cell phones. The team's \$30,000 *prototype* (working model) is a plastic eye that contains a tiny, battery-run camera and a wireless transmitter.

Spence isn't truly bionic. He can't see with the camera eye, and it's not wired to his brain. He hopes that leap in technology will happen one day soon, though. In the meantime, he plans to put the camera eye to use by filming documentaries from a unique point of view.

"[Steve Austin] became a superhero," Spence told NBC's *The Today Show*. "And that's essentially what I'm trying to do here." ■



Prof. Tobias Fischer, Volcanologist at the University of New Mexico, Albuquerque, USA



In Ol Doinyo Lengai's crater, a recent flow of black lava begins to turn white at the edges.

## Why This Volcano Is So Weird

**earth** GREAT RIFT VALLEY, Tanzania—

Ol Doinyo Lengai (ohl DOIN-yoh LEN-gigh) may be the world's weirdest volcano. Every other active volcano on the planet releases thick, red-hot lava. But Ol Doinyo Lengai's lava is not only cooler, it's also black and runny like dirty cooking oil. Now a U.S. geologist thinks he knows why.

Ol Doinyo Lengai rises out of a hot, remote grassland in eastern Africa. As in all volcanoes, its lava comes

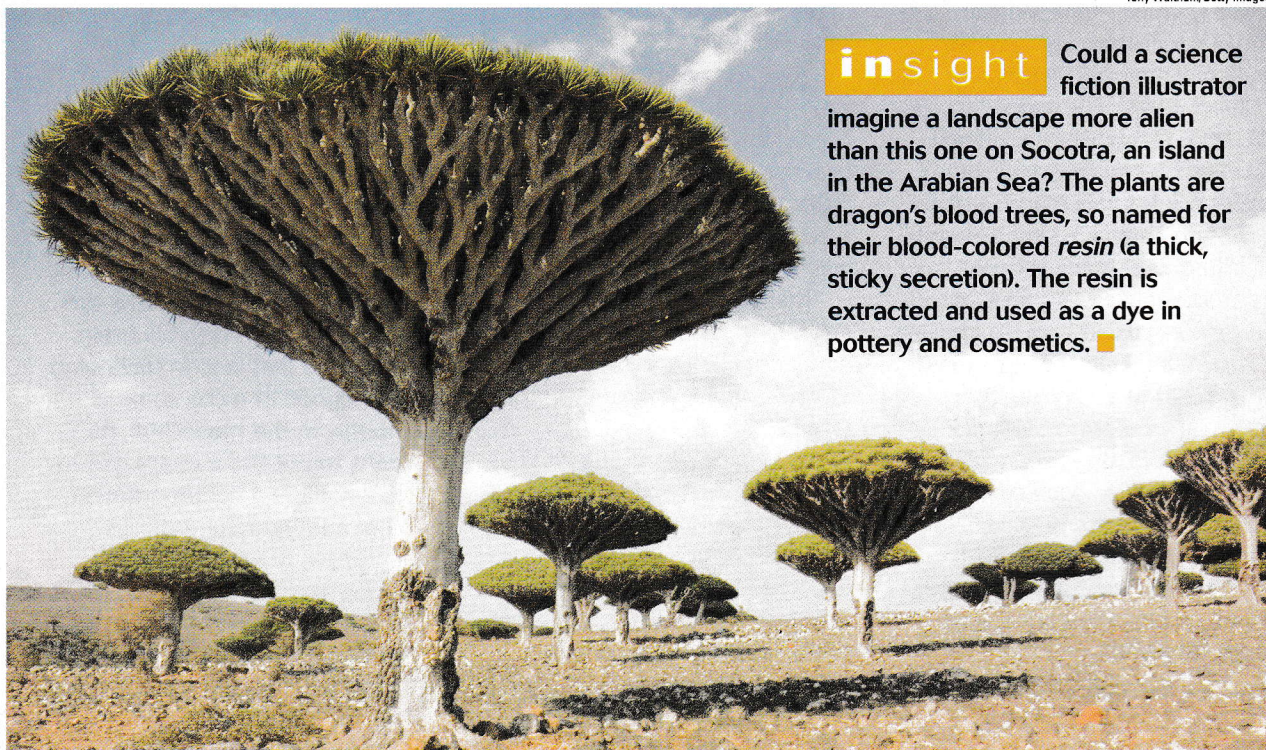
from the solid rock in Earth's *mantle*, the layer that lies beneath the crust. When that rock pushes upward through the crust, it melts and turns to lava. Almost all volcanoes spew lava that is rich in silicate minerals. Not Ol Doinyo Lengai. Its dark, runny lava contains no silicates and is called carbonatite, says Tobias Fischer, a volcanologist at the University of New Mexico.

Fischer has climbed Lengai several times to measure the volcanic gas it releases. His measurements suggest that the mantle rock that lies under Lengai is no different from the mantle rock anywhere else. So why is the lava so different, so lacking in silicates? Fischer speculates that the amount of melting that is going on under Lengai is much less than what's happening beneath other volcanoes. That small degree of melting is only sufficient to produce carbonatite, not silicate, lava.

Fischer says that Lengai actually switches back and forth between the two types of lava, depending on the degree of melting going on below ground. When carbonatite lava hardens, it turns white and crumbly as it reacts with moisture in the air. "It's a fragile rock that is easily weathered and washed away," he says. "So the volcano itself was built during those periods when it released harder, silicate-rich lava."

Doing research on Lengai is an adventure, says Fischer. The volcano is 3,000 meters (9,800 feet) high and very steep. "When you get to the top after seven to eight hours of climbing, you're exhausted," he says. "But you have to get right to work, measuring the gases." ■

Tony Waltham/Getty Images



**insight** Could a science fiction illustrator

imagine a landscape more alien than this one on Socotra, an island in the Arabian Sea? The plants are dragon's blood trees, so named for their blood-colored *resin* (a thick, sticky secretion). The resin is extracted and used as a dye in pottery and cosmetics. ■



This school bus covered in a dimpled wrap is now being road tested.

SkinzWraps (2)

## Dimpled Car Saves Fuel

### physical

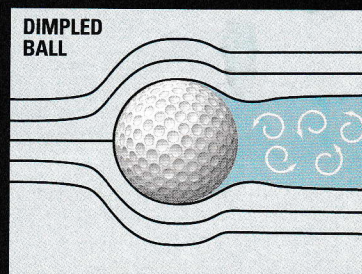
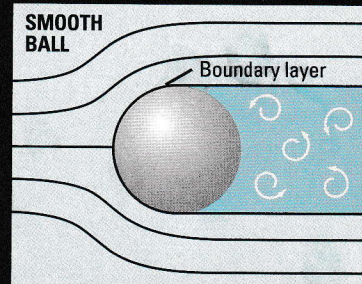
**DALLAS**—First there was the golf cart. Now comes the golf-ball car—a vehicle whose surface is indented like a golf ball's to save money on fuel.

Look closely at a golf ball and you'll see that its surface is mottled with specially molded craters, or *dimples*. Dimples were first added to golf balls many years ago when golfers began to notice that the balls sailed farther after becoming scarred and pitted from being hit again and again. Golf ball manufacturers began producing balls covered in craters.

Why don't smooth balls travel as far as dimpled ones? The answer is inferior *aerodynamics*, the flow of air around a moving object. The air flowing around a smooth ball leaves a larger path of air behind the ball, which slows the ball down. (See "Boundary Issues.")

A company in Texas has now applied the principles of golf-ball aerodynamics to transportation. The company, SkinzWraps, makes a material that is covered in small indentations similar to the dimples on a golf ball. The wrap is stuck to the body of a vehicle, giving it a dimpled complexion. SkinzWraps says the dimples improve the aerodynamics of a vehicle, reducing the amount of power needed to move the vehicle. It claims the wrap can improve the *fuel efficiency* (miles per gallon, or MPG) of a car by 20 percent. The wrap is called MPG-Plus.

Earlier this year, John Eagle Sport City Scion in Dallas became the first auto dealership to sell cars wrapped in MPG-Plus. SkinzWraps is now aiming at much bigger vehicles—tractor-trailers. It claims that the entire U.S. fleet of big rigs, covered in MPG-Plus, could save \$3 billion in fuel a year. ■

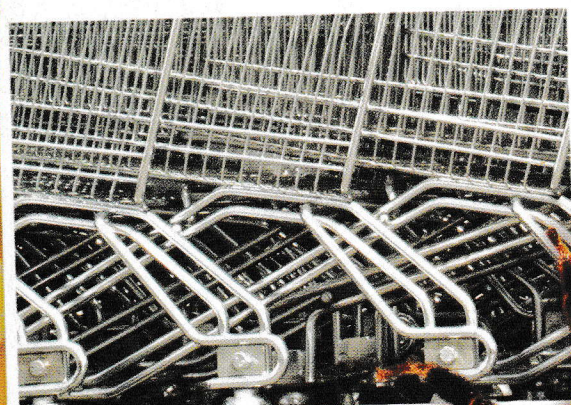
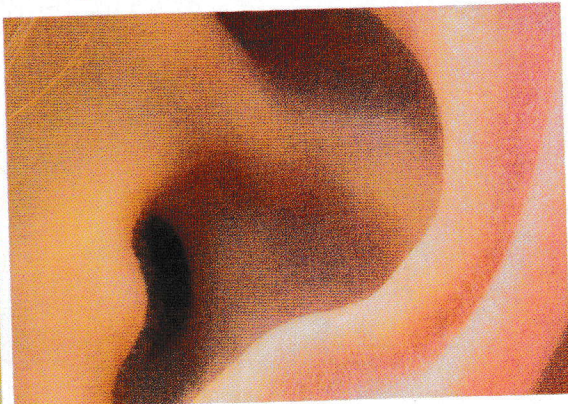


### Boundary Issues

A very thin layer of air, called a *boundary layer*, clings to a ball as it moves through the air. That layer decreases *drag*, a force that impedes motion. However, the layer also separates quickly from a ball that is smooth, leaving a large patch of swirling air behind the ball that puts a brake on the ball's forward motion.

A dimpled ball creates more *turbulence* (instability) in the boundary layer, resulting in more drag. However, that turbulence delays the separation of the boundary layer from the ball. The patch of swirling air behind the ball is smaller, and the ball sails farther than a smooth ball.

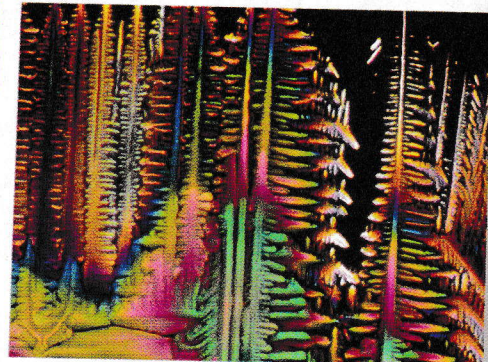
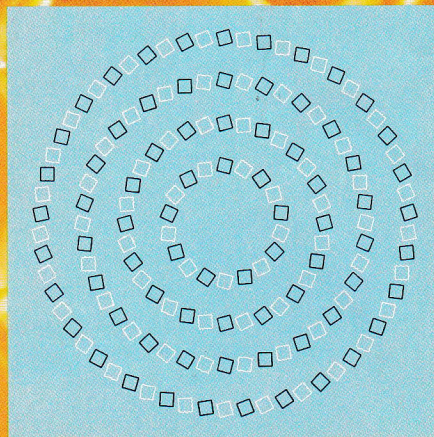
## MYSTERY PHOTOS



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Bend Your Mind: Courtesy of Baingio Pinna; Background: Shutterstock

## BEND YOUR MIND

How many perfect circles can you find?



## WHATIZIT?

This is a close-up of a nutrient that your body needs in small quantities to survive. You get it from eggs, fish, fortified milk, and cod-liver oil. Your skin is also able to make it when exposed to sunlight.

Answers to all Optricks are  
in the Teacher's Guide.

