

Life with Arsenic | Secret of Happiness | New Star Census

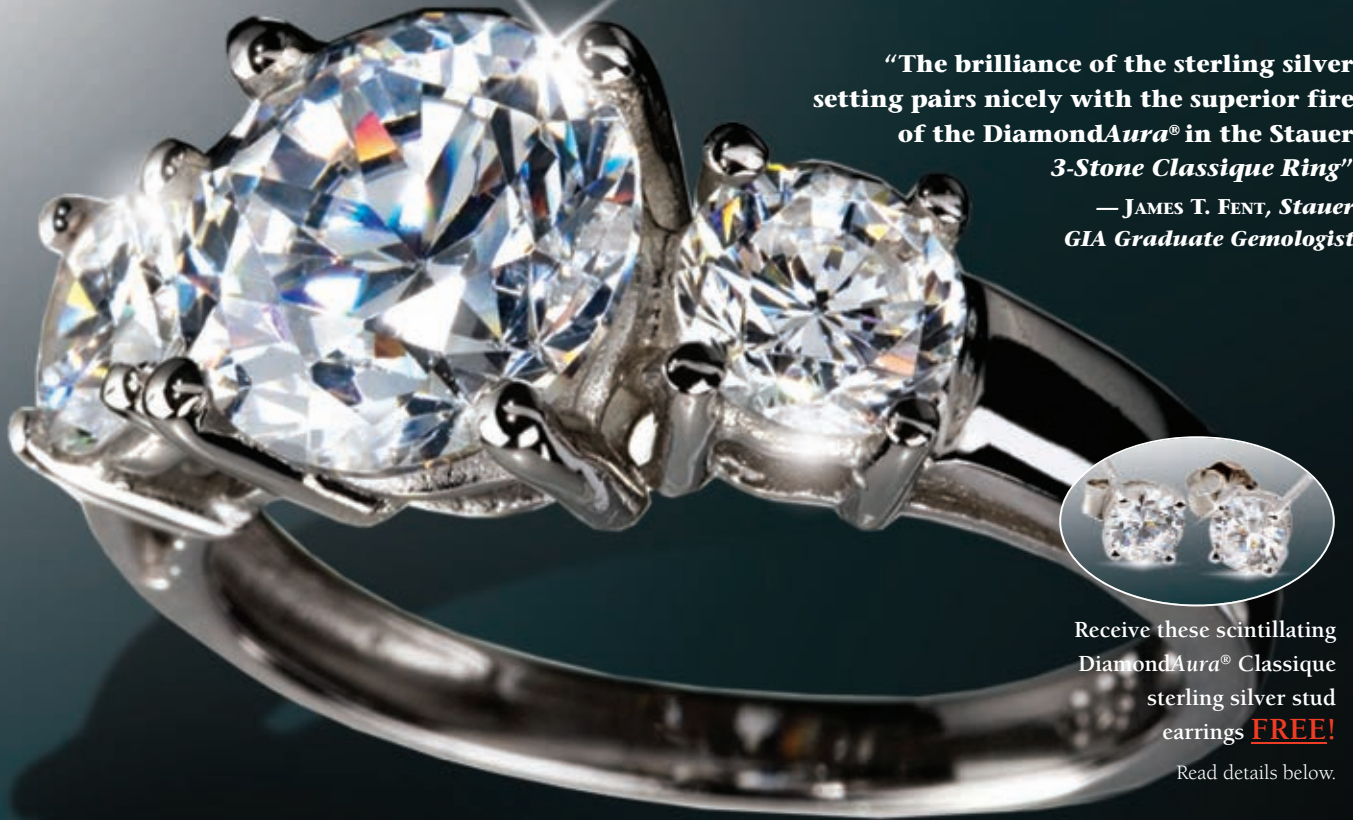
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ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ JANUARY 1, 2011

Gulf gusher
Vaccines vindicated
Fickle fish oil
Livable exoplanet
Next-gen gene therapy
Tainted receipts
Stem cells for hearts
Lucy's kin unveiled
Heat on wildlife
Finding fault in Haiti
Elements get heavy
New chlorophyll
Moving traffic
Lying lie detectors
Genomes go wholesale
Relativity hangs on
Path to opium
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9/11's effects linger
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— JAMES T. FENT, *Stauer GIA Graduate Gemologist*

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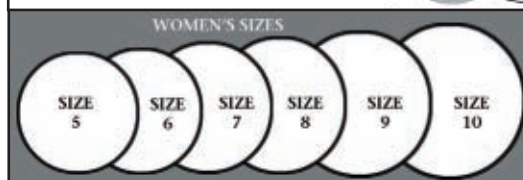
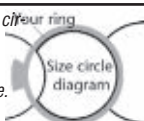
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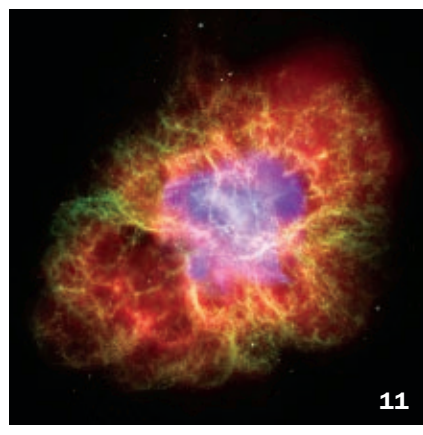
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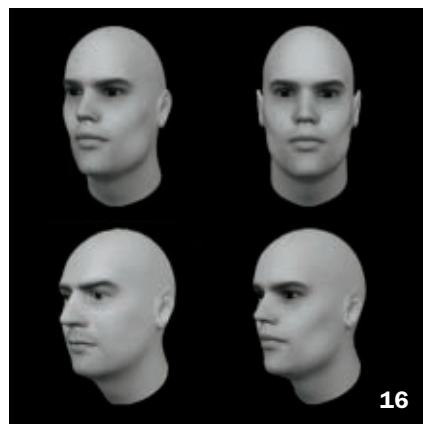
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ScienceNews



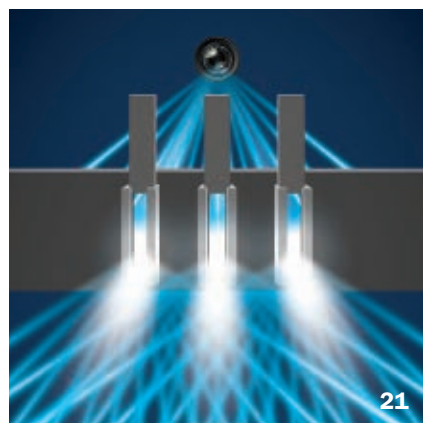
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COVER Gliese 581g, shown in this illustration, is the first exoplanet discovered with a surface temperature that can sustain liquid water—if, in fact, the planet exists.
Nicolle Rager Fuller

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FROM THE EDITOR

Even with poisonous hype, some science can survive



Scientists have to walk a thin line when communicating with the public. To convey their work's value and importance, they must present it in an engaging manner that emphasizes its most interesting aspects. In so doing, pertinent qualifications and caveats may be glossed over, leading the communicators' peers to

allege excessive hype or even to demonize the research itself.

As intermediaries conveying discoveries to the public, science journalists can get caught in this cross fire. In December, the bullets were flying furiously over a report about a microbe converted into an arsenic-loving, alien-like species proving that life on other worlds can be very different from Earth's.

Oh wait. That was the hype. NASA's clever PR machine leaked just enough information about the announcement for this new study to compete for media attention with celebrity divorces and athlete arrests. Bookies were even taking bets about the possibility that E.T. had finally phoned Earth. When the paper describing the finding was finally released by the journal *Science*, it turned out to be a simple case of an earthly species learning to substitute arsenic for phosphorus in its diet, as Rachel Ehrenberg describes in this issue (Page 5).

Of course, that really is a big deal. Life's six essential elements (carbon, hydrogen, oxygen, nitrogen, sulfur and phosphorus) aren't supposed to be negotiable. And arsenic is poisonous. So showing that a microbe could grow by eating it, apparently even incorporating it into its DNA, ranks as one of the top stories of the 21st century, so far. If it's right.

Many scientists doubt that this finding is correct, though. Maybe the researchers made mistakes, or perhaps there are other explanations for the results of their experiments. But you could say the same about almost any surprising scientific study that gets published. And the researchers did perform an array of experiments, investigating these microbes using various technologies producing quantitative data pointing in the arsenic-eating direction.

It's surely true that more work needs to be done to verify this finding. That's the way it is in science. But the ultimate outcome will not depend on how much hype surrounded the initial report. Biochemistry does not care whether NASA hypes new reports or not — had this paper been released without even a whisper, it would still have contained precisely the same evidence, with the merits of the analyses neither enhanced nor diminished. — *Tom Siegfried, Editor in Chief*

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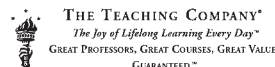
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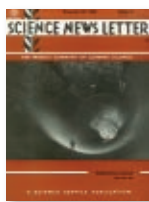
Scientific Observations

“Today I am thrilled to be able to, for the first time, show you who I really am. [Flashes part of her DNA sequence onto the screen.] That’s me. That’s me in the raw. Actually it’s a tiny section of a long arm of my chromosome 1. I think I’m fabulous, sexy, divinely complex. After seeing this I’m not going to feel guilty anymore for leaving my passport in the airport ladies’ room in Cleveland or putting my car keys in the refrigerator, because that is some

very tricky wiring.... Almost every place in my genome was sequenced over 30 times to be sure of the highest quality data. As far as my hereditary pie chart, I’m 99.99 percent Northern European with a tiny sliver of what I like to call Ghengis Khan. That sliver probably explains why I’ve survived for 36 years in the entertainment business.” —ACTRESS GLENN CLOSE IN HER TALK AT THE 2010 MEETING OF THE SOCIETY FOR NEUROSCIENCE (HER GENOME WAS “DEEP SEQUENCED” BY ILLUMINA INC.)

Science Past | FROM THE ISSUE OF DECEMBER 31, 1960

“TAKING IT EASY” IS BAD FOR BUSINESS EXECUTIVES — Physicians should not always tell worried, nervous business executives to “take it easy,” [said] Dr. Gerald Gordon....



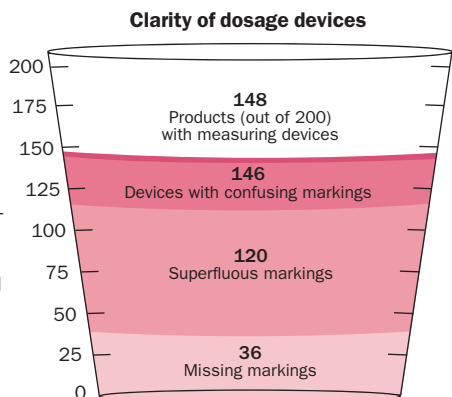
If the emotions were not released, they would be turned inward and result in “suicide through stress diseases like heart disorders,” [he] said.... The basic emotions of pain, hunger, fear and rage are designed to help us adapt to the complex, changing times. “That is not to say that many men

do not work too hard and should not take a vacation once in a while,” he said. “Many do. But modern man seems to have forgotten that life itself is a conflict. So is society. The full free life, which often includes a good scrap, has become secondary to the desire for constant peace and tranquility.”

Science Stats | READING BETWEEN THE LINES

As of October 2009, nearly 99 percent of measuring devices packaged with pediatric liquid medication sold in the United States had confusing markings, a new study finds. Markings included atypical units, such as drams.

SOURCE: H. S. YIN ET AL./JAMA 2010



SN Online

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BODY & BRAIN

Past dieting can raise present sensitivity to stress and may encourage binge eating, at least in mice. See “Dieting may plant seeds of weight regain.”

When moved to fancier cages, rats appear to be more optimistic about rewards. Read “Wealth and ambition.”



CLOCKWISE FROM TOP LEFT: CINEMAFESTIVAL/SHUTTERSTOCK; N. BRYDGES; R. KNESCHKE/SHUTTERSTOCK; E. FELICIANO

Science Future

January 3–4

The Quadrantid meteor shower peaks. Look east and up between midnight and dawn. Visit www.seasky.org/sky.html for more information.

January 8

Test engineering skills in a LEGO Building Challenge in Portland, Ore. See www.omsi.edu

January 11–20

Preschoolers experiment with the rainbow’s colors at Phoenix’s Arizona Science Center. See www.azscience.org

ATOM & COSMOS

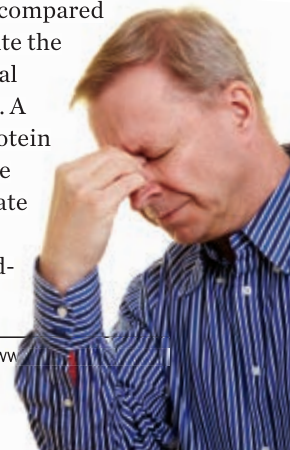
An alien system of four gas giants highlights astronomers’ unresolved questions about planet formation. See “Newfound planet stirs old debate.”

ENVIRONMENT

Rising food prices track agriculture’s instability as the global climate changes faster than farmers do. Read “Food security wanes as world warms.”

Firsts

Researchers have established the first link between a gene and the common migraine. The mostly European team found that patients with a particular gene variant have a 15 to 32 percent higher incidence of migraines compared to a control group. The gene may help regulate the neurotransmitter glutamate, a brain chemical already suspected to play a role in migraines. A previous study found that mice without a protein responsible for transporting glutamate in the brain suffer from epileptic seizures. Glutamate buildup in the synapses may contribute to migraine attacks, the team suggests. The findings appear in the October *Nature Genetics*.



“ As you approach rupture, you hear more sounds. ” — JÉRÔME FAILLETTAZ, PAGE 8

Earth How to hear a glacial collapse

Matter & Energy Going up with light

Atom & Cosmos Origins of Saturn's rings

Molecules Snot changes scents

Body & Brain Vitamin D in the spotlight

Life Goldilocks body temperature

Humans Church friends boost well-being

In the News

STORY ONE

Microbe swaps arsenic for key ingredient of life

Cells may use toxic element to help construct their DNA

By Rachel Ehrenberg

When cooking up the stuff of life, you can't just substitute margarine for butter. Or so scientists had thought.

But now researchers report having coaxed a microbe to build itself with arsenic in the place of phosphorus, an unprecedented substitution of one of the essential ingredients of life. The bacterium seems to have incorporated a form of arsenic into its cellular machinery, and even its DNA, scientists report online December 2 in *Science*.

Arsenic is toxic and is thought to be too chemically unstable to do the work of phosphorus, which takes on tasks such as holding DNA in a tidy double helix, activating proteins and forming bonds that provide energy in cells. If the finding is validated, as many scientists are arguing it needs to be, it would have huge implications for basic biochemistry and the origin and evolution of life, both on Earth and elsewhere in the universe.

"This is an amazing result, a striking, very important and astonishing result — if true," says molecular chemist Alan Schwartz of Radboud University Nijmegen in the Netherlands. "I'm even more skeptical than usual, because of

the implications. But it is fascinating work. It is original and it is possibly very important."

The experiments began with sediment from eastern California's Mono Lake, which teems with shrimp, flies and algae that can survive the lake's strange chemistry. Mono Lake formed in a closed basin — any water that leaves does so by evaporation — making the lake almost three times as salty as the ocean. It is highly alkaline and rich in carbonates, phosphorus, arsenic and sulfur.

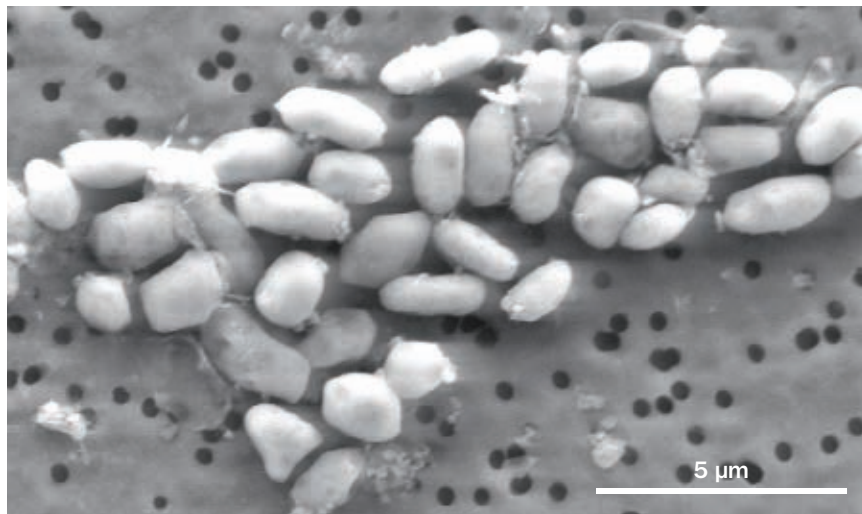
Researchers led by Felisa Wolfe-Simon of NASA's Astrobiology Institute and the U.S. Geological Survey in Menlo Park, Calif., cultured microbes from the sediment. Those microbes got a typical diet of sugar, vitamins and some trace metals, but no phosphate, biology's favorite form of phosphorus. Then the team started force-feeding the critters arsenic, in the form of arsenate, in greater and greater quantities.

One microbe in particular, now identified as strain GFAJ-1 of the salt-loving, mostly marine family Halomonadaceae, was plucked out and cultured in test tubes. Some of the microbes were fed loads of arsenate; others got phosphate.

While those subsisting on arsenate didn't grow as much as those getting phosphate, they still grew steadily, doubling their ranks every two days, says Wolfe-Simon. And while the team couldn't eliminate every trace of phosphate from the original culture, detection and analytical techniques suggest that GFAJ-1 started using arsenate as a building block in phosphate's place.

"These data show that we are getting substitution across the board," says Wolfe-Simon. "This microbe, if we are correct, has solved the challenge of being alive in a different way."

Arsenic sits right below phosphorus in the periodic table and so isn't that different, chemically speaking, notes



Scientists say they coerced a microbe in the mostly marine family Halomonadaceae into incorporating arsenic into its cells by depriving the bacterium of phosphorus.



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Wolfe-Simon. And of the six essential elements of life — carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur (aka CHNOPS) — phosphorus can be difficult to find in an available form. If a microbe in a test tube can be coerced to live on arsenic, perhaps life's primordial home was also arsenic-rich, and life that used phosphorus came later. A “shadow biosphere” of arsenic-based life may even exist unseen on Earth, or on some lonely rock in space.

“It isn't about arsenic, and it isn't about Mono Lake,” says Wolfe-Simon. “There's something fundamental about understanding the flexibility of life.” Grind up any known organism and you get CHNOPS, she says, but all those organisms are also thought to come from a single ancestor. “We have a single sample of life,” she says. “You can't look for what you don't know.”

Similarities with phosphorus are also what make arsenic poisonous to life as we know it. Living things often can't distinguish between the two, so arsenic can insinuate itself into cells. There, it competes with phosphorus, grabs onto sulfur groups, or otherwise gums up the works, causing cell death. Some microbes “breathe” by passing electrons to arsenic, but even in those cases the toxic element stays outside the cell.

Researchers are having a hard time wrapping their minds around arsenate doing the job of phosphate in cells. The “P” in ATP, the energy currency for all of life, stands for phosphate. And the backbone of the DNA double helix, the molecule containing the genetic instructions for life, is made of phosphate and sugar. Basic biochemistry says that these molecules would be so unstable that they would fall apart if they were built with arsenate instead of phosphate.

“Every organism that we know of uses ATP and phosphorylated DNA,” says biogeochemist Matthew Pasek of the University of South Florida in Tampa. He says the new research is both fascinating and fantastic. So fantastic that



NASA scientist Felisa Wolfe-Simon samples sediment cores from Mono Lake in California. A microbe from the samples was coaxed to munch arsenic.

would be attracted to such clumps, Pasek says. Perhaps the arsenic detected in the DNA was actually a nearby clump that the DNA wrapped itself around, he speculates.

The microbe may be substituting for phosphate with discretion, says geochemist Everett Shock of Arizona State University in Tempe, using arsenic in some places but not others. But Shock says the real value of the work isn't in the specifics. “This introduces the possibility that there can be a substitution for one of the major elements of life,” he says. Such research “stretches the perspective. Now we'll have to see how far this can go.” ■

a lot of work is needed to conclusively show where in their cells microbes have incorporated arsenate and how those cells function.

Both phosphate and arsenate can clump, and with their slightly negative electric charge, slightly positive DNA

Back Story | OTHERWORLDLY LAKE

Because water leaves only through evaporation, California's Mono Lake and the surrounding basin have unusual chemistry and ecology.



Salt galore For every liter of water, Mono Lake has about 80 grams of salt. In the last century, salinity has reached almost 100 grams per liter. Compare that with the ocean, which has a salinity of about 30 grams per liter.

Bizarre microbes Rich in chlorides, carbonates and sulfates, the lake hosts microbes that can survive extreme conditions. One such extremophile, *Desulfonatronum thiodismutans*, lives in Mono's mud without sunlight, getting energy from sulfates and other inorganic compounds.

Tufa towers When underwater springs bring calcium in contact with the lake's carbonates,

limestone structures can form. These “tufa” towers (shown above) often become visible following a drop in the lake's water level.

Free from fish With a pH of 10, the lake is about as alkaline as household glass cleaner. This alkalinity is the reason fish don't live in the lake.

Bird haven Brine shrimp and alkali flies thrive in the lake's waters. And with no dining competition from fish, migratory birds have made the lake a key stop. About 85 percent of California's breeding population of California gulls (*Larus californicus*) nest there.

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Earth



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Icequakes warn of avalanche risk

Listening to ice allows early forecast of glacier crack-ups

By Marissa Cevallos

Unless you're eating breakfast, hearing snap, crackle and pop may be an early warning sign of an impending avalanche. Scientists listening in on icequakes that rumble through glaciers have developed a model that can predict a collapse up to 15 days before it happens, the team reports in a study posted at arXiv.org.

With that kind of heads-up, villages could be evacuated and roads closed in avalanche-prone areas.

Though all glaciers groan and creak under stress, glaciers on an incline are especially creaky, because the top of the ice is less well supported against the pull of gravity than the base — like a book tilted at a 45-degree angle. Accumulating

snow causes more stress. These forces cause the glacier to fracture, sending tiny icequakes throughout. Eventually, if a glacier can't handle the stress, a large chunk will fall off, pummeling anything below with a moving mass of snow and ice.

To detect early signs of a rupture, scientists placed seismic instruments on a glacier precariously hugging the northeast face of the Weisshorn, a steep peak in the Swiss Alps that looms over the village of Randa. Avalanches there have claimed 51 lives since the 17th century.

In 2003, researchers traveled to the glacier in a helicopter, leaving behind a microphone to record seismic vibrations along with light reflectors, mounted on stakes, to help track the glacier's movement. A camera installed across the valley filmed any changes in the landscape.

Two weeks before the glacier cracked in 2005, researchers detected a change.


"As you approach rupture, you hear more sounds," says study coauthor Jérôme Faillietaz of ETH Zurich. "It's just like if you break a pen or a cracker. You



Studies of the Weisshorn peak reveal that telltale tremors in a glacier can alert people to an impending avalanche.

hear some small noise before it breaks."

The team also saw the reflectors accelerate several days before the rupture. Scientists knew that seismic activity increases five days before a break-off, but by combining the motion of the glacier with the icequake activity, the new model can detect a rupture 15 days in advance.

"It's the first time icequakes have been used as a precursor to these break-offs," says glaciologist Fabian Walter of the Scripps Institution of Oceanography in La Jolla, Calif. 

How a trickle can create a cavern

Model of fluid flow helps dissolve puzzle of cave formation

By Alexandra Witze

Spelunkers look at a cave and wonder how to explore its deepest reaches. But physicists look at it and wonder how it got there in the first place. A new mathematical analysis solves a long-standing cave-formation puzzle: how a trickle of water laced with carbonic acid manages to quickly dissolve rock to create massive conduits. The trick, it seems, is that fluid


flow focuses rapidly in certain channels, which grow at the expense of others and allow the acid to penetrate deeply.

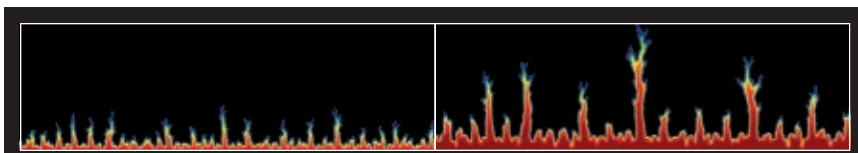
"Most of the models in cave formation today don't have this mechanism at all," says Piotr Szymczak, a physicist at the University of Warsaw. He and Anthony Ladd, a chemical engineer at the University of Florida in Gainesville, lay out their new equations in a paper to appear in *Earth and Planetary Science Letters*.

The work could improve understanding of the safety of dams, waste storage sites or anywhere else fluid might be seeping through the ground.

Limestone caves form when a tiny fracture opens in the rock, perhaps due to some internal stress, and water begins percolating through. Most water contains some carbon dioxide, making it a weak acid that can eat away at the calcium carbonate in limestone. It has been unclear how that dissolution can happen fast enough to produce deep penetration and allow long cave systems to form.

The equations describing fluid flow in the rock always contain a mathematical instability, the researchers show. That means that very soon after a fracture opens, fluid flow focuses along tiny ripples, allowing some channels to expand.

Szymczak says the new work could help explain why caves sometimes form faster than expected beneath dams. 



A new model shows how fluids penetrate rock, forming a cave. At first (left) channels develop equally, but over time (right) certain channels dominate.

Nuclear split surprises physicists

New form of lopsided fission observed in mercury isotope

By Alexandra Witze

More than seven decades after German chemists discovered nuclear fission — the basis for nuclear energy and nuclear weapons — scientists still can’t describe the process in detail. A paper to appear in *Physical Review Letters* underscores that knowledge gap, reporting an unexpected type of fission in the element mercury. Instead of splitting into two equal-mass pieces as theory predicts, one variety of mercury split into uneven chunks.

Asymmetric fission, which results in daughter fragments with different masses, has been seen before. But these earlier examples all could be easily explained. Some isotopes of uranium, for instance, tend to fission into one large chunk of tin-132 along with a smaller chunk. Like apartment dwellers filling each apartment in a complex, the 50 protons and 82 neutrons of tin-132 completely fill energy levels, or shells, within the nucleus, making it extremely stable.

In the new experiments, researchers thought the isotope mercury-180 would split equally into two blobs of zirconium-90, which has 40 protons and 50 neutrons that stably fill the shells in its nucleus. “Zirconium-90 plus zirconium-90 makes mercury-180,” says Witold Nazarewicz, a theoretical physicist at the University of Tennessee in Knoxville and the Oak Ridge National Laboratory who was not involved in the work.

Yet that’s not what the scientists saw in their experiments at the ISOLDE radioactive beam facility at CERN, Europe’s particle physics laboratory near Geneva. The researchers, led by Andrei Andreyev of the University of the West of Scotland’s Paisley campus, instead saw mercury-180 split into ruthenium-100 and krypton-80 — isotopes that don’t have completely filled

shells like zirconium-90. It’s the first time researchers have seen asymmetric fission and not been able to explain it by the filled-shells theory.

“It was a big surprise,” says team member Piet Van Duppen, a nuclear physicist at the Catholic University of Leuven in Belgium. “This is a totally new form of asymmetric fission.”

An analysis showed that it is more energy efficient for mercury-180 to split into ruthenium-100 and krypton-80 rather than equal parts of zirconium-90.

Study finds light can be uplifting

Researchers create lightfoil able to deflect small objects

By Laura Sanders

Light has been put to work generating the same force that makes airplanes fly. With the right design, a uniform stream of light has pushed tiny objects in much the same way that air pressure hoists a 747 off the ground, scientists report online December 5 in *Nature Photonics*.

Researchers have long known that blasting an object with light can push the object away. That’s the idea behind solar sails, which harness radiation for propulsion in space. “The ability of light to push on something is known,” says study coauthor Grover Swartzlander of the Rochester Institute of Technology in New York.


Light’s new trick is fancier: It created the more complicated force called lift, evident when a flow in one direction moves an object perpendicularly. Airfoils generate lift; as an engine propels a plane forward, its wings cause it to rise.

Lightfoils aren’t about to keep an Air-

bus aloft, but arrays of the devices might power micromachines, transport particles or improve steering on solar sails.

Optical lift is “a really neat idea,” says physicist Miles Padgett of the University of Glasgow in Scotland, but it’s too early to say how the effect might be harnessed. “Maybe it’s useful, maybe it’s not. Time will tell.”

Modeling indicated that an asymmetrical deflection of light would create a surprisingly stable lift force. The researchers created micrometer-sized lightfoils shaped kind of like airplane wings — flat on one side and rounded on the other. When immersed in water and hit with 130 milliwatts of infrared light from the bottom of the chamber, the tiny rods started to move up, as expected. But they also moved to the side, perpendicular to the incoming light.

Optical lift differs from aerodynamic lift. A plane flies because air flowing more slowly under its wing exerts more pressure than the faster air flowing above. In a lightfoil, the lift is created as the beam shines through the object. The transparent lightfoil’s shape causes light to be refracted differently depending on where it passes through the device, which correspondingly bends the beam’s momentum to create lift. 

Atom & Cosmos



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Billions, billions and more billions

New estimate triples number of stars populating cosmos

By Ron Cowen

Astronomers studying eight galaxies have found evidence of a surprising abundance of faint, low-mass stars — each galaxy has about 10 times as many as the Milky Way. The scientists extrapolate that the heavens contain up to three times the total number of stars previously estimated.

That profusion suggests that early cosmic history may need a rewrite. Previous estimates of the total stellar mass in many of the universe's first, massive galaxies may need to be doubled. Pieter van Dokkum of Yale University and Charlie Conroy of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., describe their study online December 1 in *Nature*.

The researchers examined light from the central regions of each of eight massive elliptical galaxies — four in the Coma cluster and four in the Virgo cluster. Such galaxies are thought to account for one-third of the stellar mass in the universe.

Spectra of the galactic light indicate that faint red dwarfs account for 80 percent of stars in elliptical galaxies.

“Extrapolating from the central regions of these eight galaxies to the entire universe is somewhat hazardous, but if the galaxies are typical examples of their class it may well lead to a tripling” of the number of stars in the cosmos, van Dokkum says. Previous estimates put that number at roughly 100 billion trillion.

Still, the results might be otherwise explained by fewer low-mass stars if they differ in chemical makeup from those in the Milky Way, says astronomer Richard Ellis of Caltech.

Demise of a moon, rise of the rings

Icy particles surrounding Saturn may be remains of satellite

By Alexandra Witze

Saturn's majestic rings are the remnants of a long-vanished moon that was stripped of its icy outer layer before its rocky heart plunged into the planet, a new theory proposes. The icy fragments would have encircled the solar system's second largest planet as rings and eventually spalled off small moons of their own that are still there today, says Robin Canup, a planetary scientist at the Southwest

Research Institute in Boulder, Colo.

“Not only do you end up with the current ring, but you can also explain the inner ice-rich moons that haven't been explained before,” she says. Her paper appears online December 12 in *Nature*.

Earlier ideas about how Saturn's rings formed have fallen into two categories: either a small moon plunged intact toward the planet and shattered, or a comet smacked into a moon, shredding the moon to bits. Both scenarios would produce an equal mix of rock and ice in Saturn's rings — not the nearly 95 percent ice seen today.

Canup studied what happened after Saturn (and the sun's other planets) coalesced from a primordial disk of gas and dust 4.5 billion years ago. In previous work, she had shown that moon after moon would be born around the infant gas giant, each growing until the planet's gravitational tug pulled it to its destruction. Moons would have stopped forming when the disk of gas and dust was used up.

In the new study, Canup calculated that a moon the size of Titan — Saturn's largest, at some 5,000 kilometers across — would begin to separate into

layers as it migrated inward. Saturn's tidal pull would cause much of the moon's ice to melt and then refreeze as an outer mantle. As the moon spiraled into the planet, Canup's calculations show, the icy layer would be stripped off to form the rings.

A moon so large would have produced rings several orders of magnitude more massive than today's, Canup says. That, in turn, would have provided a source of ice for new, small moons spawned from the rings' outer edges. Such a process, she says, could explain why Saturn's inner moons are icy, out to and including the 1,000-kilometer-wide Tethys, while moons farther out contain more rock.

“Once you hear it, it's a pretty simple idea,” says Canup. “But no one was thinking of making a ring a lot more massive than the current ring, or losing a satellite like Titan. That was the conceptual break.”

“It's a big deal,” agrees Luke Dones, also of the Southwest Research Institute, who has worked on the comet-makes-rings theory. “It never occurred to me that the rings could be so much more massive than they are now.”

Some questions still linger about Canup's model, says Dones, like why some of Saturn's inner icy moons have more rock in them than others.



The ice in Saturn's rings may be remains of a moon that crashed into the planet.

50
percentIce content of
most of the
solar system95
percentIce content of
Saturn's puzzling
ring system

Shocking signals from Crab nebula

Gamma-ray flares from supernova remnant baffle astronomers

By Ron Cowen

Radiation from the Crab nebula supernova remnant is believed to be so constant that astronomers use it as a standard candle with which to measure the energetic radiation of other astronomical sources.

That's why researchers are astounded that two spacecraft recently recorded giant gamma-ray hiccups from the Crab, the remnants of a stellar explosion 6,500 light-years from Earth.

For three days beginning September 19, the intensity of the Crab's gamma-ray radiation suddenly became two to three times stronger, scientists with the Italian Space Agency's AGILE telescope reported. The Fermi Gamma-ray Space Telescope detected an even larger increase over roughly the same time period.

Both teams also announced they had found evidence of previous similar flares. AGILE recorded an outburst in fall 2007, and Fermi spotted one in February 2009.

The suspected source of the energetic flares, along with steadier radiation emanating from the nebula, is blizzards of electrons spit out by the Crab's pulsar—the rapidly rotating, exploded cinder of a star that lies at the nebula's center. Figuring out exactly how the electrons got revved up to energies of at least 10^{15} electron volts—the most energetic charged particles ever associated with a distinct astrophysical object—for so short a time has astronomers scratching their heads.


Finding the flares “was a shock,” said AGILE team member Marco Tavani of

the INAF-IASF in Rome and the University of Rome Tor Vergata, who spoke about the findings on December 6 and 7.

Fermi researcher Rolf Buehler joined Tavani in a December 6 session to discuss variable sources of energetic radiation in the Milky Way. Tavani and Buehler declined to talk to reporters because both teams have submitted papers to *Science*.

In one widely accepted model, the stage is set for any kind of gamma-ray emission—steady or short-lived—when electrons hurled from the Crab's core run into strong magnetic fields in surrounding debris. The electrons gyrate in the magnetic fields and get revved up to energies high enough to emit gamma rays.

But the Crab's recently detected outbursts would seem to pose problems for that acceleration model. The brevity of the flares suggests that the electrons couldn't have gyrated long enough to produce the energetic radiation, Buehler noted. And because electrons accelerated to very high energies lose that energy quickly, the magnetic field in the inner region of the nebula might have to be three to 10 times stronger than commonly assumed.


The short duration may mean that the gamma rays originated in a relatively small part of the inner nebula. Astronomers are trying to pinpoint the exact outburst region. Buehler suggested that in addition to magnetic fields, the pulsar's electric field may have helped accelerate the electrons in the inner part of the nebula to energies high enough to emit the gamma rays. 




The Crab nebula, shown in multiple wavelengths, has hosted some surprising gamma-ray flares recently.

MEETING NOTES

Beast at galaxy's core lacks spin

The Milky Way center's supermassive black hole barely spins, say Avery Broderick of the Canadian Institute for Theoretical Astrophysics in Toronto and colleagues, including Avi Loeb of Harvard University. The scientists base those tentative findings on radio emissions from the galactic center. The emissions are believed to be generated by material at the inner edge of the whirlpool of matter that spirals into and fuels the black hole. Combining the radio data with modeling of the expected emissions suggests that the supermassive black hole spins slowly or not at all, Loeb reported December 6. —Ron Cowen 

Particle collider in the sky

Protons caught between two fierce stellar furnaces are being boosted to energies comparable to those at the world's most powerful atom smasher, new observations suggest. The two orbiting stars form the Eta Carinae system, some 7,500 light-years from Earth. Every week, Eta Carinae expels dense winds of material equivalent to about an Earth mass. NASA's Fermi Gamma-ray Space Telescope recently recorded gamma rays from Eta Carinae ranging in energy from 20 billion to 50 billion electron volts, Roland Walter of the University of Geneva reported December 9. The most plausible explanation for the high energy is that protons bouncing back and forth between the two stellar winds attain energies of at least 10 trillion electron volts. The protons then collide with protons in the winds to produce pions, which decay into the energetic gamma rays seen by Fermi. —Ron Cowen 

Molecules

“Most people and most scientists pay no attention at all to mucus.” —LESLIE VOSSHALL

The nitty-gritty of diamond polishing

Computer modeling offers insights into centuries-old method

By Rachel Ehrenberg

You can soften your sweetie with diamonds, but to soften a diamond takes some special chemistry. A liquidlike layer of carbon at the interface between diamond-polishing wheel and gem makes the magic that turns a grubby stone into a girl's best friend, new research finds.

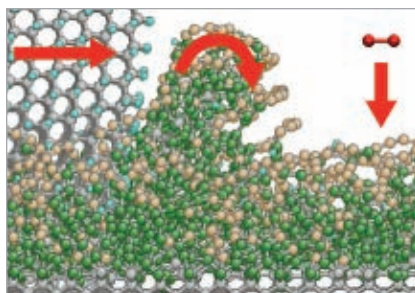
New polishing tricks may emerge from the research, perhaps allowing scientists to exploit diamonds for use in optics or semiconductors. And the computational approach used in the study, published online November 28 in *Nature Materials*, could aid in understanding wear in materials such as metals or ceramics.

Gemstones are typically worked with materials harder than themselves, an approach not possible with diamond, one of the hardest natural materials. So polishers use diamond on diamond. The method, which has remained unchanged for centuries, involves coating a cast-iron disk with olive oil and a layer of diamond grit. The stone to be polished is pressed against this “skeif,” and it's up to the skill of the polisher to find the grain of the diamond. Polishing in the wrong

direction can damage the gemstone.

It was thought that polishing simply fractured off small bits of diamond. But scientists recently noticed odd particles on the polishing wheel surface that couldn't have resulted from fracturing. Now molecular modeling reveals that those particles are part of a liquidlike layer of carbon that forms between the skeif and the gemstone. This layer joins forces with the sharp diamond grit and oxygen in the air to polish the diamond.

When the gemstone and wheel first make contact, carbon atoms in the grit and the gem form very strong bonds, seeding a



A diamond-polishing study finds that oxygen (red) and a liquidy carbon layer (green) help grit particles (gray, upper left) shine the gem (gray, bottom).

strange amorphous layer of carbon, says Michael Moseler of the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg, Germany. This liquidlike layer between the two surfaces is very reactive, says Moseler, who led the new work. As the sharp edges of the grit plow by, they scrape off some of the liquidy layer and expose long carbon chains to the air. Oxygen then can swoop in, snatching off carbons to form carbon dioxide and leaving behind a smoother surface than scraping alone would achieve.

The research explains why polishing a diamond in certain directions is difficult and potentially damaging. The latticelike arrangement of carbon atoms is such that in some directions the carbon atoms are so tightly bound that they resist becoming part of the amorphous layer.

“The exciting thing about this paper is that molecular dynamics could prove to be the most efficient way of designing new diamond-processing technologies,” says physicist Jonathan Hird of UCLA. The new study describes diamond polishing with unprecedented detail, he says.

Further research needed to validate the modeling may be tough. “Studying diamond polishing is experimentally challenging and expensive,” Hird says. “Diamond does not give up its secrets without a fight.” ■

Snot has power to alter scents

Mice studies show sense of smell is modified by mucus

By Laura Sanders

A rose sniffed through a snotty nose may not smell so sweet. Enzymes in mice's nasal mucus transform certain scents before the nose can detect them, researchers report December 1 in the *Journal of Neuroscience*.

“It is completely unexpected that snot


would play a potential role in changing how we perceive odors,” says neuroscientist Leslie Vosshall of Rockefeller University in New York City. “Most people and most scientists pay no attention at all to mucus.”

But there's more to mucus than what meets the nose: The thick goo that serves to lubricate the nose is teeming with proteins and protein-chopping enzymes.

In the new study, Ayumi Nagashima and Kazushige Touhara of the University of Tokyo added odorants to tiny amounts of mucus sucked out of a mouse's nose and tested the resulting chemical composition of the mix. After five minutes

of sitting in mucus, about 80 percent of almond-smelling benzaldehyde was converted into benzyl alcohol (a scent found in some teas and plants) and odorless benzoic acid. Inactive enzymes in boiled mucus couldn't do this odor conversion.

Parts of the brain called glomeruli get signals from mice's smell-sensing nerve cells. When the researchers inactivated a scent-chopping enzyme in the mice's noses, the pattern of glomeruli activation changed, suggesting that the snot enzymes affect what the mouse smells.

Snot enzymes can cut up aldehydes and molecules with chemical features called acetyl groups, the researchers report. 

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Wearable Hearing Aid	1935	Weighed 2.5 pounds	No	No
Digital Hearing Aid	1984	No	No	Not for most people
Neutronic Ear	2010	Yes	Yes	Yes

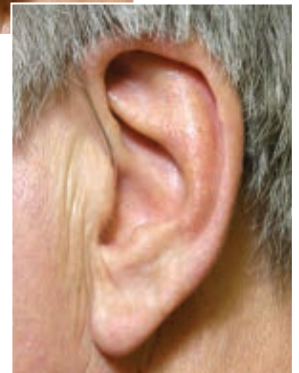
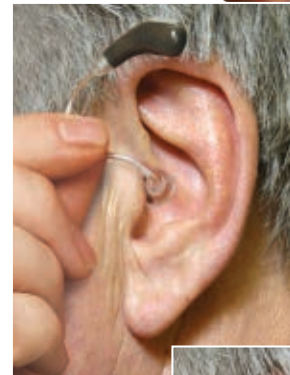
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800
IU daily | New vitamin D target for people over 70

Panel increases vitamin D targets

But some scientists say new numbers are still way too low

By Nathan Seppa

A scientific panel has called for tripling the recommended dietary allowance of vitamin D for most children and adults and raising the amount slightly for older people. The panel also doubled the upper level of vitamin D that older children and adults can safely take in any given day from 2,000 international units to 4,000. The panel's report, commissioned by the National Academies' Institute of Medicine at the request of the U.S. and Canadian governments, was released November 30.

Vitamin D recommendations hadn't been changed since 1997. Despite a wave of studies suggesting that the nutrient has benefits far beyond bone health, the panel restricted its rationale to just that. Apart from aiding bone fitness, the panel said, the benefits of vitamin D "are currently

not supported by evidence that could be judged either convincing or adequate."

"We had to look at the totality of the evidence," says Patsy Brannon, a molecular nutritionist at Cornell University who served on the panel. The panel scoured studies showing vitamin D's effects on other health problems but found "very limited randomized control trials," she says. The trials that panel members did find didn't establish cause and effect or clarify beneficial

doses for other conditions, Brannon says. The panel suggested that fears of vitamin D deficiency might be overblown.

"Given the [panel's] superconservative philosophical approach to decision making, the tripling of IU recommendations for people up to age 50 is pretty good," says Reinhold Vieth, a nutritionist at the University of Toronto.

But the report was rebuked by some well-known vitamin D researchers who saw the increases as woefully inadequate. "This was a big waste of money," says Bruce Hollis, a nutritional biochemist at the Medical University of South

Carolina in Charleston.


Vitamin D isn't a true vitamin, but a hormone made when skin cells are hit by ultraviolet radiation from the sun. Food cannot provide enough unless it is artificially fortified, such as milk.

Because of vitamin D's unique origin, randomized, controlled trials — the kind that the panel noted are lacking — are nearly impossible to do: People can't be kept out of the sun and their vitamin D levels are hard to

The panel says fears of vitamin D deficiency might be overblown.

control, Hollis says.

"I agree with their recommendations for the first year of life," he says, citing the panel's target of 400 IU for infants, double the previous amount. But he was puzzled that the panel didn't substantially boost amounts for older children and adults — it set the recommended daily intake at only 600 IU for ages 1 to 70 and 800 IU for older people. Tripling a low number, Hollis says, still leaves a low number.

A person who is deficient in vitamin D could remain deficient taking these recommended amounts, says biochemist Michael Holick of Boston University. 

H1N1 exploited antibody mismatch

Middle-aged flu victims may have succumbed to friendly fire

By Tina Hesman Saey

Faulty immunological memories could have made middle-aged people more susceptible to the 2009 H1N1 pandemic flu, a new study shows.

Middle-aged people's bodies tried to defend against H1N1 by hurling antibodies for similar viruses at the new flu. But the old antibodies' aim wasn't true and may have ended up backfiring, a study published online December 5 in *Nature Medicine* suggests.

In most flu seasons, the most vulnerable people are infants and the elderly. But during the 2009 H1N1 pandemic, young


adults and middle-aged people were hit unusually hard, says viral immunologist Fernando Polack of Vanderbilt University in Nashville, a coauthor of the study.

"The middle-aged population usually doesn't have much of a problem," Polack says. "They miss a few days of work, but they aren't typically dying in the intensive care unit" as they were during the 2009 pandemic.

Polack and colleagues found that people born before 1958 had antibodies against the 2009 H1N1 virus. Those people had been exposed to a very similar virus that circulated in the population between 1918 and 1957 or so. The anti-

bodies weren't a perfect match, but were close enough to neutralize the new virus.

But people born after the late 1950s didn't have those antibodies. Instead, those people had antibodies against many other flu viruses similar to H1N1, but not a close enough match to actually fend off the strain. These mismatched antibodies triggered the immune system in a way that ended up damaging delicate lung tissue, the researchers say.

"This has never been proposed" for influenza viruses, says Adolfo García-Sastre, a microbiologist at Mount Sinai School of Medicine in New York City. "There's still a lot of debate," he says, over why middle-aged people fare poorly in some pandemics. Thanks to the new study, "it's going to be a healthy debate," he says. 

Life

“Mammals don’t make any sense. We have to eat all the time. Our reproduction rate is low.” —**ARTURO CASADEVALL**

Fighting fungi with bodily warmth

Survival temperature may balance fuel needs, disease risk

By Tina Hesman Saey

Fungi may be to thank for mammals’ warm blood, a new theory suggests.

The optimum body temperature for organisms to ward off fungal infections without burning too much energy is 36.7° Celsius — close to the core body temperature of mammals, researchers at Albert Einstein College of Medicine in New York City report online November 9 in *mBio*. The finding is the latest evidence that fungi may have been a driving force in the evolution of mammalian body temperatures, and also helps explain why mammals aren’t even hotter.

“Mammals don’t make any sense,” says Arturo Casadevall, a microbiologist at Einstein who devised the theory. “We

have to eat all the time. Our reproduction rate is low.” Casadevall wondered why reptiles didn’t just retake the Earth after the dinosaurs’ extinction.


Two pieces of evidence led him to develop the new theory. First, a massive fungal bloom swept the Earth about the time of the dinosaur extinction. Second, fungi plague plants, insects and other cold-blooded creatures far more often than they do mammals or birds. So Casadevall proposed that the body heat of mammals and birds protected them from fungal pathogens that kept the reptiles from rising again.

To test the theory, Casadevall and Vincent Robert of the Fungal Biodiversity Center in Utrecht, the Netherlands, measured the thermal tolerance of 4,802

types of fungi. For every degree the temperature was raised above 30° C, 6 percent fewer fungal species could grow, the team reported last year.

Most mammals have body temperatures of about 37° C (98.6° F). But if higher temperatures ward off more fungi, why don’t mammals run even hotter?

In the new paper, Casadevall and coauthor Aviv Bergman, an evolutionary systems biologist at Einstein, used a mathematical model to show that mammalian body temperature is a trade-off between fighting fungi and burning too much fuel. “If you were to go higher, you’d have more protection,” Casadevall says. “But then you’d have to eat a lot more.”

“I think it’s a really cool idea,” says Leah Cowen, a medical mycologist at the University of Toronto. What’s striking is that the model is simple, “but the vision is large,” potentially answering a huge question in evolutionary biology. 



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Humans

“There is still room for improvement after years of learning faces.” —ISABEL GAUTHIER

Face memory skill peaks after 30

Find challenges view that mental faculties all max out in 20s

By Bruce Bower

Youth is wasted on the young, but not for face memory. In an unexpected discovery, scientists have found that people between ages 30 and 34 are best at remembering unfamiliar faces.

Many researchers think word skills, memory and other mental functions crest in the early 20s, as the brain attains full maturity. Consistent with that belief, memory for names and upside-down

faces — a task that requires recognition of general visual patterns — hits a high point at ages 23 to 24, a team led by psychology graduate student Laura Germine of Harvard University reports in an upcoming issue of *Cognition*.

But in an unanticipated twist, face learning takes about a decade longer to be the best it can be, the researchers find



Volunteers viewed a face from three angles (top), then tried to distinguish it from two others (bottom).

in online experiments conducted with 44,680 volunteers, ages 10 to 70.

“Specialized face processing in the brain may require an extended period of visual tuning during early adulthood to help individuals learn and recognize lots of different faces,” Germine says.

Although researchers have not previously looked for late-developing face

memory, the new findings fit with evidence that a brain structure crucial for face recognition — the fusiform gyrus — undergoes reorganization at least through young adulthood, says psychologist Isabel Gauthier of Vanderbilt University in Nashville. Gauthier hypothesizes that this brain area underlies all sorts of visual expertise, with face recognition as its most prominent achievement (*SN: 7/7/01, p. 10*).

“What is somewhat surprising is that there is still room for improvement after years of learning faces,” Gauthier says.

It’s not clear why it should take at least 30 years to refine a person’s ability to remember new faces, remarks psychologist Catherine Mondloch of Brock University in St. Catharines, Canada. Facial features change during adolescence, so improvements in face memory among teens make sense, she notes. Perhaps other enhancements occur as young adults enter the workplace and encounter more adult faces, Mondloch proposes.

Scientists now need to track individuals from childhood to adulthood to confirm that face memory hits its prime shortly after age 30, Germine says. [f](#)

Happiness found in next pew over

Religion aids well-being via social networks, study finds

By Bruce Bower

When it comes to feeling good about one’s life, friendliness is next to godliness.

Personal well-being blossoms among U.S. adults who identify strongly with their religion, regularly attend church and have three or more close friends in their congregation, say sociologists Robert Putnam of Harvard University and Chaeyoon Lim of the University of Wisconsin–Madison.

Members of this devoutly connected

group cite especially high levels of satisfaction regardless of how many or how few friends they have outside their congregation, Lim and Putnam report in the December *American Sociological Review*.

“Our evidence shows that it is not really going to church and listening to sermons or praying that makes people happier, but making church-based friends and building social networks there,” Lim says.

The new findings apply to mainline and evangelical Protestants and to Catholics. Too few people from other religions were surveyed to make comparisons.

Researchers have long noted that religious people report higher levels of happiness than nonreligious folk. Analyzing results of telephone surveys of 1,915 U.S. adults in 2006 and 2007, Lim and Putnam found that people who

belong to a congregation but have no friends there report less satisfaction with their lives than those who don’t attend religious services or who are religious but have no congregation. In other words, sitting alone in the pew does not make for a happy life.

Sociologist Michael Hout of the University of California, Berkeley notes that the survey questions did not cover the gamut of spiritual beliefs, even among members of the same congregation, that forge religious identity. Those beliefs combine with congregational friendships to make life more satisfying, he proposes.

In both survey years, about half of Lim and Putnam’s national sample regarded religion as central to a sense of self. Another 17 percent had no religious preference or affiliation. [f](#)

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Nicholas J. Bruyer, CEO, First Federal Coin Corp.
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20

SCIENCE NEWS OF THE YEAR

A year ago, most geneticists had all but dismissed the notion that humans and Neandertals interbred. But with the cataloging of the full Neandertal genome, announced in May, we now know that people of European and Asian descent really have inherited a small percentage of their DNA from a rival species that went extinct about 30,000 years ago.

That's not all we now know that we didn't know way back in the first decade of the 21st century. Then, it was still an open question whether NASA's Kepler mission would be able to fulfill its goal of detecting Earthlike planets orbiting distant stars. Now Kepler has collected evidence for hundreds of extrasolar planets. And another planet search has found hints of an object that appears to orbit the star Gliese 581 at just the right distance to support life.

This year's scientific progress hasn't been limited to the long ago and far away. Last January 1, nobody really understood how cats drink. Now high-speed imaging has revealed that lapping up a saucer of milk is a sophisticated trick of fluid dynamics that involves pulling a column of liquid off the surface and then snapping it up before it splashes back down.

That's not all, of course. The number of people who have had their full genetic complement cataloged has grown from a handful to hundreds, providing insights into human diversity and disease. New species have been discovered, and others found to be threatened by global warming and other ills. Natural disasters like the Haiti earthquake, and man-made ones like the Gulf oil spill, have challenged and expanded scientists' understanding of how the Earth works.

What will science bring to light during our planet's next lap around the sun? Keep reading *Science News* in 2011 to find out. — *Matt Crenson, News Editor*

On the Web For a complete year-end recap with links to the original online articles, visit www.sciencenews.org/2010



Paper chase Bisphenol A, an estrogen-mimicking compound, has been found in the paper used for many store receipts (*SN: 8/28/10, p. 5*). The compound is linked to a variety of health concerns including heart disease in adults (*SN: 2/13/10, p. 13*) and increased risk of diabetes in pregnant animals and their young (*SN Online: 5/19/10*). Health concerns have led the federal government to recommend that parents minimize their kids' exposure to plastics containing BPA (*SN Online: 1/15/10*), and led the only U.S. supplier of BPA-free cash register paper to tag its product (*SN Online: 11/8/10*).

Herbicide concerns Studies link water polluted by the common farm weed killer atrazine with birth defects and low birth weights in newborn humans (*SN: 2/27/10, p. 18*). Other work suggests the chemical itself can cause male tadpoles to develop into egg-laying adults that mate with other males (below) (*SN: 3/27/10, p. 9*).

Acid-spiked oceans Ocean acidification caused by increasing concentrations of dissolved carbon dioxide in seawater is found to threaten virtually all forms of marine life: compromising reproduction of corals



An oil slick (in white outline) from the leaking *Deepwater Horizon* well off the Mississippi Delta on April 29.

New Orleans



Gulf drilling disaster

The biggest oil spill in U.S. history began April 20, when an explosion and fire on the *Deepwater Horizon* offshore drilling platform sent oil spewing into the Gulf of Mexico at rates at times exceeding 65,000 barrels a day (*SN Online*: 9/23/10). By the time the well was capped 12 weeks later, an estimated 5.2 million barrels of oil had been released, all but 800,000 of which ended up in the water. Much of the oil drifted in diffuse subsea plumes (*SN*: 7/3/10, p. 5) that

may have contained twice as much natural gas as oil (*SN*: 10/9/10, p. 10). Although native bacteria began degrading the oil (*SN*: 9/11/10, p. 5), much of the gas—especially methane—was expected to prove more resistant to rapid biodegradation. In late September, scientists reported that significant quantities of oil had landed in sediment or were headed there (*SN Online*: 9/28/10), where the crude is expected to resist breakdown.

(*SN*: 12/4/10, p. 10), confusing reef-dwelling fish (*SN Online*: 7/6/10) and reducing iron uptake by marine microorganisms, which may stifle the growth of phytoplankton that help absorb carbon dioxide emissions (*SN Online*: 1/14/10).

Dioxins down the drain

Researchers show that once washed down the drain, triclosan, the germ-fighting chemical in most liquid hand soaps, can generate dioxins of unknown toxicity (*SN Online*: 5/18/10).

In with the new Replacements for the toxic flame retardants found in many

household products can also escape into and persist in the environment (*SN*: 4/24/10, p. 12).

New thyroid threat Scientists link relatively high blood levels of PFOA, a common stain repellent widely used in everything from fabrics and carpeting to popcorn bags, with thyroid disease in people (*SN Online*: 1/22/10).

Diabetes link to pollution

Air pollution may negatively influence blood sugar control in a large and growing number of people, new studies indicate (*SN Online*: 10/4/10).

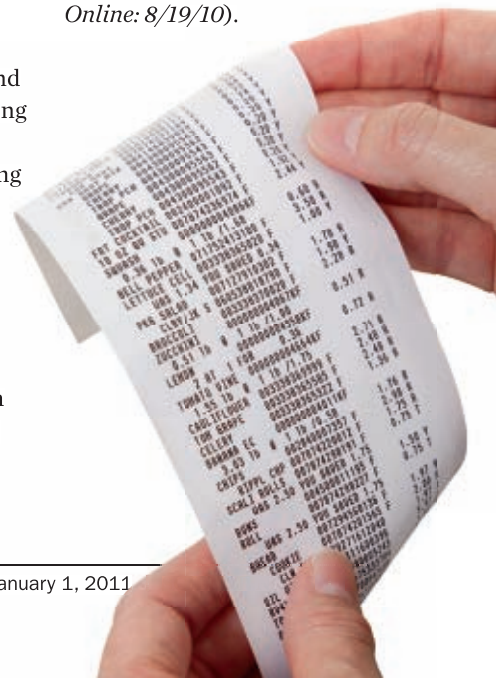
Dumbfounded Researchers link lower IQs in kids to phthalates, chemicals found in some plastics and food packaging (*SN Online*: 4/5/10).

Infected tobacco Tests find hundreds of disease-causing bacteria species in major cigarette brands, suggesting a possible source of smokers' respiratory infections (*SN*: 3/13/10, p. 10).

Pollutants and obesity

Some babies exposed in the womb to a breakdown product of DDT grow fast, putting them on track for obesity, a study finds (*SN Online*: 10/5/10).

Forests falter In the last decade, carbon uptake by the world's vegetation has slowed considerably, largely because of droughts (*SN Online*: 8/19/10).





Warming changes how and where animals live

New concerns have emerged about how climate warming might challenge animals and change the way they go about their lives. For example, a coalition of lizard specialists suggests that by midcentury a third of lizard populations won't have enough time for foraging or other vital pursuits simply because they'll have to spend long stretches cooling off in shady refuges (*SN Online*: 5/13/10). Overall, organisms such as lizards that depend on their environment to regulate body temperature—those often referred to as cold-blooded—may get a disproportionate jolt in the tropics. A temperature uptick has more metabolic impact on lizards living in already hot climates, researchers report, with effects that could ripple through tropical ecosystems (*SN Online*: 10/6/10).

Climate change also appears to be revamping relationships among species, according to an analysis of Europe's common cuckoo and the birds it dupes into raising its young. As warmer springs have pushed short-distance migrators toward earlier nesting times, cuckoos have fallen out of sync and are instead laying more eggs in the nests of fellow long-distance migrants such as reed warblers (*SN*: 10/9/10, p. 11). Meanwhile, migration itself has become problematic for a population of Yellowstone elk that can no longer find good summer grazing in high meadows (*SN*: 7/17/10, p. 12).

Warming may threaten tropical lizards like this caiman.

What counts More than 2,700 scientists worldwide conclude the decade-long Census of Marine Life by reporting that the majority of sea organisms (Hydromedusae jellyfish shown below) are still unknown to science (*SN*: 10/23/10, p. 14). And that doesn't even count microbes.

O no Three species of tiny sediment-dwelling loriciferans from a briny basin deep in the Mediterranean may live their entire lives without oxygen, which would make them the first multicellular animals known to do so (*SN*: 5/8/10, p. 5).

O yes Microbiologists have found a fourth biological pathway for producing oxygen: a method, employed by certain bacteria, that breaks down nitrite compounds (*SN Online*: 3/24/10).

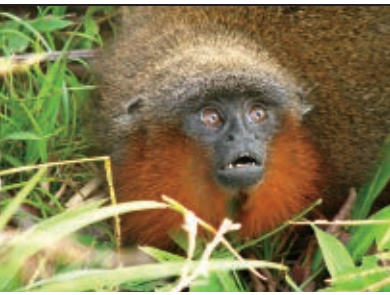
New species DNA analysis suggests killer whales might be not one but at least four species (*SN*: 5/22/10, p. 8). A shy monitor lizard in the Philippines was described only this year, even though it reaches 2 meters in length

and has bright yellow spots (*SN*: 5/8/10, p. 8). Primatologists finally describe a new species of titi monkey (right) that had remained undocumented because of violence in its region of Colombia (*SN Online*: 8/12/10). A newly discovered cricket turns out to be the first recorded pollinator in its taxonomic order (*SN Online*: 1/18/10). Males of a newly described species of dance fly have lopsided front legs, growing one typical appendage and another adorned with what looks like a little tufted balloon (*SN Online*: 9/21/10). A mongooselike creature from Madagascar is the first new carnivore species to be discovered in more than 20 years (*SN Online*: 10/12/10). And two new fish species, both pancake batfishes, are discovered in a habitat that has been threatened by the Gulf oil spill (*SN*: 8/14/10, p. 10).

Missed it A deadline passes for 193 member nations of the Convention on Biological Diversity to make significant progress on slowing species loss, but the targets aren't met (*SN*: 3/13/10, p. 20).



FROM TOP: TIM VICKERS/WIKIMEDIA COMMONS; GARY CRANITCH/QUEENSLAND MUSEUM



Bat trouble White-nose syndrome, a fatal disease of hibernating bats, spreads widely; biologists predict that it could wipe out the Northeast's population of the once-common little brown myotis bat in as few as 16 years (*SN Online*: 8/5/10).

A salty tail Just adding sodium can spur limb regrowth in tadpoles, a study finds, suggesting that it may be possible to stimulate some tissue regrowth in humans (*SN*: 10/23/10, p. 15).

New blood A controversial move to boost genetic diversity in faltering Florida panthers, by importing females of the same species from Texas, has resulted in a more robust population of mixed-heritage cats (*SN*: 10/23/10, p. 9).

Just warm enough The need to avoid fungal infections without wasting energy may have driven mammals to evolve their characteristic body temperature (*SN*: 1/1/11, p. 15).

I, monkey Though monkeys hadn't previously shown clear signs of recognizing themselves in a mirror, when wired with experimental headgear, rhesus monkeys checked themselves out (*SN Online*: 9/29/10).

Photons lassoed Physicists set a new record for quantum entanglement by linking five light particles that exist in two states at once, a property called superposition (*SN Online*: 5/15/10).

Calculating nature For the first time, a quantum computer predicts the behavior of a hydrogen molecule (*SN Online*: 1/22/10).

Microchill A new model shows how physicists could construct the world's smallest fridge out of microscopic particles (*SN*: 9/25/10, p. 11).

Same rules apply Physicists demonstrate quantum properties in objects big enough to see, linking the physics of the ultrasmall to the everyday world (*SN*: 4/10/10, p. 10).

String theory tangled Stringy math helps describe the quantum property known as entanglement (*SN*: 9/25/10, p. 11).

3.5 | Typical laps per second for a drinking cat

Everyday relativity Two tabletop experiments demonstrate the time-warping effects of relativity at the human scale (*SN*: 10/23/10, p. 10).

Gravity reconsidered Entropy and information may be crucial concepts for explaining why what goes up must come down (*SN*: 9/25/10, p. 26).

Quantum lemonade Physicists harness forces that usually destroy quantum connections to entangle isolated globs of atoms (*SN Online*: 6/29/10).

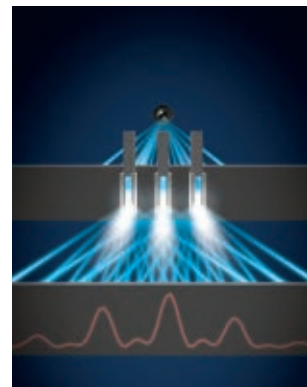
Weakest strength A blob of cold beryllium atoms measures the smallest force yet — a 174-yoctonewton tug by an electric field (*SN*: 5/22/10, p. 11).

Triple play Adding a third slit to the famous double-slit experiment (right) confirms a basic axiom of quantum

mechanics: More slits don't make for more interference (*SN*: 8/14/10, p. 12).

Free fall Physicists drop a cloud of supercold atoms down a 120-meter-tall elevator shaft, an experiment that may lead to new insights about gravity (*SN*: 7/17/10, p. 16).

Feline fluid dynamics Experiments and high-speed photography reveal that cats drink by pulling up columns of liquid with their tongues, finely balancing inertia and gravity (*SN*: 12/4/10, p. 5).



Approaching the island of stability

Smashing together the elements calcium-48, with 20 protons, and berkelium-249, with 97, has produced superheavy atoms containing 117 protons, albeit for a tiny sliver of a second (*SN*: 4/24/10, p. 15). Temporarily known as ununseptium, the new element fills an empty spot in the periodic table between the previously discovered elements 116 and 118.

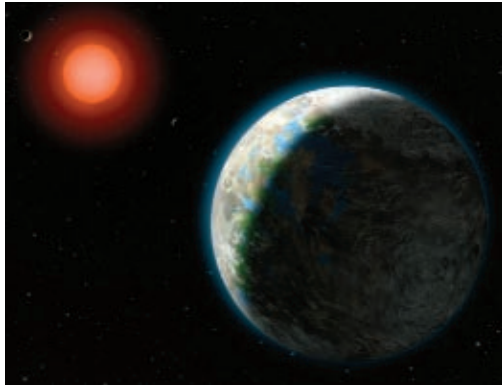
Down at spot 112 on the periodic table, an element first produced in 1996 by German scientists now has a name: copernicium, for the 16th century astronomer Copernicus (*SN*: 3/27/10, p. 13).

There are also six new isotopes of existing heavy elements, produced as researchers at Lawrence Berkeley National Laboratory in California monitored the radioactive decay of element 114 (*SN*: 11/20/10, p. 12). While not as dramatic as an entirely new element, new isotopes such as these help illuminate how matter behaves when lots of protons and neutrons get squished into a single atomic nucleus. Many researchers think that if they can make elements heavy enough, perhaps with 120 protons or more, the atoms will be relatively stable and stick around on an "island of stability" for several seconds instead of decaying away immediately (*SN*: 6/5/10, p. 26).

Extrasolar planets coming into focus

The discovery of a planet orbiting a dim dwarf star about 20 light-years from Earth has encouraged astronomers in their hunt for habitable, and maybe even inhabited, worlds elsewhere in the galaxy (*SN: 10/23/10, p. 5*). Though some researchers question the finding (*SN: 11/6/10, p. 14*), astronomers suspect that dozens of potentially habitable worlds will be discovered as the number of known exoplanets continues to climb.

The Kepler spacecraft, which monitors some 156,000 stars for dips in starlight that indicate the passage of planets, had found a whopping 706 candidate bodies by June, bringing the total of presumed extrasolar worlds to well over 1,000. One of Kepler's



Astronomers have evidence of a habitable planet (right, in this illustration) 20 light-years off.

discoveries, though much too close to its parent star to support life, has a diameter only about twice that of Earth (*SN: 7/3/10, p. 11*). The finding demonstrates Kepler's potential for finding Earth-sized planets.

Astronomers have also found evidence for planets originating outside the galaxy (*SN: 12/18/10, p. 11*), in the form of a Jupiter-sized body orbiting the star HIP 13044. The star is thought to have been hurled into the Milky Way after being ripped from a satellite galaxy billions of years ago.

Tiny martians Tiny fossils discovered in sulfate minerals on Earth suggest that similar remnants of life might be found on the Red Planet (*SN Online: 4/29/10*).

Second look Martian soil could contain the building blocks of carbon-based life after all, despite the negative results of an analysis performed by the Viking

missions (Viking 1 shown below) more than three decades ago (*SN: 10/9/10, p. 9*).

Dark glimmers An excess of gamma rays emanating from the galaxy's center may indicate the presence of dark matter, an exotic material that has never been observed but must exist to keep galaxies and galaxy

clusters from flying apart (*SN: 11/20/10, p. 11*).

Galaxies far, far away

Astronomers identify galaxies that may be the most distant starlit bodies known, each lying 13.2 billion light-years from Earth (*SN: 1/30/10, p. 5*).

LHC revs up The Large Hadron Collider sets a record for the highest-energy collision of subatomic particles (*SN: 4/24/10, p. 10*).

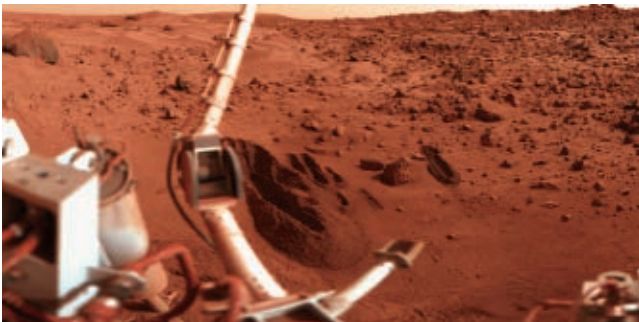
Flushing out the Higgs The elusive Higgs, a proposed subatomic particle that would explain the origin of mass, has fewer places to hide, two experiments reveal (*SN: 8/14/10, p. 16*).

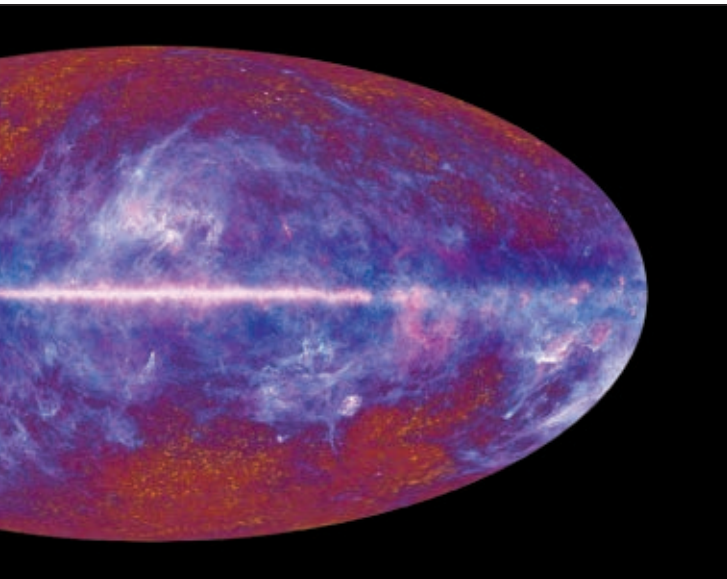
Early light dawns The Planck spacecraft obtains the sharpest view yet of the early universe (shown above), while an older craft looking just as far back in time refines the age of the cosmos (*SN: 7/31/10, p. 15; SN: 2/27/10, p. 7*).

Big star Astronomers have discovered the heaviest known star, which tips the scales at about 265 times the sun's mass and at birth weighed more than twice the generally accepted limit for a newborn (*SN: 8/14/10, p. 16*).

Sky-high life Simulations of Saturn's moon Titan suggest that the ingredients for life, such as the building blocks of DNA and RNA, may have formed in the atmospheres of planets and moons without the presence of liquid water (*SN: 11/6/10, p. 15*).

Heads-up Fluctuating bursts of microwave energy from the sun could provide warning of the huge solar flares known as coronal mass ejections (*SN: 8/28/10, p. 13*).





Galaxy fell together A preliminary analysis of elderly stars suggests seemingly disparate chunks of the Milky Way formed at the same time from one blob of gas and dust, possibly striking a blow against the prevailing theory of galaxy formation (*SN Online*: 5/4/10).

Lying about its age A meteorite's age has pushed back the estimated time of the solar system's formation by almost 2 million years (*SN Online*: 8/23/10).

Radio silence With Earth — and perhaps other places in the galaxy — growing more radio silent, many researchers are rethinking the search for extraterrestrial life. But better radio telescopes (Allen Telescope Array below) are still in the works (*SN*: 4/24/10, p. 22).



Slow cycle Gas flows on the solar surface may explain why the sun recently had such a prolonged case of the doldrums, and could lead to more accurate predictions of the duration and severity of future solar cycles (*SN*: 4/10/10, p. 8).

Seltzer moon A fizzy ocean, similar in carbonation to Perrier, may feed the plumes of water vapor, gas and ice that erupt from the south pole of Saturn's moon Enceladus, a new model suggests (*SN*: 11/6/10, p. 15).

Full of stars The abundance of red dwarfs in eight nearby galaxies suggests the stellar population of the universe may be three times current estimates (*SN*: 1/1/11, p. 10).

Milky Way bubbles Astronomers discover two giant blobs of gamma ray-emitting gas above and below the galaxy's center, probably produced by the super-massive black hole presumed to lurk there (*SN*: 12/4/10, p. 18).

Safe bet The same mathematical principles underlie massive economic crises and tiny fluctuations, and calamitous collapses are inevitable (*SN*: 4/10/10, p. 11).

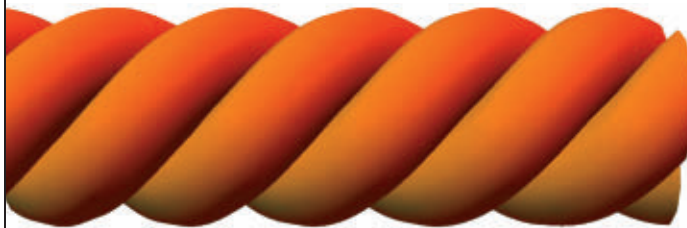
Fractal foraging Sharks and other marine predators follow fractal paths when cruising for a meal, resulting in a pattern known as a Lévy walk (*SN*: 7/3/10, p. 15).

Finding fakes A new computer program can “see” the differences between real art pieces and impostors better than previous techniques (*SN Online*: 1/11/10).

Drugs you'll like A computer algorithm picks out promising drug compounds much the same way Netflix recommends DVDs to its customers (*SN Online*: 4/20/10).

Surviving the marathon Competitors can avoid hitting “the wall” by calculating and keeping to a physiologically sustainable pace (*SN*: 11/20/10, p. 8).

Twisty math No matter the material, a maximally twisted triple-stranded rope (below) is 68 percent the length of its untwisted strands (*SN*: 5/8/10, p. 17).



The Tao of traffic lights

When a traffic light goes green can seem to hinge on whimsy rather than the number of vehicles waiting. Scientists propose speeding up traffic by making signals go with the flow (*SN*: 10/23/10, p. 8). Inspired by the movement of crowds through narrow spaces such as doorways, Swiss and German researchers tried a responsive, flexible approach, rather than a top-down, centralized system. Their strategy puts two sensors at each intersection: One measures incoming flow and one measures outgoing flow. Lights are coordinated with every neighboring light, giving signals at the next intersection just enough time to prepare for the incoming vehicles. A simulation of the approach that tackled the center of Dresden, Germany, reduced time in traffic by 56 percent for city trams and buses, 9 percent for cars and trucks and 36 percent for pedestrians crossing intersections. Similar approaches could help reduce the estimated 500,000 person-years that the U.S. driving population spends in traffic each year and the estimated \$87 billion lost to delays.

1 in 5 | U.S. adolescents with measurable hearing loss

Stroke timing Magnetic resonance imaging done promptly when a patient arrives at a hospital could pinpoint when a stroke began, rendering more patients eligible for clot-busting therapy that can limit brain damage (*SN: 12/4/10, p. 12*).

Heartburned Proton pump inhibitors are great at blocking stomach acid, but their overuse could pose health risks (*SN: 12/4/10, p. 30*).

Aha! Sudden insight occurs when neurons in the brain alter their activity all at once (*SN: 6/5/10, p. 9*).

Early detection High levels of the protein EGFR can show up 17 months before breast cancer is diagnosed (*SN: 5/22/10, p. 15*).

Whisker therapy A study in rats suggests that rubbing a stroke victim's face or fingers right after onset might reduce brain damage (*SN: 12/4/10, p. 14*).

Artificial eye A new type of prosthetic retina can analyze patterns of cell activity to reproduce images similar to those produced in normal vision (*SN: 12/4/10, p. 14*).

Beyond a buzz Components in marijuana (left) show potential against pain, multiple sclerosis, Crohn's disease and even cancer (*SN: 6/19/10, p. 16*).

Barrier builders The blood-brain barrier, which keeps both bacteria and some drugs out of the brain, relies on cells called pericytes, a discovery that scientists hope to exploit to better understand brain diseases and trauma (*SN Online: 10/13/10*).

HDL booster A new drug called anacetrapib more than doubles "good" cholesterol and lowers bad forms in study volunteers, paving the way for a large clinical trial (*SN: 12/18/10, p. 14*).

So sleepy A survey finds that only 7.6 percent of U.S. teens get the ideal quota of sleep most nights — and about 16 percent average no more than five hours (*SN Online: 1/8/10*).

Years in the making In pancreatic cancer, a decade can elapse from the first cancer-related mutation to tumor formation, and several more years pass before the disease spreads to other organs. The work raises the possibility that an often deadly malignancy can be treated before it's too late (*SN: 11/20/10, p. 9*).

Marburg vaccine An experimental vaccine can waylay the deadly tropical virus even after exposure, tests in monkeys show (*SN: 7/31/10, p. 12*).

MicroRNAs anonymous Increasing levels of the microRNA *miR-212* in rats' brains helps protect the rodents from cocaine addiction (*SN: 7/31/10, p. 11*).

Tossing and turning Violent dreams can precede brain disorders by decades (*SN: 8/28/10, p. 9*).

Insulin insight Renal failure in people with diabetes may be linked to poor insulin uptake by kidney cells called podocytes (*SN: 11/6/10, p. 11*).

Not-so-total recall Older mice lose genetic packaging that helps activate genes involved in making memories (*SN: 6/5/10, p. 8*).

Medical roach Ground-up brain tissue from cockroaches and locusts contains antibacterial compounds that might lead to new drugs for fighting infectious diseases in humans (*SN: 10/9/10, p. 14*).





Gene therapy moves forward

Despite their promise, technologies to correct defective genes have been plagued by safety problems leading to unintended—and sometimes fatal—outcomes. But scientists are inching toward safer, more effective gene therapies that may one day treat a range of diseases, from psychiatric disorders to autoimmune diseases to cancers.

Studies in animals and isolated cells in the lab are showing promise. In mice, correcting gene function reverses depression-like behaviors (*SN: 11/20/10, p. 14*), blindness (*SN: 7/17/10, p. 11*) and type 1 diabetes.

Researchers have also pushed forward on tests of gene therapy in humans. Small clinical trials have had preliminary

Scientists hope to one day use gene therapy to treat diseases such as severe combined immunodeficiency, which confined David Vetter (left, in 1973) to a plastic bubble.

success in treating several rare disorders, though not without risks. A study published in the July 22 *New England Journal of Medicine* reports that eight to 11 years after nine children underwent gene therapy for severe combined immunodeficiency (widely known as bubble boy syndrome), seven of the children had improved immune systems. Four of the children, however, developed leukemia, and one died.

Researchers also report in the Nov. 11 *New England Journal* the successful treatment of two boys with a rare immune disease called Wiskott-Aldrich syndrome. Introducing a functional copy of the disease-causing gene improved the boys' symptoms, and both were doing well more than two years after the therapy.

Gene therapy still faces many hurdles before it can become a common, safe and effective treatment, but today things look more hopeful, researchers say. "We're certainly in much better shape than we were 10 or 15 years ago," says Cynthia Dunbar of the National Institutes of Health in Bethesda, Md. "Things looked pretty grim in the 1990s, but now there are clear clinical advances moving us forward."

Taste cells all over Taste receptors throughout the gut, not just on the tongue, help activate the digestive system in response to incoming food (*SN: 3/27/10, p. 22*). In the lungs, taste receptors open airways in response to acrid gases, perhaps to ventilate infected tissue (*SN: 11/20/10, p. 8*).

Say what? Teen hearing-loss rates have risen by a third since tests in the 1980s and '90s (*SN: 9/11/10, p. 14*).

New stem cell source Injecting stem cells harvested

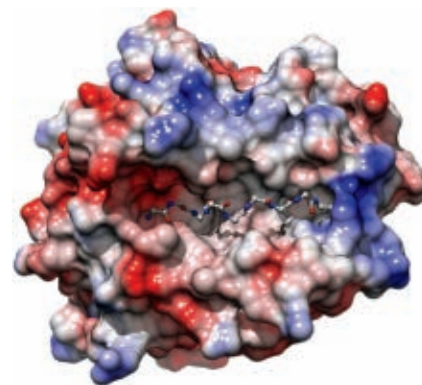
from fat tissue into coronary arteries could limit damage after a heart attack (*SN: 12/18/10, p. 15*).

Disease transplants Organ donors can unwittingly share a toxic bonus, such as brain-seeking amoebas, case reports reveal (*SN Online: 9/24/10*).

Muscle memory Muscles store memories of past fitness in the form of extra nuclei (bright green, below) that allow muscle cells to rebound quickly after a period of disuse. The find

suggests that working out early in life could help stave off frailness later (*SN: 9/11/10, p. 15*).

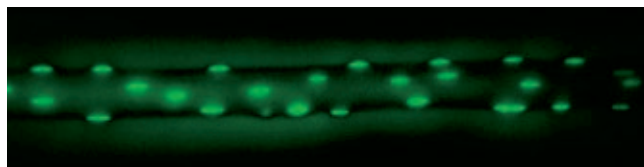
HIV advances Giving an antiretroviral drug mix to men at high risk of HIV may help prevent infection (*SN: 12/18/10, p. 16*). For women not already infected, a new vaginal gel shows promise as a preventive (*SN: 8/14/10, p. 9*). Research also shows that HIV drugs could prevent millions of TB cases in Africa (*SN Online: 2/21/10*). Scientists find that having high levels of the tumor-suppressing protein p21 may fend off HIV (*SN: 11/20/10, p. 9*). What's more, people infected with HIV but able to keep the virus in check often make a variant form of the



HLA-B protein (above), new work shows (*SN: 6/5/10, p. 8; SN: 12/4/10, p. 12*).

Genetic TB prognosis

Profiles of gene activity in the blood of people infected with tuberculosis can help predict who will get sick, and possibly head off lung damage or save people from unnecessary treatments (*SN: 9/11/10, p. 14*).



CLOCKWISE FROM TOP: © BETTMANN/CORBIS; P. DE BAKKER; COURTESY OF J.C. BRUUSGAARD/UNIV. OF OSLO



Lie detectors blend fact and fiction

Devices that can discern honest statements from lies are much sought after, especially since a 2003 National Research Council report concluded that traditional polygraphs flag stress, not deception. But newer gadgets increasingly used by police departments and other agencies don't tell fact from fiction either, researchers now say (*SN*: 7/3/10, p. 28). Known collectively as voice stress analyzers, these next-gen lie detectors aim to tease out truth by reading consistent changes in speech that occur when someone is lying—a signature that acoustics researchers say may not exist. Two large studies, one examining voice stress analyzers in a lab and the other in a jailhouse setting, found that the analyzers do pinpoint some lies. But they also peg true statements as lies at similar rates. These false positives, which are often left out of studies and company descriptions of the technologies, are key for evaluating merit, says James Harnsberger of the University of Florida in Gainesville. "A common mistake is to only report how many lies were successfully detected," he says. "You could write 'lie' on a piece of paper and hold it up every time someone speaks to you, and you will detect 100 percent of the lies."

New voice-based lie detectors are no more reliable than polygraphs, studies now suggest.



Picker-upper A gripper made of a bag of coffee grounds (left) has advantages over robots that use individual digits (*SN*: 11/20/10, p. 10).

Cheaper wheels Trading platinum for perovskite, a cheaper and possibly more effective material, in cata-

lytic converters would lower the cost of diesel vehicles (*SN*: 4/24/10, p. 14).

Smoother pixel Fifty years after the first digital image, one of its creators devises an algorithm to take the edge off square pixels (*SN*: 7/17/10, p. 17).

Got sound? Sterilizing milk by bombarding it with sound waves leaves a fresh, raw taste that is lost in high-temperature pasteurization (*SN Online*: 7/21/10).

Tsunami alert Giant waves can create voltage pulses in underwater communication cables, offering a potential early warning system (*SN*: 2/13/10, p. 15).

Dusty detector A new twist on an analytical method called Raman spectroscopy uses a sprinkling of gold to detect trace substances and could be used at crime scenes (*SN*: 4/24/10, p. 15).

Trading places Researchers have found the optimal spots on the globe for speedy electronic communication with the world's 52 major financial exchanges (*SN*: 11/20/10, p. 10).

Mind over machine With only their thoughts, people whose brains are connected to computers can toggle between images of Marilyn Monroe and Josh Brolin (*SN Online*: 10/27/10).

Bomb foiler A handheld device can sniff out minuscule amounts of TATP, the explosive favored by the would-be shoe bomber (*SN*: 12/4/10, p. 8).

Live in 3-D A new technology sends holograms via the Internet in nearly real time, putting holographic teleconferencing and 3-D video chatting almost within reach (*SN*: 12/4/10, p. 8).

Wandering minds

A cell phone–based survey finds that people frequently feel worse when their minds wander than when they focus on the moment (*SN*: 12/4/10, p. 11).

Neandertals blown away

Volcanic eruptions may have wiped out Neandertals in Europe and western Asia, clearing the region for Stone Age *Homo sapiens* (*SN*: 10/23/10, p. 12).

Bridge species Fossils discovered in a South African cave may come from a hominid species that lived nearly 2 million years ago and provided an evolutionary bridge to the *Homo* genus (*SN*: 5/8/10, p. 14).

Delayed disgust It takes kids until about age 5 to understand facial expressions of disgust, challenging the view

that evolution produced an innate expression for that emotion (*SN*: 6/19/10, p. 10).

Duds for tots Best-selling videos marketed as vocabulary boosters for toddlers don't work as advertised, though some parents mistakenly think they see results (*SN*: 9/25/10, p. 15).

Ancient mariners Stone tools found on the Mediterranean island of Crete may have belonged to a *Homo* species that used rafts or other seagoing vessels to journey from northern Africa to Europe at least 130,000 years ago (*SN*: 1/30/10, p. 14).

Gene trek DNA extracted from 4,000-year-old hair points to a previously unknown migration of northeastern Asians into the New World about 5,500 years ago (*SN*: 3/13/10, p. 5).



Iceman's demise A controversial analysis of artifacts found near a prehistoric man's frozen body (above) in the Italian Alps argues that he was ritually buried there (*SN*: 9/25/10, p. 14).

Stranger beside me Young couples are better than long-term partners at discerning each other's preferences for food, movies and home decor (*SN*: 11/6/10, p. 16).

Genetic victims Bullied kids who carry one form of a

stress-related gene have an elevated risk of emotional problems by age 12, a study finds (*SN*: 6/19/10, p. 10).

Heading north Stone tools unearthed in England suggest that human ancestors settled in northern Europe at least 800,000 years ago (*SN*: 7/31/10, p. 5).

Memory boosts By creating associations, quizzes improve recall more effectively than just reviewing notes (*SN*: 11/6/10, p. 16).



Extreme makeover for Lucy's kind

Recent fossil discoveries suggest that the early hominid species represented by the famous bones of Lucy, who lived 3.2 million years ago in Ethiopia, may have been more like modern humans than previously thought. The skeleton of a 3.6-million-year-old male of the same species, *Australopithecus afarensis*, shows that he had a nearly humanlike gait and ground-based lifestyle, says a team led by anthropologist Yohannes Haile-Selassie of the Cleveland Museum of Natural History. Dubbed Big Man, the male stood an estimated 5 to 5.5 feet tall and would have towered over the 3.5-foot-tall Lucy (*SN*: 7/17/10, p. 5). Big Man's anatomy challenges an influential view, largely based on analyses of Lucy's remains, that *A. afarensis* had a chimplike build suited to frequent tree climbing. The team contends that, instead, a skeleton enabling a smooth, upright stride was established by the time Lucy's kind evolved around 4 million years ago. In another revelation, butchery marks on animal bones from about 3.4 million years ago suggest that Lucy's species wielded stone tools, making it the oldest known group to do so (*SN*: 9/11/10, p. 8). Other scientists reject this claim, saying that marks found on the bones could have resulted from trampling by animals or from incidental movement across abrasive soil following burial (*SN*: 12/18/10, p. 8).

A 3.6-million-year-old skeleton of *Australopithecus afarensis* suggests an upright gait.

93 percent | Portion of human DNA that a study suggests may be unnecessary



Gene sequencing for all, even Neandertals

An unprecedented picture of life's diversity is emerging as researchers publish the full genetic instruction books of a growing list of species—including one that has been extinct for more than 30,000 years.

A project sequencing Neandertal DNA harvested from bones reveals evidence of prehistoric interbreeding between humans and Neandertals (*SN*: 6/5/10, p. 5). As for modern humans, scientists have compiled complete genetic profiles of Archbishop Desmond Tutu and a Bushman tribal elder named !Gubi (*SN*: 3/13/10, p. 16). Full genomes are also available for the first time for people of African-American, Mexican-American (*SN*: 7/3/10, p. 13), Japanese and Irish descent.

In addition, the pilot phase of the 1000 Genomes project has unveiled millions of genetic variants in about 800 people of several different ethnic origins (*SN*: 11/20/10, p. 14). This snapshot reveals that the average person carries defective copies of 250 to 300 genes, plus about 75 DNA variants associated with disease. Similar advances in DNA sequencing are also allowing researchers to decode the genomes of more species (See March of genomes, Page 29).

Now scientists are looking for ways to put all this information to use. New techniques to read just the protein-coding portions of genes, for example, show how some mutations may contribute to mental retardation (*SN Online*: 11/14/10) and have revealed the genetic causes behind some inherited diseases (*SN*: 4/10/10, p. 12).

Some modern humans have inherited a fraction of their DNA from Neandertals (reconstruction, above right).

Single life source Statistical analyses of protein structure show that there is almost no chance that present-day life on Earth had more than one common ancestor (*SN*: 6/5/10, p. 12).

The Adam sperm A gene crucial for sperm production arose just once, 600 million years ago, and has governed the genesis of male gametes in animals ever since (*SN*: 8/14/10, p. 14).

Vestigial no more Pseudogenes, once thought to be defunct copies of genes, still have a purpose in life—to regulate protein production of their “functional” twins (*SN*: 7/17/10, p. 14).

Prions not all bad A study in sea slugs suggests that prions, the disease-causing agents in mad cow disease, may help form protective sheaths around nerves (*SN*: 2/13/10, p. 17). A separate study indicates proteins that act like prions could be key players in forming memories (*SN*: 2/27/10, p. 13).

Gene count A decade after completion of the Human Genome Project, researchers still have not pinned down the precise number of protein-producing genes in a human being, though one

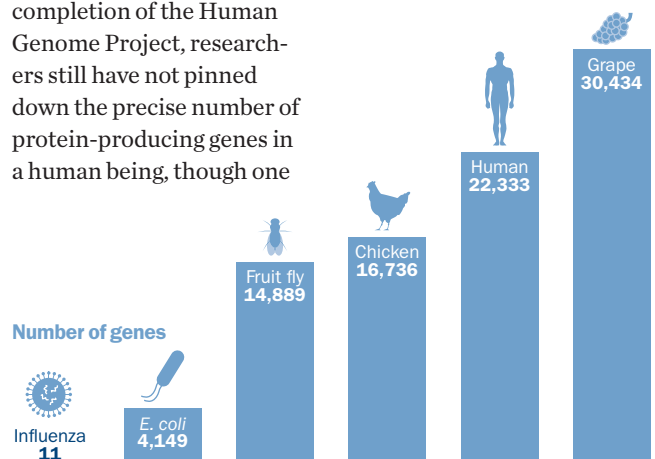
count (chart below) puts the figure at 22,333 (*SN*: 11/6/10, p. 5).

Skin to neuron Using a new technique, skin cells can be converted directly into neurons without first reverting to an embryonic state (*SN*: 2/27/10, p. 5).

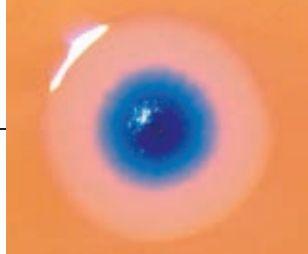
Walking bacteria Bacteria can stand on end and stagger around, thanks to hairlike appendages called pili (*SN*: 11/6/10, p. 8). The behavior may be involved in exploring new environments and could help explain how antibiotic-resistant microbe communities called biofilms form.

Junk DNA A cross-species comparison suggests that more than 90 percent of DNA in the human genome has no known function (*SN*: 12/4/10, p. 17).

DNA tagged for obesity Chemical modifications to DNA near genes involved in weight regulation may affect who becomes obese and who stays lean (*SN*: 10/9/10, p. 15).



FROM TOP: ©JOE MCNALLY/RECONSTRUCTION BY KENNIS AND KENNIS; T. DUBÉ; CHICKEN ICON: PINARE/SHUTTERSTOCK. HUMAN ICON: MYSONTUNA/SHUTTERSTOCK



Artificial life Scientists insert the genome of one type of bacterium into the empty husk of another (SN: 6/19/10, p. 5), causing the empty cell to switch species (recipient cell, above). The transfer is touted by some as the creation of the first synthetic life, but the achievement falls short of creating life from scratch (SN: 6/19/10, p. 32).

Changing batteries A new technique that swaps sick mitochondria for healthy ones could help prevent many human diseases (SN: 5/8/10, p. 16).

March of genomes Newly decoded animals include Western clawed frogs (SN: 5/22/10, p. 14), sponges (SN: 8/28/10, p. 8), ants (SN Online: 8/26/10), zebra finches (SN: 4/24/10, p. 16), mosquitoes (SN Online: 9/30/10), pea aphids, body lice and their symbiotic bacteria, the sleeping sickness parasite, hydras and ancient polar bears (SN: 3/27/10, p. 14). Plants joining the list include soybeans (SN: 2/13/10, p. 16), seaweed (SN Online: 6/2/10), Golden Delicious apples and the black truffle fungus. Coming soon: cocoa (SN Online: 9/15/10), a complete wheat (SN Online: 8/31/10), peach and the Tasmanian devil.

RNA glitch In thousands of genes, RNA fails to accurately transcribe DNA. Geneticists have no idea why (SN: 12/4/10, p. 17).

Opiates for the masses

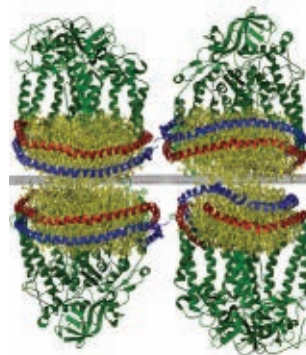
Researchers unravel the final steps in the opium poppy's production of morphine, which could mean cheaper painkillers (SN: 4/10/10, p. 5).

See the heat The protein that makes wasabi feel fiery also lets snakes "see" heat radiating from their prey (SN Online: 3/14/10).

Howdunit Figuring out how chemical warfare agents such as mustard gas were made may help identify their maker (SN Online: 3/23/10).

Aluminum foils water

Tiny clusters of aluminum atoms can extract pure hydrogen from water, which may aid the production of hydrogen-based fuels (SN Online: 3/4/10).



Presto chango! Researchers watch as energy-producing photosynthetic complexes self-assemble (final product, above), a possible first step to self-repairing solar cells (SN: 10/9/10, p. 14).

Life's cold start RNA, the molecule of heredity that may have kicked off life on Earth, can begin to replicate within tiny liquid pockets in ice, suggesting life didn't need a warm cocoon (SN: 10/23/10, p. 11).

Dark and delicious

Compared with lighter roasts, dark-roasted coffees have higher levels of a compound that helps dial down production of stomach acid (SN: 4/24/10, p. 13).

Scent of fear A compound that prompts aggression makes mice freeze with fear when they smell the molecule coming from a rat or cat (SN: 6/5/10, p. 14).

Dietary toxin A newly described microbe may substitute arsenic for phosphorus, a basic ingredient of life, raising questions about the limits of biochemistry (SN: 1/1/11, p. 5).

Tiny tools Enzyme-based machinery could have medical applications (SN: 10/23/10, p. 11).

Gimme an F

Chlorophyll, the pigment that makes the world go 'round, has come in four known flavors for more than 60 years: chlorophylls a, b, c and d. Now scientists have discovered another version of the pigment that allows plants and other photosynthesizing organisms to harness sunlight for making food and oxygen. Dubbed chlorophyll f, the new version is found in extracts of ground-up stromatolites—knobby chunks of rock and algae—collected in western Australia's Shark Bay (SN: 9/11/10, p. 13).

Chlorophyll f absorbs light most efficiently at a wavelength around 706 nanometers, just beyond the red end of the visible spectrum. The previously known chlorophylls absorb light of shorter wavelengths. Exploiting slightly longer wavelengths may allow the microorganism that makes chlorophyll f (a filamentous cyanobacterium, scientists think) to survive in shady habitats, beneath creatures that snatch up the other usable wavelengths. A chemical extra known as a formyl group on one of the chlorophyll's carbons appears to set chlorophyll f apart from its kin, says study leader Min Chen of the University of Sydney in Australia. "This very small modification of the pigment happens," Chen says, "then the organism can use this unique light."



An organism with a newly found form of chlorophyll lives in stromatolites (shown).

Knocked for a loop

A magnitude-8.8 earthquake in Chile tilts Earth's axis a few centimeters and shortens the day, models suggest (*SN Online*: 3/3/10).

Aussie rex Paleontologists digging in Australia unearth the first known fossils of a tyrannosaur from the Southern Hemisphere (*SN Online*: 3/25/10).

Desktop discovery Google Earth images reveal one of Earth's freshest impact craters, a 45-meter-wide hole in southwestern Egypt



whacked out by a meteorite just a few thousand years ago (*SN*: 8/14/10, p. 13).

Early landing Fossilized footprints in 395-million-year-old rocks offer the earliest evidence for four-limbed creatures and raise new questions about when and where land dwellers evolved (*SN*: 1/30/10, p. 9).

Accelerated cycling Rising global temperatures are driving up river runoff to the sea by some 540 cubic kilometers per year (*SN Online*: 10/5/10).

Early bird A 125-million-year-old humpbacked dino may have had feathered arms (illustration, left), pushing back the first appearance of feathers in the fossil record (*SN*: 10/9/10, p. 16).

**Farming's surprise yields**

Irrigation in the American Midwest could be substantially cooling the region in the summer (*SN*: 2/13/10, p. 15). In the African Sahel (above), the arrival of large-scale agriculture has caused dust emissions to skyrocket (*SN*: 7/31/10, p. 14).

Nonliving color Researchers are using fossilized pigment structures to give dinosaurs and ancient birds a colorful makeover. One team has reconstructed the plumage on the oldest known feathered dino (*SN*: 2/27/10, p. 9). And giant emperor penguin fossils reveal that the birds

once wore ruddy brown getups rather than tuxedo coloration (*SN Online*: 9/30/10).

Icy hot The eruption of Eyjafjallajökull in Iceland has researchers monitoring activity at nearby Katla (*SN Online*: 4/15/10) and has focused attention on the dangers of ice-covered volcanoes (*SN*: 9/25/10, p. 16).

Warm in the water Ancient marine reptiles may have been warm-blooded, with some species 20 degrees Celsius warmer than the surrounding waters (*SN Online*: 6/10/10).



Studies of the earthquake that devastated Port-au-Prince in January found that the area remains at risk.

Inside the Haiti quake

Some 230,000 Haitians died when a magnitude-7 earthquake struck just outside Port-au-Prince on the afternoon of January 12. Scientists from around the world scrambled to the scene (*SN Online*: 1/16/10) to assess which fault had ruptured and whether more people were at risk. Early ideas held that the quake had broken along the well-known Enriquillo-Plantain Garden fault, which divides the Caribbean and North American tectonic plates. But U.S. Geological Survey scientists found no evidence of a large surface rupture there, instead spotting corals west of Port-au-Prince that had been lifted by the quake. Researchers concluded that most of the movement had been along a previously unknown fault (*SN Online*: 8/11/10), now called the Léogâne. If that's correct, the strain that has accumulated in the last few centuries on the Enriquillo-Plantain Garden fault has not been released, and seismic hazard in Haiti remains high. Because such a large quake occurred without much surface rupture, geologists may need to rethink how to identify past quakes in the rock record, one team suggests in a special issue of *Nature Geoscience*.

600 international units | New recommended daily intake of vitamin D

Eating wrong The National Academies' Institute of Medicine reports that "nearly the entire U.S. population consumes a diet that is not on par with recommendations" (*SN Online*: 9/29/10).

Breast milk takes on HIV Two research teams have developed tactics to protect babies of HIV-infected women by supplementing mom's breast milk with virus-quashing bacteria (*SN Online*: 8/6/10).



New antioxidant benefits An antioxidant chemical in grapes, peanuts and wine can boost the action of insulin, which would benefit people with type 2 diabetes, two new studies suggest (*SN Online*: 6/23/10). Two more show how this molecule, resveratrol, might fight retinal and heart disease (*SN Online*: 6/28/10).

Take dairy to heart A Swedish study links high concentrations of dairy fats in the blood to a reduced risk of heart attacks (*SN Online*: 8/27/10).

Mercurial fish and rice U.S. studies offer guidance on how to tap the dietary benefits of fish without risking mercury poisoning. One suggestion: Focus on low-contamination species (*SN*: 5/22/10, p. 10). Researchers also discover that rice is the

leading mercury source for many people in China (*SN Online*: 4/16/10).

Pucker no more Japanese scientists have engineered tomatoes to produce a natural taste-altering protein that makes sour foods seem oh-so-sweet (*SN Online*: 8/10/10).

Chili diets A study shows that an ingredient in peppers can rev up the metabolism of obese diners — a potential boon to weight loss — and another study identifies the molecular changes that fight fat (*SN Online*: 4/27/10; *SN Online*: 6/3/10).

Deficient in D Research continues to link a shortage of vitamin D with health risks. Lymphoma patients deficient in the "sunshine vitamin" do poorly compared with those who have plenty of it (*SN*: 1/2/10, p. 15), and children getting extra doses of vitamin D fend off the flu better than those getting placebos (*SN Online*: 3/16/10). The Institute of Medicine has tripled the dietary reference intake for vitamin D (*SN*: 1/1/11, p. 14) from 200 international units to 600 IU for people ages 1 to 50, and has also raised it for other age groups. But researchers say the new targets are still way too low to address widespread vitamin D deficiency.

Fattening after dark When it comes to limiting weight gain, timing of dining may be as important as what's on



Fish oil packs a punch

Omega-3 fatty acids are turning up in plenty of promising reports, but some tests fail to show a benefit. Reported anti-inflammatory effects of the compound may help to shake out just how these nutrients boost health. High levels of omega-3s are found in fish oil from cold-water species and in walnut and flaxseed oils.

Scientists report that people with sepsis, a lethal inflammatory overreaction triggered by a blood infection, fare better if they get fish oil rather than soybean oil (*SN*: 2/13/10, p. 14). Other researchers find that ample omega-3 in the blood can protect the ends of chromosomes, helping cells live longer.

On the cancer front, fish oil and its anti-inflammatory cargo of omega-3s seem to guard against breast cancer (*SN*: 7/31/10, p. 13), while 14 other over-the-counter supplements fail to show a benefit. And lab research in mice induced to have prostate cancer finds that their tumors grow more slowly on a diet rich in walnut oil, which is high in omega-3s, compared with soy oil (*SN*: 4/24/10, p. 13; *SN Online*: 3/27/10).

In some studies, though, omega-3 benefits come up short. For example, people with heart arrhythmia may not be helped by fish oil (*SN*: 12/18/10, p. 15), and other reports cast doubt on a protective effect against dementia. The research continues.

Omega-3 fatty acids found in cold-water fish appear to have benefits, including guarding against some cancers.

the menu, animal data indicate (*SN*: 11/6/10, p. 10).

Healthy perks At least among aging rats, coffee can boost memory and signaling essential to motor coordination (*SN Online*: 7/22/10).

Seaweed superpowers Gut microbes found in Japanese people can break down a compound in seaweed. The ability may come from a

gene picked up from marine microbes hitchhiking through the intestines (*SN*: 5/8/10, p. 13).



Vaccine link to autism dismissed

In February, *Lancet* formally retracted a 1998 study that had kindled a storm of opposition to vaccines (*SN Online*: 2/3/10). The research suggested that autism arose in a handful of children after the kids received shots to prevent measles, mumps and rubella. The study's lead author committed several ethical breaches, and the selection of participants in the study may have been biased, the U.K. General Medical Council reported in January following an investigation. Following suit, *Lancet* retracted the paper, noting that "several elements" of the study were incorrect. Alarms that the study raised about vaccines, though, continue to reverberate despite subsequent research in Britain, Japan and Finland that has found no connection between the MMR vaccine and autism.



Buried data Important details from roughly one in five drug trials for treating the most common type of stroke were never made public, a study finds (*SN Online*: 4/22/10).

Telltale smudge Imaging technology reveals that Thomas Jefferson made a last-minute revision to the Declaration of Independence (below), calling colonists citizens instead of subjects (*SN Online*: 7/3/10). A Library of Congress scientist spotted a smudge on an early draft of the historic document, then discovered what had been erased by photographing the paper in 13 different wavelengths of light and subjecting the images to 10 hours of computer processing.



Lingering effects Many emergency responders to the 9/11 attack in New York City (above) still have breathing problems (*SN*: 5/8/10, p. 12).

R&D investments lag U.S. research competitiveness remains in peril even as other nations steam ahead, a report finds (*SN Online*: 9/23/10).

Time is money Minor air-traffic delays due to inclement weather cost the U.S. economy more than hurricanes, meteorologists calculate (*SN*: 2/13/10, p. 9).

Risk-blind cons Compared with men lacking prison

records, inmates have a harder time assessing the probability of big gains or losses when taking risks (*SN*: 11/20/10, p. 7), suggesting that programs helping convicts understand risk could decrease recidivism.

Don't know much Science literacy in the United States has tripled over the past 20 years — to 28 percent — which is better than almost anywhere else (*SN*: 3/13/10, p. 13).

Dual diagnosis U.S. health care is not fully prepared to cope with the nation's 75 million patients per year with at least two chronic medical conditions (*SN Online*: 4/6/10).

Stifled R&D Making scientific information proprietary, such as by licensing intellectual property, can quash innovation, a study of patented genes concludes (*SN Online*: 8/9/10).

Summertime blues Teaching hospitals tend to make more medication

errors during July, when newly minted doctors arrive (*SN Online*: 6/2/10).

Shields up Adding face protection to current U.S. military helmets could deflect some of the blast force that causes brain injury (*SN*: 12/18/10, p. 16).



CLOCKWISE FROM TOP: A IMAGES/ISTOCKPHOTO; FRANCE/ LIBRARY OF CONGRESS; U. S. NAVY PHOTO BY PHOTOGRAPHER'S MATE 2ND CLASS JIM WATSON



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Deadly Choices: How the Anti-Vaccine Movement Threatens Us All

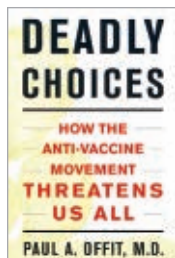
Paul A. Offit

Vaccines, once the darlings of medical science, lost their reputation for safety in the 1980s and 1990s. After a flurry of disturbing “news-you-can-use” segments, some parents refused to get their kids immunized. For vaccines, the journey back to credibility has been slow.

Physician Paul Offit provides a road map for that voyage. In a meticulously researched tour de force, Offit exposes the lack of science underlying the claims of the anti-vaccine movement. Some fears were legitimate — polio and rotavirus vaccines, he notes, posed real risks for certain people. Both were replaced by safer vaccines.

But over the past 25 years, vaccines have been accused of causing multiple sclerosis, diabetes, learning disabilities and attention disorders. Under attack were shots for whooping cough, meningitis, measles and hepatitis B — all of which were later found to be safe.

The cause célèbre was a 1998 scare in which a British physician claimed to link autism in 12 children with the measles vaccine. Several subsequent studies proved this claim false. But by then four unvaccinated children had died of measles and many more had gotten sick. “We’ve reached a tipping point,” Offit



writes. “Children are suffering and dying because their parents are more frightened by vaccines than by the diseases they prevent.”

In 2009 and 2010, U.S. courts ruled against claims linking autism with vaccines. Still, many vaccine opponents aren’t persuaded, and they have talk show access and Hollywood friends. To level the playing field, every doctor’s office should have a copy of Offit’s book, giving parents the other side of the story. — *Nathan Seppa*
Basic Books, 2010, 288 p., \$27.50.

Written in Stone: Evolution, the Fossil Record, and Our Place in Nature

Brian Switek

Notions of evolution have, for lack of a better word, evolved, and with wonderfully broad strokes science writer and long-time paleontology blogger Switek takes readers on a fascinating historical, scientific and cultural tour of the theory’s various incarnations.

Well before anyone came up with the idea of evolution, theologians and phi-



losophers generally ranked species from “lower” to “higher” forms along a Great Chain of Being, with humans representing the highest point of Creation. Then the fossil record

revealed that plants and animals had changed through time, and the notion of a march of progress along paths of ever-increasing complexity took hold.

As more and more fossils were unearthed, however, researchers recognized that evolution doesn’t proceed toward a single goal. Instead, as Switek illustrates through captivating timelines of discoveries, scientists found a much more haphazard process, resulting in a mélange of “primitive” forms living alongside their evolutionarily more-advanced relatives. It’s a pattern seen in many groups, from the wildly branching family trees of elephants and whales to those of horses and hominids.

Chapter by chapter, the author recounts how fish conquered the land, how reptiles evolved to produce birds and how fox-sized, deerlike creatures returned to the seas to become whales. Finally, Switek shows that many modern human traits can be traced back millions of years, and none of them deny *Homo sapiens’* close relationships with other primates. Humans are apes, Switek says, just of a different sort. — *Sid Perkins*
Bellevue Literary Press, 2010, 246 p., \$17.95.



From Jars to the Stars

Todd Neff

An engaging history recounts how the Ball Brothers Co. went from making mason jars to building the Deep Impact spacecraft. *Earthview Media*, 2010, 327 p., \$24.95.



Come See the Earth Turn

Lori Mortensen, illustrations by Raúl Allén
Aimed at kids age 7 to 9, this picture

book shows how Léon Foucault and his pendulum demonstrated the Earth’s spin. *Tricycle Press*, 2010, 32 p., \$17.99.



Where Good Ideas Come From

Steven Johnson

In what he calls a “natural history of innovation,” a science writer identifies patterns

throughout history, mining the past for lessons in creativity. *Riverhead Books*, 2010, 336 p., \$26.95.



Escape from the Ivory Tower

Nancy Baron

A communications expert gives scientists a practical guide to making their work bet-

ter understood. *Island Press*, 2010, 272 p., \$27.50.



What Technology Wants

Kevin Kelly

By viewing technology as an organism, a tech journalist projects how new devices might

evolve. *Viking*, 2010, 336 p., \$27.95.

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Quality check

Thank you for great reporting. I'm a longtime subscriber to *Science News* (since the 1970s) and want to compliment your reporters, writers and editors on the high quality of your articles, which often involve material that is difficult to explain. They make the news of science understandable, informative and entertaining. Hopefully, publications like yours, together with good science education in our schools, will inspire our youth and combat the politicized science and the pseudo-science now prevalent in our society.
Leon R. Pacifici, Underhill, Vt.

Viral infection and obesity

The correlation between obesity and adenovirus-36 antibodies (*SN*: 10/9/10, p. 5) is interesting, but what is causing what? The article says 22 percent of obese children and 7 percent of normal-weight children in the study carried the antibodies. For a virus as "common" as

the common cold, these seem like low exposure rates. Is it possible that many people are exposed but either never develop or stop producing the antibodies? Or that obese people produce more of the antibodies than nonobese people?
Tom Lippe, El Cerrito, Calif.

It's true that cause and effect can't be established by association studies, such as the one by Jeffrey Schwimmer and colleagues showing a link between adenovirus-36 infection and childhood obesity. But this study is just one of many, including research showing that more body fat accumulates in animals infected with AD-36. Researchers now plan to follow groups of people to see whether body-fat patterns change after infection with the virus. As for exposure rates, the common cold is caused by many different types of viruses, not just adenoviruses, so the rates in the study aren't necessarily low. Adenoviruses account for only about 8 percent of viral

illnesses, including respiratory and gastrointestinal illnesses, Schwimmer says. In people with normal immune systems, viral infections lead to antibody production, although it may take a few days or weeks. If anything, obese children might make fewer antibodies than non-obese children do, since obesity is linked to suppression of the immune system.
 — *Tina Hesman Saey*

Correction

The Comment piece by U.S. Geological Survey director Marcia McNutt (*SN*: 12/18/10, p. 32) reported that, during a well-integrity test in July, the pressure in the *Deepwater Horizon* oil well was considered too high to take a chance on reopening it. In fact, the concern was that the pressure was too low.

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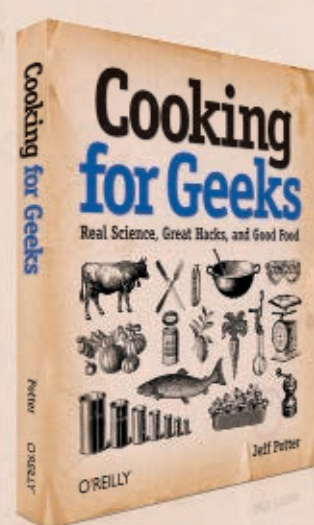
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Elizabeth Marincola



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Tradition, innovation and hope in new year for science

With this issue, *Science News* journeys into its 90th year. In 1921, Science Service was founded to share the unfolding new world of scientific discovery with America. Initially a mimeographed sheet known as the *Science News-Letter*, first published in 1922, the publication reported on such historic events and discoveries as the Scopes “Monkey Trial” in 1925 and the discovery of the DNA double helix in 1953. Over the decades, *Science News* thrived and evolved, as did its non-profit parent organization. Science Service, now Society for Science & the Public, launched the world’s most important science competitions for young people, including the Intel Science Talent Search (first as the Westinghouse Science Talent Search) and the Intel International Science and Engineering Fair, to encourage and inspire students across the globe.

All successful organizations benefit from introspection and reflection, recommitment to effective practices and revision of priorities. A few years ago, under the leadership of Nobel laureate and then-SSP Board Chair Dudley Herschbach, a distinguished volunteer panel chaired by former National Academy of Sciences President Bruce Alberts analyzed the organization’s strengths and weaknesses. As I wrote in *Science News* in the first issue of 2008, “The core of its findings was that now, more than ever, the voice of science must be heard clearly in public discourse.”

I am happy to report that three years later, SSP has reinforced and strengthened the mission set by its founders while revitalizing its advocacy for science and science education. For example, in order to supply more timely and accessible information in a changing media climate, in 2008 *Science News* began publishing daily online, in addition to the biweekly print magazine. Expanding access to its award-winning content even further in 2010, *Science News* became available at more than 500 newsstands across the country and on Kindle. We look forward to expanding to more new platforms as technology grows and evolves.

SSP also continues to add new programs to decades-old initiatives. The SSP Fellowship, launched in 2009 with support from Intel, provides resources and training to teachers at schools where students do not have access to independent research opportunities. With SSP’s support, students from Holdenville, Okla., are building robots; students in New York City’s East Harlem are learning firsthand about environmental protection and water quality at a local marsh; and students from the Oneida Nation in Wisconsin are working on wind genera-

tors that have the potential to provide energy for their tribe.

SSP has also launched new efforts to reach students during middle school, a critical time in intellectual development when an interest in science often takes root. In 2010, SSP partnered with Broadcom to launch the Broadcom MASTERS, a national science competition for students in grades 6 through 8. Also for this important age group, SSP is finalizing a redesign of its online publication, *Science News for Kids*, with the support of the Lasker Foundation and others. New resources and materials for students, educators and parents will be added to the website’s award-winning science reporting—all in a format and language that middle school students can understand, and by which they will be inspired.

Most recently, eight alumni of SSP’s science competitions were invited to attend the first ever White House Science Fair. President Obama’s recognition of student accomplishments demonstrates commitment at the Administration’s highest level of the importance of science to our collective future. An array of influential scientists and leaders, from Bill Nye, to the *MythBusters*, to cabinet secretaries, to the President, discussed the science projects of our young innovators and advocated national investment in these young minds.

Much has been made of U.S. science education’s shortcomings and the public’s lack of a basic understanding of the scientific process in the face of challenges as varied as climate change, the economy and the most devastating diseases. However, there is hope for science in 2011 and the years ahead. I see that hope every day, in the focus of curious students who will not let a mystery alone until they

have solved it, in the dedication of volunteer judges and evaluators who give up their evenings and weekends to pore over thousands of project entries, and in the millions of *Science News* readers who share the Society’s dedication to science through their commitment to stay informed of the latest discoveries.

Opportunities to disseminate science are as unlimited as scientific discovery itself. *Science News* readers support public engagement in science by reading this magazine and by choosing to become members of and/or donors to SSP. Such support is essential to ensure that the Society enters its centennial year, a mere decade away, even stronger, more vital and with redoubled determination to advance public engagement in the beauty of science and its power to contribute to human advancement. ■



SSP has reinforced and strengthened the mission set by its founders while revitalizing its advocacy for science and science education.

Elizabeth Marincola is president of Society for Science & the Public and publisher of Science News.

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