SN
SCIENCE NEWS MAGAZINE
SOCIETY FOR SCIENCE & THE PUBLIC
JANUARY 10, 2015

Gamma Rays Zap Life

Methane on Mars

Cancer Cells Gang Up

How to Escape From Alcatraz

WILDLIFE in the City

Ecologists go urban to study the creatures that thrive in our midst

King Solomon's Secret Treasure: FOUND

Ancient beauty trapped in mines for centuries is finally released and available to the public!

King Solomon was one of the wealthiest rulers of the ancient world. His vast empire included hoards of gold, priceless gemstones and rare works of art. For centuries, fortune hunters and historians dedicated their lives to the search for his fabled mines and lost treasure. But as it turns out, those mines hid a prize more beautiful and exotic than any precious metal: chrysocolla.

Prized by the wisest king of the Bible. Known as the "Wisdom Stone," chrysocolla was considered a powerful talisman of healing and calming energy. Ancient rulers of the Biblical era relied on it for guidance and now this legendary treasure can be yours with our stunning ***Earth & Sea Chrysocolla Necklace.*** Call today to bring home 325 carats for **ONLY $49!**

Nothing like it on Earth. The mesmerizing swirls of color in chrysocolla come from a unique combination of elements found in the rich mineral deposits of copper mines. When miners find a vein of blue-green, all digging stops so that the delicate chrysocolla can be extracted by hand.

Masterpieces of natural art. Our ***Earth & Sea Chrysocolla Necklace*** features a strand of polished, enhanced chrysocolla ovals—and silver-colored beads—that meet at a gorgeous teardrop pendant. Every chrysocolla is unique, showcasing a canvas painted by Mother Nature herself.

Your satisfaction is guaranteed. Wear the ***Earth & Sea Chrysocolla Necklace*** for a few weeks. If you aren't convinced that it's one of nature's most elegant creations, simply send it back within 60 days for a full refund of your purchase price. But once you experience this gorgeous gemstone for yourself, we're betting that you'll want to share King Solomon's secret with the world!

Own the Most Beautiful Stone You've Never Seen Before— 325 carats for only $49!

TAKE 84% OFF INSTANTLY!

When you use your INSIDER OFFER CODE

Earth & Sea Chrysocolla Necklace ~~$299~~*

Offer Code Price— **$49**

You must use the insider offer code to get our special price.

1-888-870-9513

Offer Code ESN180-01
Please use this code when you order to receive your discount.

- **325 carats of chrysocolla**
- **18" necklace (with 2" extender) secures with a lobster clasp**

Smart Luxuries—Surprising Prices™

** Discount for customers who use the offer code versus the original Stauer.com price.*

Necklace enlarged to show luxurious detail.

Stauer®
14101 Southcross Drive W.,
Dept. ESN180-01,
Burnsville, Minnesota 55337
www.stauer.com

BBB ACCREDITED BUSINESS
Rating of A+

VOL. 187 | NO. 1

ScienceNews

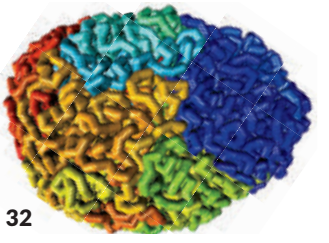
22

Features

News

6

CLOCKWISE FROM TOP: JOHN GUSSMAN; A. SANBORN AND E.L. AIDEN; T. SIEGFRIED



32

Departments

COVER Biologist Clint Penick of North Carolina State University studies ants that survive on human junk food in New York City. *Lauren Nichols*

Lessons for the new year

It's that time of year when people think about turning over a new leaf, making a new start, setting new goals. Reading over this issue, I found inspiration for a few New Year's resolutions of my own.

• Stop and watch the birds — and the ants. Since I live in a city, I often feel far away from nature and its wonders. But as intern Kate Baggaley reminds readers in her story about urban ecology on Page 18, nature is everywhere, even in dense urban centers. It's a matter of pausing long enough to take it in. Shift your perspective on those pigeons congregating at the park, the ants attacking someone's discarded lunch or even the rats lurking beneath the trash dumpster. You might find something interesting. Urban ecologists have done just that, discovering how some wild things thrive in cities. And some of those creatures play surprisingly important roles in ecosystems constructed and dominated by humans.

• Be willing to demolish once-useful structures and strategies, but do so thoughtfully and deliberately. And then monitor the results. Tearing down two hydroelectric dams on the Elwha River, which runs through Olympic National Park in Washington state, was a dramatic move, as contributing correspondent Alexandra Witze describes on Page 22. As the river returns to its native course, scientists are carefully tracking downstream changes, from a greater number of salmon breeding grounds to the creation of new riverbanks. As more aging dams around the country are targeted for possible removal, the Elwha experience can inform the best practices for bringing health back to these artificially altered landscapes.

• Be grateful. Life on Earth could have been obliterated by gamma rays from nearby stellar explosions, physics writer Andrew Grant reports on Page 15. But it wasn't. Earth happens to be in the sweet spot, where destructive gamma rays are a rare, if real, possibility. Many exoplanets, scientists argue, might not be so lucky. That could mean a slimmer chance that life evolved on those worlds. The study is a reminder that we live in a special spot at a special time.

Happy 2015 to all. — *Eva Emerson, Editor in Chief*

EDITORIAL, ADVERTISING AND BUSINESS OFFICES

Audit Bureau of Circulations

1719 N Street NW, Washington, DC 20036
Phone: (202) 785-2255
Customer service: member@societyforscience.org
Editorial/letters: editors@sciencenews.org
Sponsor content: snsales@sciencenews.org

Science News (ISSN 0036-8423) is published biweekly by Society for Science & the Public, 1719 N Street, NW, Washington, DC 20036.

Online and iPad access: Activate your subscribing member account, including digital access and the ability to opt out of print, at www.sciencenews.org/activate

Subscribe:
Web www.sciencenews.org/join
For renewals, www.sciencenews.org/renew
Phone (800) 552-4412 in the U.S. or
(570) 567-1191 outside of the U.S.
E-mail member@societyforscience.org
Mail *Science News*, PO Box 1205, Williamsport, PA 17703-1205

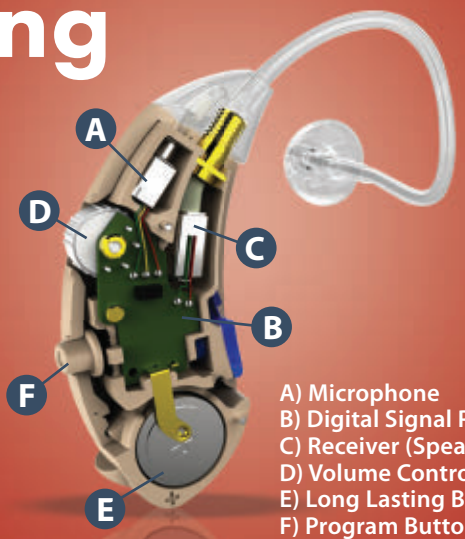
Subscribing memberships include 26 issues of *Science News* and are available for $50 for one year (international rate of $68 includes extra shipping charge). Single copies are $3.99 (plus $1.01 shipping and handling). Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

Postmaster: Send address changes to *Science News*, PO Box 1205, Williamsport, PA 17703-1205. Two to four weeks' notice is required. Old and new addresses, including zip codes, must be provided.

SANDY SCHAFFER

Advanced Hearing Aid Technology Only $299!

Learn about our great digital technology at an incredible price.



A) Microphone
B) Digital Signal Processor
C) Receiver (Speaker)
D) Volume Control Wheel
E) Long Lasting Battery
F) Program Button

The All New HCX!

- Digital sound processing chip provides **crystal clear sound and makes speech easier to understand** without feedback
- Multiple memory programs **adapt to most listening situations**
- Nearly invisible thin tube design
- Helpful **low battery warning** so you are never caught unprepared
- **Long lasting size 13 batteries**
- 10 bands of layered noise reduction helps to **emphasize voices while balancing out background noise**
- **100% Money Back Guarantee**

The HCX™

Customer Reviews

"I will definitely recommend your company to my patients."
- Dr. Arun P.

"Thank You. It works better than my $2,000 hearing aid"
- Jim W

"We had no idea it would be such a fast, simple and enjoyable process..."
- Monique S.

Same Technology... Dramatically Lower Price!

All hearing aids work the same way. The **microphone** picks up the sound and sends an electrical signal to the digital signal processor. The **digital signal processor** is the "brains" of the hearing aid. It takes the sound it receives and adjusts the sound to amplify important speech sounds as well as filtering out unwanted noise. To ensure the best in quality, the digital processor is designed and manufactured right here in the **United States**. Once the processor has amplified the sound it is passed to the **receiver** (also known as the speaker) where it emits a corrected and amplified sound through the **sound tube** into your ear.

More importantly, our hearing aid works at a **fraction of the cost** of name-brand hearing aids. The HCX uses long-lasting **size 13 batteries**. In addition to the technical pieces of the hearing aid, we also include a **self-adjustable volume control** that can be modified with a light touch of the finger. You also receive a hearing aid with **3 different audio programs** that are designed to fit most desired sound profiles. These too are self-adjustable, requiring a light tap of the program button.

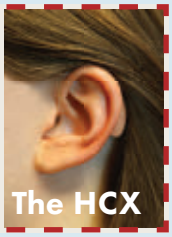
You can spend thousands for a high-end hearing aid or you can spend $299 for a hearing aid that just plain works. We are so sure you will love our product, that we offer a **100% Money Back Guarantee - Risk Free** if you are not satisfied for any reason. It's time to get great digital technology at an incredible price!

CALL TODAY: SAVE $50 PER PAIR!

1-888-788-1770

Use Coupon Code For FREE Batteries: **S4B**

Visit Us: www.advancedhearing.com/S4B



Advanced Affordable Hearing
Affordable Quality Since 1996!

Find us on Facebook

100% Money Back Guarantee

RISK FREE Trial

US Company Owned And Operated

FDA REGISTERED

Excerpt from the January 9, 1965, issue of *Science News Letter*

50 YEARS AGO

Soviet ALS virus claim

Soviet claims that a virus causes amyotrophic lateral sclerosis (ALS)... are getting further study by U.S. scientists. Six of them have just returned to Bethesda, Md., to report on a 12,000-mile trip to visit 23 clinical and laboratory research centers in the Soviet Union. Neither the Russian nor the American scientists are completely satisfied that a virus really does cause ALS.... But they find the idea worth pursuing.

UPDATE: The cause of ALS, a degenerative neurological disease, is still unknown but viruses remain a prime suspect, particularly retroviruses. This family of viruses uses molecular machinery called reverse transcriptase to reproduce. Many ALS patients have reverse transcriptase in their blood. ALS patients have also been found to have unusual retrovirus activity in the parts of the brain damaged by the disease. But a causal link between a retrovirus and ALS has evaded scientists. Physical trauma, toxins and genetic mutations have also been blamed for the disease.

IT'S ALIVE

Why ground squirrels go ninja over nothing

Whole scientific careers have gone into understanding why a harmless handful of fluff like a California ground squirrel taunts rattlesnakes. Now Rulon Clark and his team at San Diego State University are exploring the puzzle of why the squirrels also seem to taunt rocks, sticks and the occasional shrub.

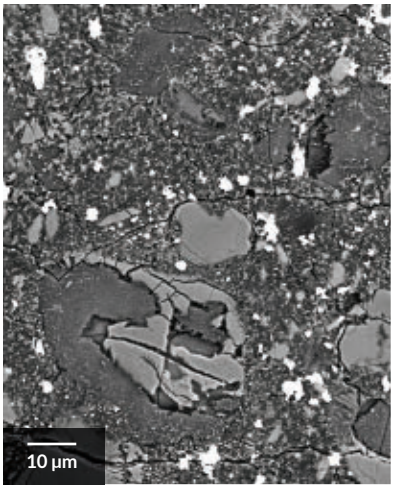
On spotting a snake, a California ground squirrel (*Otospermophilus beecheyi*) stares and sniffs, or if the snake is uncoiled, may even kick sand

INTRODUCING

A name for Earth's most abundant mineral

A space rock has helped scientists characterize, and finally name, the planet's most common mineral.

The newly christened bridgmanite, named for high-pressure physicist Percy Bridgman, is a high-density form of magnesium iron silicate and makes up about 38 percent of Earth's volume. Scientists need a natural sample of a mineral before it can be officially named. However, Earth's bridgmanite is entombed 660 to 2,900 kilometers below the planet's surface, and it doesn't survive the trip up. For half a century, scientists have fruitlessly hunted for traces of bridgmanite forged during powerful meteorite impacts that mimic the high temperatures and pressures deep inside Earth.



In the Nov. 28 *Science*, mineralogist Oliver Tschauner of the University of Nevada, Las Vegas and colleagues describe bridgmanite found inside a meteorite (sample shown, left) that slammed into a remote part of Queensland, Australia, in 1879. The researchers estimate that the impact generated temperatures of around 2,000° Celsius and pressures greater than an adult blue whale's mass crushing each square centimeter of rock.

The newfound bridgmanite will help scientists better understand the churning of Earth's mantle, the team says.

— *Thomas Sumner*

FROM TOP: DAS_MILLER/FLICKR, (CC BY-NC-SA 2.0); O. TSCHAUNER *ET AL*/*SCIENCE* 2014

Watch a video of leaping squirrels at **bit.ly/SN_squirrel**

A California ground squirrel is much more capable than it looks when it comes to battling rattlesnakes that lurk to feast on baby-squirrel nuggets.

at it. And in bursts, the squirrel flags its tail left and right "like a windshield wiper," Clark says.

A rattler can strike a target 30 centimeters away in less than 70 milliseconds. But ground squirrels twist and dodge fast enough to have a decent chance of escape. Also, adult squirrels from snake country have evolved some resistance to venom. So taunting is worth the risks as a signal to neighboring squirrels and to the snake that its ambush attempt has been discovered.

After getting publicly and lengthily squirreled, snakes often just slip away.

Yet the squirrels also nyah-nyah tail flag at places where snakes might be but aren't. To see if flagging indicates wariness, Clark and his colleagues built a squirrel startler that shoots out a cork using the classic spring that launches gag snakes out of cans.

At spots with no sign of real snakes, squirrels mostly nibbled seeds in apparent tranquility with only a rare tail flag. The pop of a cork typically sent these squirrels scampering off on four speed-blurred paws.

But when a squirrel revisited a worrisome spot where it had recently seen a snake (tethered by researchers), there was more and faster tail flagging. When the cork popped, more than half the squirrels flipped. "All four legs came off the ground and their tails were torquing around," Clark says.

Those just-in-case tail flags could tell a still-hidden snake that this is one wary squirrel ready for extreme body displacement, Clark and Breanna Putman report in an upcoming *Behavioral Ecology*. Earlier work showed that frequent flaggers often escaped attacks. So flagging may persuade a smart snake to wait for an easier target. — *Susan Milius*

Escape plan
An unwary ground squirrel will often scramble away when surprised. But a vigilant squirrel at a site that recently hosted a snake is more likely to do an acrobatic leap.

SCIENCE STATS

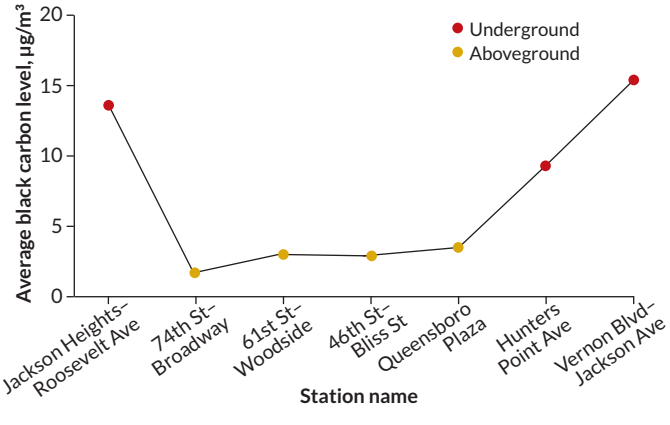
Black carbon fouls New York subway

Among the grit and grime cloaking New York City's subway stations, one type of tiny, sooty particle looms large. Black carbon, an easily inhaled by-product of burning diesel fuel, clogs the air of underground stations along several subway lines; particle levels can reach an average of seven times as high as those at the roadside, a new analysis suggests.

Researchers knew that subway air was dirty. High levels of black carbon have been found at subway stations in Amsterdam and Helsinki, though New York City's stations may now claim the title for most polluted, researchers report November 19 in *Environmental Science & Technology*.

Passenger trains in New York City use electricity, but maintenance trains still run on diesel and trigger spikes in underground black carbon levels. Breathing in too much black carbon could spark respiratory problems such as asthma. — *Meghan Rosen*

Air pollution along New York's Number 7 subway line



SOURCE: M.J. RUZMYN VILCASSIM *ET AL/ENVIRON. SCI. & TECHNOL.* 2014

FROM TOP: KEN-ICHI UEDA/FLICKR (CC BY-NC 2.0); B.J. PUTMAN AND R.W. CLARK/*BEHAVIORAL ECOLOGY* 2014; ONESEVENONE/FLICKR (CC BY-NC-SA 2.0)

LIFE & EVOLUTION

Genetics study revises bird family tree

Avian evolution produced some counterintuitive convergences

BY SUSAN MILIUS

An ambitious genetic analysis of deep avian history strongly supports some counterintuitive ideas about bird evolution that differ from the species groupings familiar in field guides.

Falcons are more closely related to parrots than to hawks and eagles, for instance, researchers report in the Dec. 12 *Science*. And the new family tree of living birds shows that flamingos' closest relatives are chunky waterbirds called grebes. Both are more closely related to pigeons than to the rest of waterbirds, the new analysis indicates.

Bird history is full of such stories, in which descendants of unsimilar ancestors converge on similar lifestyles, capacities or shapes, says neuroscientist Erich Jarvis of Duke University. He is one of the leaders of the worldwide consortium that produced the new family tree of avian life.

The study relates bird groups in ways that may startle bird-watchers. But whether the new tree shocks scientists "depends on who you are," says Jarvis. "Because there were so many different views out there, so many different trees of birds published, some people said, 'Ah, you confirmed what I said a long time ago,' and others were just torn apart."

Sorting out which modern birds are truly related to each other has been a notorious problem in evolution, says ornithologist Shannon Hackett of the Field Museum in Chicago, who was not involved in the new work. The trouble comes from an avian big bang that sent many lineages flying off in different directions during a relatively short time. Figuring out which fossils belonged with which emerging group has been tricky, as has been sifting reliable signals from the clutter of kinda-similar, kinda-not DNA among living birds. "Some people thought it was unresolvable," Hackett says.

In 2008, Hackett and her colleagues made what was for its time an ambitious push to expand genetic studies by looking at 19 stretches of genetic material for each of 169 bird species. The tree that emerged suggested that many apparent similarities, as between falcons and hawks or grebes and ducks, were convergences instead of close ancestral relationships.

Using new high-capacity genetic technologies, a consortium of about 200 scientists worldwide, with funding from the Chinese genetics institute BGI and other sources, has compiled nearly complete catalogs of DNA's basic units for 48 representative bird species. First the team analyzed DNA containing blueprints for proteins to generate various possible family arrangements. "We didn't get a tree that made any sense," Jarvis says. "Protein-coding genes tell the wrong story," he and colleagues concluded.

Only when researchers considered all genetic material, including bits involved in regulating genes, did clear-cut trees emerge. "This is going to be a bit of a lesson to many of us," Jarvis says.

On the new tree, ostriches and tinamous perch on the earliest branch. Then come chickens, turkeys and ducks. Then the tree splits in a lopsided fork. One side contains flamingos, grebes and pigeons; most remaining birds occupy the other.

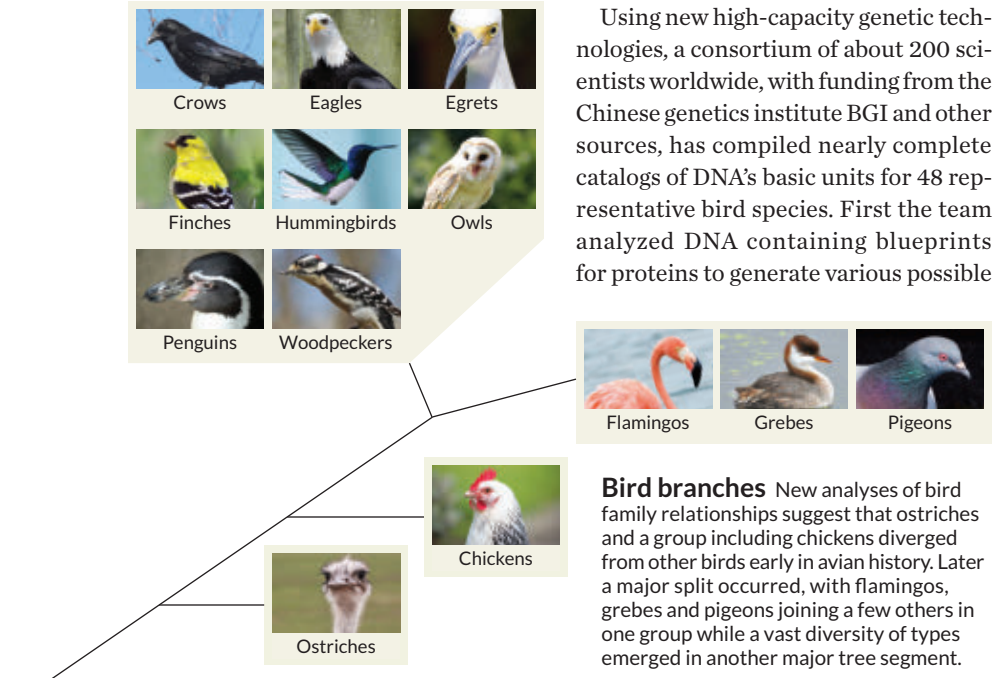
The main impact of the new study may be to give scientists confidence in some controversial ideas from earlier genetic work, says evolutionary biologist Sushma Reddy of Loyola University Chicago, who coauthored the 2008 tree but was not part of the new consortium.

Particularly striking for her is parrots' position on the branch nearest songbirds, which learn their vocalizations in different ways. The rich lode of genetic data in this study also offers new insights into many other avian matters. Songbirds and parrots (and humans) have converged on very similar genes to power the brain centers involved in vocal learning, Jarvis and colleagues report. Birds may prove to be useful species for insights into speech disorders, he says, because the usual medical research species, such as monkeys or mice, don't learn to vocalize.

Also, the new genetics suggest that the avian big bang took place at about the time dinosaurs went extinct. That issue has been hotly debated and may not be resolved even with all the new data.

Coauthor Jon Fjeldså of the Natural History Museum of Denmark says he is satisfied with the tree's branch arrangement but that time estimates for branching events may have inaccuracies.

Hackett says the tree now needs to leaf out. "There are more than 10,000 species of birds, and the tree has 48 of them." ■



Bird branches New analyses of bird family relationships suggest that ostriches and a group including chickens diverged from other birds early in avian history. Later a major split occurred, with flamingos, grebes and pigeons joining a few others in one group while a vast diversity of types emerged in another major tree segment.

GENES & CELLS

New approach to reprogramming makes stem cells fuzzy and flexible

F-class could make experiments easier, avoid ethical issues

BY RACHEL EHRENBERG

"Don't judge a cell by its cover" has turned out to be sage advice for stem cell scientists. They have discovered a new class of cells, generated from mouse tissue, that can be reprogrammed to become almost any cell in the body.

Called F-class cells for their fuzzy appearance in a petri dish, they were probably overlooked in the past because they don't look like ordinary stem cells. But experiments suggest they have similar powers of flexibility. The F-class cells are described in two papers appearing December 11 in *Nature* by a worldwide stem cell research collaborative called Project Grandiose.

These cells aren't as sticky as typical stem cells and don't grow in smooth, compact clumps. Their unstickiness means that F-class cells can be grown by the billions in a flask rather than in single layers on a petri dish. That quality will make experiments easier, possibly leading to new drugs or even engineered replacements for diseased organs or tissues.

F-class cells can be grown by the billions in a flask ... possibly leading to new drugs or even engineered replacements for diseased organs.

"This is a real conceptual advance," says stem cell biologist Jun Wu of the Salk Institute for Biological Studies in La Jolla, Calif., coauthor with Salk's Juan Carlos Izpisua Belmonte of a *Nature* commentary on the new research.

There's still much work to be done, cautions Wu. For starters, scientists need to determine if F-class cells can be generated from human cells. But the discovery is exciting, he says. It's the first case of culturing a new kind of stem cell in the lab, and the method used to coax the F-class cells into being offers a new way to engineer stem cells from ordinary tissue.

Stem cells, defined by their dual ability to renew themselves exactly and, at the right time, to specialize into all sorts of cell types, come from two primary sources. One is embryonic cells found in the inner layer of the blastocyst, the small mass of cells created when sperm meets egg. Scientists can prompt these embryonic stem cells into specializing — becoming heart cells that pump blood, for example, or brain neurons. But research on embryonic stem cells has been roiled in ethical debates concerning the use of embryos. Induced pluripotent stem cells, called iPS cells, provide a second source of stem cells. Scientists create iPS cells by coaxing adult skin cells into an embryonic-like state. This is managed by dosing the cells with a cocktail of four particular proteins that somehow reprogram the cell.

The new F-class stem cells differ from standard iPS cells. Typically, to prod a skin cell into becoming a stem cell, scientists deliver into the host skin cell genes for making the four reprogramming proteins. Once it becomes a stem cell, the host cell normally shuts off the genes controlling the reprogramming proteins.

But researchers led by stem cell scientist Andras Nagy of Mount Sinai Hospital in Toronto used a different system to deliver the reprogramming proteins. This approach evades the host cells' ability to shut down protein production. Instead the researchers control the on/off switch with a drug called doxycycline.

After several days in a dish with doxycycline and the reprogramming proteins running on high, mouse skin cells started to clump into colonies. Since the colonies didn't look like smooth, shiny stem cells and the reprogramming proteins were still turned on, many scientists probably wouldn't have looked at them twice, says Nagy.

"Most people would have said, 'this is not what we are looking for,'" he says. "But we decided to pick our cells blindfolded, to use everything that was growing." When the scientists investigated whether these strange fuzzy cells were indeed stem cell–like, the F-class cells passed two standard stem cell tests: They could be prompted into becoming different types of cells, and they form a specific kind of tumor containing many different tissue types.

By manipulating the amount and timing of exposure to the reprogramming proteins, and the media that the cells were grown in, the scientists could convert the F-class cells into a more ordinary iPS cell state. They could also convert those iPS-like cells back into the F-class cell state.

An exhaustive analysis of molecular and gene activity in the two states suggests that changes in DNA packaging, which result in different genes being turned on and off, are a major force behind the differences between F-class cells and typical iPS cells. These analyses are described further in three additional papers by Project Grandiose December 11 in *Nature Communications*.

Considerable additional research will be necessary to make the new approach practical. Not only are experiments needed with human cells, but researchers have also not yet made fully functioning adult cells from the F-class cells — liver cells that can metabolize toxins, for example. But the research offers a new approach to making stem cells and is a major first step in characterizing how cellular reprogramming happens, says Wu. "It opens the door to engineering cells," he says. "We might be able to customize these cells in the future." ■

ATOM & COSMOS

Ocean water may not be from comets

Comet 67P's ratio of hydrogen isotopes doesn't match Earth's

BY ASHLEY YEAGER

Data from the Rosetta mission are raising doubts about the idea that Earth's oceans are filled with water from comets.

The water that was detected in comet 67P/Churyumov–Gerasimenko's thin, hazy atmosphere doesn't chemically match Earth's oceans, suggesting that asteroids, not comets, brought water to Earth billions of years ago, said planetary scientist Kathrin Altwegg of the University of Bern in Switzerland in a news conference December 9.

Altwegg and colleagues used an instrument aboard the Rosetta spacecraft to measure deuterium, a heavy form of hydrogen, in comet 67P's meager atmosphere, known as its coma. The results revealed that the comet's water has a deuterium-to-hydrogen ratio roughly three times as high as water on Earth does, the team reports December 11 in *Science*.

The makeup of a comet's thin, hazy atmosphere offers hints about how water got to Earth. New data raise doubts that Earth's water was delivered by comets like 67P.

Understanding how Earth got its oceans would give scientists clues to events in the solar system's formative years and could hint at how common water may be in Earthlike planets beyond the solar system. Scientists use deuterium and hydrogen as tracers of the origins of water in the solar system. If two planetary bodies have similar ratios of deuterium to hydrogen, then their water probably came from the same place.

Some scientists suggest that Earth may have had water when it formed. Others argue that it would have been bone-dry and needed a special delivery from comets or asteroids to become so wet. Scientists have tested these ideas by measuring deuterium-to-hydrogen ratios in comets and meteorites (*SN Online: 11/1/14*).

In the 1980s, some scientists thought comets ferried water to Earth. In 1986, the Giotto spacecraft flew through the coma of comet Halley and found a deuterium-to-hydrogen ratio twice as high as Earth's. Other studies found that comets originating in the far-off Oort cloud had ratios similar to Halley's.

More recently, the pendulum has swung back, as researchers have found comets with ratios similar to Earth's. In 2011, scientists announced that comet 103P/Hartley 2, from the Kuiper belt, had a deuterium-to-hydrogen ratio nearly identical to Earth's. Another comet that formed in the Kuiper belt, 45P/Honda–Mrkos–Pajdušáková, also had a deuterium-to-hydrogen ratio close to Earth's. Scientists started to consider the possibility that Earth's water came only from comets originating in the Kuiper belt, an icy debris disk in the outer solar system that includes Pluto (*SN: 10/19/13, p. 19*).

Measuring the deuterium-to-hydrogen ratio of comet 67P, which originated in the Kuiper belt, allowed Altwegg and her team to test the idea. Its ratio turned out to be about 5.3×10^{-4}; Earth's is 1.5×10^{-4}.

"These new data require us to think harder," says Edward Young, a geochemist at UCLA who isn't involved in the Rosetta mission. The disparity in deuterium-to-hydrogen ratios between Hartley 2 and 67P rules out simple ideas suggesting that comets formed in restricted regions of the early solar system.

Young thinks it's naïve to say that one type of body was the sole source of Earth's water. Perhaps water came from a mix of comets with high deuterium-to-hydrogen ratios and asteroids with low ones, which would average out to what's seen on Earth, he suggests. Altwegg agrees that this scenario is possible. ■

ATOM & COSMOS

Comet may expose its building blocks

Rosetta images reveal possible pristine solar system material

BY ANDREW GRANT

SAN FRANCISCO — The dynamic, rugged terrain of comet 67P/Churyumov-Gerasimenko may be exposing the meter-wide building blocks that make up the comet, scientists reported December 17 at the American Geophysical Union's fall meeting.

If confirmed, the finding could give scientists an unprecedented look at pristine samples of the original material that bonded to form comets, asteroids and planets when the solar system formed nearly 4.6 billion years ago.

The enticing evidence was delivered by the Rosetta spacecraft's OSIRIS instrument, which snaps photos of the comet's surface with a resolution as high as two centimeters per pixel. The images quickly revealed that 67P violates the conventional wisdom of comets resembling smooth dirty snowballs, said Rosetta team member Holger Sierks of the Max Planck Institute for Solar System Research in Göttingen, Germany.

The photos, which are not yet available to the public, reveal cliffs tens or hundreds of meters tall, as well as mysterious pits, some about as long as two football fields and just as deep, that are venting gas into space.

But it was the components of the cliffs and pits that caught Sierks' eye. Embedded along their edges are strange spheres, most between 1 and 3 meters in diameter.

Sierks hypothesizes that the spheres are examples of the fundamental units of ice and dust that were sintered together in the infant solar system to form asteroids, planets and comets like 67P. ■

GENES & CELLS

Cells in groups may aid breast cancer's spread

Gangs, not individuals, form distant tumors, study finds

BY TINA HESMAN SAEY

Some cancer cells rove as a gang instead of moving out on their own.

Researchers have previously thought that single rogue cancer cells broke away from tumors and migrated to other places in the body to give rise to new tumors. But a study of mice shows that breast cancer cells decamp in groups, and the clumps have a better chance of establishing a colony than loners do, Kevin Cheung of Johns Hopkins University reported December 7.

An improved understanding of how cancer spreads could influence treatments for the disease, said cell biologist Crislyn D'Souza-Schorey of the University of Notre Dame. Chemotherapy aimed at killing single cells may not work as efficiently against bands of spreading tumor cells, she said.

Cheung and his colleagues used mice genetically engineered to produce fluorescently tagged breast cancer cells. Within a tumor, some cells were red and some were green. The researchers watched through a microscope as cells spread from the original tumor. On average, about a third of cells that left the tumor migrated as bicolored clumps of cells. In some cases more than 60 percent of breakaway cells moved in groups, the team found.

100 times

Likelihood that cells in clumps will grow into a tumor compared with single cells

Moving in clumps gives cancer cells a competitive advantage, Cheung and colleagues found. The researchers injected tumor cells into the tail veins of mice and then later assessed how many tumors sprouted. Cells injected in clumps were about 100 times as efficient at taking hold and growing into a tumor as those cells forced to go it alone.

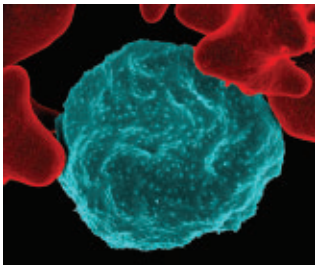
Cancer cells that move as groups may support each other's growth, Cheung said. The results may "shift the focus from the Superman cell to teams of cells that work together."

The data showing that the breast cancer cells spread more successfully in clumps are compelling, D'Souza-Schorey said, but no one yet knows whether cells from other types of cancer also need help to migrate. ■

MEETING NOTES

Imprisoning parasites can deter malaria's spread

Locking malaria inside red blood cells may prevent mosquitoes from spreading the disease from person to person, and researchers may now know which key to throw away. Disabling one protein that the parasite uses to escape from blood cells can keep malaria from reproducing in mosquitoes. Svetlana Glushakova, a cell biologist at the National Institute of Child Health and Human Development in Bethesda, Md., reported the finding December 9.



Malaria parasites need to break out of an infected red blood cell (blue) to reproduce. Inactivating a protein may keep the parasite sequestered.

NIAID/FLICKR (CC BY 2.0)

Ordinarily, malaria-causing parasites seal themselves behind two membranes inside red blood cells of infected people. To reproduce in mosquitoes, the parasites have to break out of their hiding compartment, called a vacuole, and then bust through the red blood cell's outer membrane. Opening the membranes requires the action of proteins that form pores.

Genetically disabling one of those pore-forming proteins, called PPLP2, allows the malaria parasites to break free of the vacuole but keeps them firmly sealed inside the red blood cell, Glushakova and colleagues discovered.

Future drugs that interfere with PPLP2 would not cure an infected patient but could keep the disease from spreading to others, Glushakova said. — *Tina Hesman Saey*

Softness stifles some chemotherapy drugs

Keeping a stiff upper lip may help certain chemotherapy drugs fight cancer. Some of these drugs, including the leukemia drug Gleevec, don't work as well as expected when blood cancer cells grow in soft surroundings, bioengineers Jae-Won Shin and David Mooney of Harvard University reported December 7.

The finding was unexpected because cells grow faster in softer tissues than they do in stiffer ones. And previous experiments in laboratory dishes suggested that faster-growing cells are easier to kill.

Chronic myeloid leukemia cells grew slower in stiffer three-dimensional gels, the researchers found. But the slow-growing cells in stiff gels were more vulnerable to chemotherapy drugs than faster-dividing cells grown in soft gels.

While Gleevec and many other drugs were less efficient at killing leukemia cells in soft gels, several other drugs were impervious to gel stiffness. That indicates that taking tissue stiffness into account when devising a combination of chemotherapy drugs may improve treatment, Shin suggested. — *Tina Hesman Saey*

ATOM & COSMOS

Solar wind may leach Mars' air

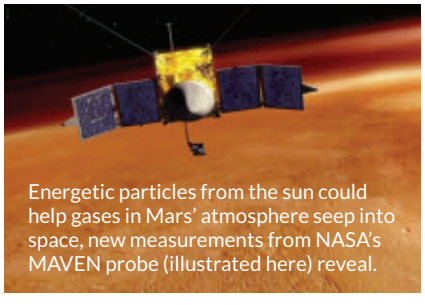
NASA's MAVEN probe spots fast, penetrating particles

BY THOMAS SUMNER

Particles blasted from the sun probably spring leaks in the lower Martian atmosphere, new research suggests.

NASA's Mars Atmosphere and Volatile Evolution probe, or MAVEN, has detected high-speed particles in the solar wind penetrating deeper into the planetary atmosphere than previously thought possible, mission scientists announced December 15. The particles could give an energetic kick to atmospheric gases, causing them to escape into space and helping to strip away the planet's atmosphere, the researchers hypothesize.

The work will help scientists better "understand how loss of the atmosphere over billions of years might have changed the ability of the surface of Mars to sustain life," said MAVEN instrument scientist Paul Mahaffy of NASA's Goddard Space Flight Center in Greenbelt, Md.



Energetic particles from the sun could help gases in Mars' atmosphere seep into space, new measurements from NASA's MAVEN probe (illustrated here) reveal.

Dry lake beds and river channels carved into the Martian landscape suggest that the planet once had a warm, wet surface and therefore a thick encasing atmosphere. Over billions of years, lighter forms of gas molecules such as carbon dioxide, nitrogen and argon escaped the atmosphere, leaving behind those with heavier isotopes. The exact mechanism and rate of this atmospheric thinning isn't fully understood.

MAVEN, launched in 2013, has been hunting for mechanisms responsible for this atmospheric loss. Since September 22, the spacecraft has been cruising around Mars in an oval-shaped path, ranging from 150 to 6,000 kilometers above the planet's surface. On each orbit, the probe dips into a layer of electrons and charged atoms called ions that surrounds the planet. Scientists had believed that this ionosphere acts as a protective barrier around Mars, deflecting any incoming solar wind away from the planet. MAVEN's new measurements, however, reveal that this isn't always the case.

The probe observed ions from the solar wind piercing much deeper into the Martian atmosphere than previously thought possible, to about 200 kilometers above the surface and well below the ionosphere. These particles move at roughly 450 kilometers per second and provide a speed boost to any atmospheric gases they crash into. If enough energy is transferred during the collision, the gas might break free from Mars' gravitational pull.

The particles may be able to penetrate into the atmosphere by donning a disguise as they descend, said MAVEN team member Jim McFadden, a planetary scientist at the University of California, Berkeley. Positively charged atoms in the solar wind could pick up electrons along the way and become neutral, he proposes. Without a net charge, these atoms would pass through the ionosphere and into the lower atmosphere where they might somehow lose the hitchhiking electrons and regain a charge. Once in the atmosphere, the solar wind particles could help strip away parts of the atmosphere.

"This is kind of remarkable," said McFadden. "There's some population of the solar wind energy that's there at high altitudes, goes away at middle altitudes, and comes back at low altitudes."

How large a role these shape-shifting solar wind ions play in Mars' atmospheric losses is uncertain, McFadden said. ■

EARTH & ENVIRONMENT

South Napa earthquake revitalized bone-dry streams

Temblor apparently freed groundwater trapped in nearby hills, isotope analysis suggests

BY THOMAS SUMNER

The South Napa earthquake that rattled Northern California in August shook roughly a billion liters of groundwater out of nearby hills, new research suggests.

Shortly after the magnitude 6.0 quake struck near Napa Valley, residents reported water rushing through previously dry streambeds. Geoscientists Chi-Yuen Wang and Michael Manga of the University of California, Berkeley ran over to sample the water. It contained a higher concentration of lighter oxygen and hydrogen isotopes compared with other water flowing in the valley. Because lighter water molecules typically gather at higher elevations, the water was probably coming from the surrounding hills, Wang proposed December 17.

Wang thinks that groundwater was jolted free by the quake. The water then trickled down into the streams and reached a peak outpour about 30 days later. Other earthquakes have been associated with increased streamflow, Wang said, but the South Napa quake is unlike the others because it was responsible for all the water flowing through previously dry streams.

Generalizing their results to the entire rattled region, Wang and Manga estimate that the quake freed enough groundwater to fill about 400 Olympic-sized swimming pools. But this won't quench the drought-stricken area, Wang added, which uses about 40 times that volume of water annually. ■

GODDARD SPACE FLIGHT CENTER/NASA

EARTH & ENVIRONMENT

Alcatraz escapees could have made it

Simulations of San Francisco Bay reveal survivable scenarios

Three convicts who escaped Alcatraz Island's prison in 1962 using a crude raft could have made it ashore, new computer simulations of the San Francisco Bay suggest.

BY THOMAS SUMNER

Three inmates who escaped from Alcatraz in 1962 and set off into the San Francisco Bay on a makeshift raft could have safely reached shore if they timed their escape just right, new research suggests.

If the escapees had cast off between 11 p.m. and midnight, the trio could have reached a beach just north of the Golden Gate Bridge as the outgoing tide slackened, researchers proposed December 16. But if the prisoners had set off before 11 p.m., the tide's strong currents would have swept the raft into the Pacific Ocean, a computer reconstruction of the bay suggests.

"In our worst-case scenario, they had an almost zilch chance of surviving," said hydrologist Rolf Hut of Delft University of Technology in the Netherlands. "If they left at the right time and paddled in the right direction, they had an almost 100 percent chance of making it."

Beyond illuminating a 52-year-old cold case, the three-dimensional simulation of the bay's currents, tides and winds will help scientists identify flood-prone areas in the region and assess the potential impacts of sea level rise, said hydrologist Oliver Fringer of Stanford University, who did not work on the project.

"This is a fun case study," he said, "but a good model of the bay is critical to a lot of important work."

On the night of June 11, 1962, bank robbers Clarence Anglin, John Anglin and Frank Morris escaped from their cells through holes dug using sharpened spoons. Sneaking to the water's edge, the prisoners inflated a raft made from a patchwork of stolen raincoats and cast off into the night, never to be seen again.

Resolving the convicts' disappearance wasn't the team's intention, said Fedor Baart, a coastal scientist at the Deltares research institution in the Netherlands. The main goal was to assess the impacts of future sea level rise on industries lining the banks of the San Francisco Bay.

The idea for reconstructing the escape came when one of the researchers watched a TV show re-creating the event. "We thought if we're able to look into the future with our model, we should be able to look into the past as well," Baart said.

The team simulated the release of 50 boats from possible escape spots every 30 minutes during the escape night. Some boats drifted with the current; others were paddled in various directions.

Whether the prisoners reached shore or died at sea largely depends on how well they planned, Baart said. If the prisoners paddled against or with the current, they probably would not have survived the trip. If the escapees paddled perpendicular to the outgoing tide and left shortly before midnight, however, they probably would have reached Horseshoe Bay near where the bay opens to the Pacific Ocean.

An oar found in 1962 on Angel Island supports this scenario; it could have floated over from Horseshoe Bay if the escapees discarded it after they landed. ■

WILLIAM WARBY/FLICKR (CC BY 2.0)

ATOM & COSMOS

Mars rover finds signs of methane

Curiosity reports finding gas and other organic chemicals

BY ERIN WAYMAN

NASA's Curiosity rover has caught a whiff of methane in Mars' atmosphere and has for the first time detected organic molecules in rocks on the planet's surface.

"After two years, we're basically declaring we had a major discovery," Curiosity's project scientist, John Grotzinger of Caltech, said December 16.

Curiosity detected several organic molecules, including what may be chlorobenzene, from rock at one site. But the team can't say whether the organics are signs of life or the result of nonbiological activity.

Similar uncertainty applies to life's role in the presence of methane. In 20 months of study, Curiosity generally recorded just trace amounts of methane in Mars' air. But during one roughly 60-day stretch, the rover collected four measurements that averaged about 7 parts per billion of methane, 10 times as much as background levels. (Earth's atmosphere has about 1,800 ppb of methane.) That spike suggests that the Red Planet is home to periodic methane releases, supporting earlier observations by Earth-based telescopes and orbiting spacecraft.

Researchers can't yet pinpoint the methane's source. On Earth, microbes make the majority of the methane. And it's possible that microbes generate the gas on Mars, or did so in the past. Any methane produced by now-extinct organisms long ago could be buried deep in the planet and periodically disturbed and vented to the surface through cracks, said mission scientist Sushil Atreya of the University of Michigan. Methane could also have a nonbiological source, perhaps chemical reactions between water and minerals or reactions between the sun's ultraviolet radiation and cosmic dust.

To determine the methane's origins, scientists need to measure the ratio of different carbon and hydrogen isotopes in the gas, said Michael Mumma of NASA's Goddard Space Flight Center in Greenbelt, Md., who is not on the rover team.

If Curiosity can get a larger sample of methane, it might be able to do isotopic analysis, Atreya said. If not, the European Space Agency's ExoMars Orbiter, planned for a 2016 launch, will be able to detect minute traces of methane and analyze the gas's chemistry. Such data could help researchers find the best place to land the next rover, Mumma said. ■

EARTH & ENVIRONMENT

Volcanoes cited in dinosaurs' demise

Deccan eruptions began before mass extinction, new work finds

BY THOMAS SUMNER

New dating of the colossal Deccan volcanic eruptions bolsters the idea that the Chicxulub asteroid impact had help in wiping out the dinosaurs 66 million years ago.

Using crystals embedded in lava, geologists have deduced the most precise timing yet for the eruptions, which poured out hundreds of thousands of cubic kilometers of molten rock in western India. The most intense volcanic activity began about 250,000 years before the Chicxulub impact and continued for about 500,000 years after it, the researchers report online December 11 in *Science*. The finding supports the claim that climate disruptions caused by the eruptions played a major role in the dinosaurs' extinction, says study coauthor Gerta Keller, a paleontologist at Princeton University.

"For the last 30 years it has been basically ruled as the given truth that Chicxulub caused the mass extinction," she says. "[We're] now finding that maybe Chicxulub was not the main cause."

But not all experts are convinced. David Fastovsky, a paleontologist at the University of Rhode Island in Kingston, says fossil and geological records suggest that a single sudden event triggered the extinction, something the drawn-out climate change caused by volcanism doesn't fit. "Those of us who are 'impactors' have to keep an open mind to other possibilities," he says. "But the question that needs to be answered is, if the asteroid is good enough, why do you need this?"

The Cretaceous Period ended with a purge of over 60 percent of living species on Earth, including all nonbirdlike dinosaurs. Around this time, the Deccan eruptions in India belched gas and oozed more than 1.3 million cubic kilometers of lava and rock. The remnants of these eruptions, known as the Deccan Traps, encompass an area the size of Spain.

The massive volcanic eruptions that formed the Deccan Traps rock formation (shown) in western India may have helped bring down the dinosaurs, new dating suggests.

Two other mass extinctions coincide with volcanic outpourings, known as flood basalts, similar to the Deccan Traps eruptions. Gases from the Deccan eruptions probably caused short-term cooling and a worldwide increase in greenhouse gases and ocean acidification. Deccan gases have been a suspect in the Cretaceous extinction, but scientists didn't know exactly when the volcanism happened relative to the extinction event.

Keller and colleagues compared the number of uranium and lead atoms in zircon crystals, which form in volcanic eruptions, to estimate the time of their formation to within 85,000 years. These measurements indicate that 80 to 90 percent of the Deccan outpouring took place over 750,000 years, and that the eruptions began before the extinctions. ■

BODY & BRAIN

New target for treating Alzheimer's

Blocking molecule on immune cells could prevent dementia

BY KATE BAGGALEY

A molecule on disease-fighting cells may cause their failure to clear errant protein fragments in the brains of people with Alzheimer's disease. Removing this molecule in mice allowed their cells to gobble up the culprit fragments more efficiently, a new study finds, and prevented mice susceptible to Alzheimer's from developing memory problems as they aged.

"This is a possible target that we could look at for preventing Alzheimer's disease," says Katrin Andreasson, a coauthor of the new research, published December 8 in the *Journal of Clinical Investigation*.

Patrick McGeer, a neuroscientist at the University of British Columbia in Vancouver, warns that treatments that ease Alzheimer's symptoms in mice have not translated well to people. "Mouse models have been helpful, but a mouse is not a man, and too often models have led people down a false track," he says.

In many neurodegenerative diseases such as Alzheimer's, proteins fold into the wrong shape and build up to form plaques in the brain. Normally, immune system cells called microglia clear out misfolded proteins. One such protein fragment, amyloid-beta, is produced when nerve cells fire. When folded properly, it may play a role in turning off synapses, where nerve cells transmit signals.

In Alzheimer's, the immune cells are impaired. "The microglia become really dysfunctional over time," says Andreasson, a neurologist at Stanford University School of Medicine. "They will launch ... very toxic inflammatory responses."

This abnormal immune activity damages nerve cells and somehow triggers them to produce even more amyloid-beta, creating a vicious cycle of inflammation.

People with early Alzheimer's also have higher amounts of certain lipids in their spinal fluid. These lipids fasten onto a molecule called a receptor on the surface of microglial cells. Andreasson and her team found that the receptor, EP2, plays a role in impairing microglia in Alzheimer's. When exposed to amyloid-beta, young mouse macrophages — immune cells that behave like microglia — barely responded. Old macrophages, with more EP2 receptors, responded with more inflammation.

Among mice modified to be more susceptible to Alzheimer's disease, those without the EP2 receptor developed fewer memory problems as they got older. ■

BLAIR SCHOENE

Impacts may have aided origin of life

Lasers zapping primordial chemical produce RNA ingredients

BY BETH MOLE

Asteroids and comets that pummeled the Earth billions of years ago may have jump-started life with an intense zap of energy.

The jolts given off by such explosive impacts would have been strong enough to spark the formation of genetic molecules, scientists report December 8 in the *Proceedings of the National Academy of Sciences*. Using a high-power laser, the researchers simulated how the collisions' energy might smash apart formamide, a simple primordial chemical, into fragments. The researchers spotted nucleobases, the building blocks of genetic material, among the molecular rubble.

"We were looking for the simplest possible scenario in which these nucleobases could have formed," says planetary scientist David Nesvorný of the Southwest Research Institute in Boulder, Colo. "When things are simple, it's more likely that they occurred somewhere."

Formamide, a nitrogen-containing compound, is simple enough to have been a likely inhabitant of early Earth. Previous studies found that it can break apart and recombine to form nucleobases. But those earlier chemical reenactments relied on an array of catalysts, such as silica and limestone. Nesvorný and colleagues relied on collision energy.

"These impacts of the past had enormous energy," Nesvorný explains. Picture a 50- to 100-kilometer-wide asteroid smashing the Earth at 10 to 20 kilometers per second. The impact is explosive, blasting electrons off atoms and forming plasma that can spur chemical reactions.

Such molecular cataclysms were regular events about 4 billion years ago during the Late Heavy Bombardment, when Earth was hit by as much as a billion tons of space shrapnel a year. That time coincides with the origin of nucleobases.

Nesvorný and colleagues simulated the energized aftermath of such collisions by shooting formamide with a laser. In the resulting plasma, some formamide molecules broke down, creating radicals that attacked the remaining formamide to create 2,3-diaminomaleonitrile, which went on to form nucleobases.

In the zapped formamide, the team found the nucleobases of RNA, commonly believed to have been Earth's pioneering hereditary molecule. RNA's nucleobases include adenine, cytosine and guanine (also found in DNA), plus uracil.

"The results are exciting," says chemist Hicham Idriss of the King Abdullah University of Science and Technology in Thuwal, Saudi Arabia. But if scientists had added other chemicals, such as catalysts, perhaps the nucleobases would have begun to assemble into full-fledged genetic matter, he says. ■

An electric eel's high-voltage bursts take control of the nervous system of nearby prey and make muscles twitch and clench.

LIFE & EVOLUTION

Electric eels can control their prey

High-voltage zaps hijack nervous system of hiding fish

BY SUSAN MILIUS

Electric eels evolved hacking long before humans did. Zapping other fish with high-voltage bursts lets eels remotely control their prey's nervous system to make muscles twitch and clench.

That takeover is how electric eels (*Electrophorus electricus*) immobilize their prey, Kenneth Catania of Vanderbilt University in Nashville reports in the Dec. 5 *Science*. And in experiments exploring just what the eels' high-voltage discharges (up to 600 volts) do to prey physiology, Catania uncovered another spooky effect: Isolated electrical discharges that the eels occasionally release make nearby prey fish twitch involuntarily, giving away their hiding places.

Discovering that those electrical volleys — pairs or triplets of quick discharges — apparently probe for prey is "a remarkable finding," says Mark Nelson, a sensory neurobiologist at the University of Illinois at Urbana-Champaign who has studied electric fish. "This elevates the eel's strategy from a simple, reflexive stun-and-strike behavior to a more deliberative process."

Only a few fish species have beaten humankind to the development of the Taser, evolving specialized muscle tissue that emits strong electrical discharges that stun prey. A champion at this kind of attack, the electric eel has fascinated scientists for centuries. Less attention has gone into exactly what the stun attack does to eels' prey. Catania got curious about it when he turned a high-speed video camera on the attacks and was intrigued at their speed. An eel can stop all voluntary motion in another fish within just three or four milliseconds.

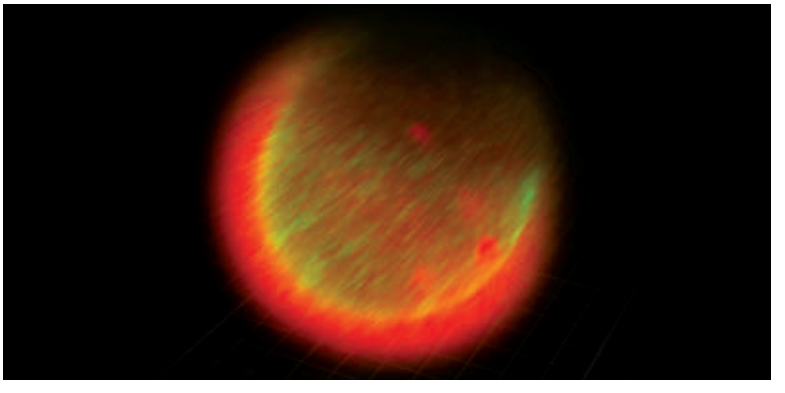
Unpleasant as this attack would be for the target, Catania doesn't want electric eels demonized. He doesn't know of any serious reports of an electric eel killing a human being.

To see whether the jolt of eel voltage acts directly on prey's muscles or on the nervous system, Catania suspended a pair of anesthetized fish in an eel tank. One had been treated with curare, a substance that keeps nerves from transmitting signals to muscles. When the eel sent out a volley of electric shocks, muscles in the curare-treated fish didn't clench, but the other fish's muscles did. The prey fish's own nervous system must relay the contraction signals to the muscles, Catania concluded.

The eels also remote-control quick muscle twitches in prey, Catania found. But he struggled to find a way to test whether those quick volleys actually helped the eel reveal some hapless fish in range or were merely a routine prelude to an attack. Finally, he placed brain-disabled prey fish in a plastic bag to prevent the eel's zaps from reaching them. Then he used laboratory electrical stimulators inside the bag to create — or not — a fish twitch.

When the eel sent out an electrical volley and no fish twitch answered it, the eel didn't fire its full stun attack. But the eel did proceed to an attack when Catania triggered the twitching response. That, plus some other experiments, convinced Catania that the discharges really are a nocturnal predator's search tricks.

Electric organs, either strong ones like the eels' or much weaker ones, have evolved independently at least six times among the world's fishes, notes Jason Gallant of Michigan State University in East Lansing. Now he'd like to know whether other electric predators give little search zaps, too. ■



GENES & CELLS

Images reveal secrets of zinc sparks

When egg meets sperm in mammals, zinc sparks fly. These sparks (yellow) are created when billions of zinc atoms shoot from thousands of small pouches nestled just beneath the surface (green) of a mouse egg cell, researchers from Northwestern University and Argonne National Laboratory report December 15 in *Nature Chemistry*. The team used detailed imaging and mapping techniques to capture the outburst and origin of the sparks, which are needed to stimulate the transition from egg to embryo. The research could help scientists figure out how changes in zinc levels control what's happening in cells and may have implications for identifying the best eggs for in vitro fertilization. — *Ashley Yeager*

FROM TOP: K. CATANIA; NORTHWESTERN UNIV.

See video of electric eels hunting at **bit.ly/SN_eels**

ATOM & COSMOS

Gamma-ray bursts bad news for life

Earth may have been zapped, leading to mass extinctions

BY ANDREW GRANT

Deadly jets of high-energy radiation may short-circuit life throughout the cosmos. These gamma-ray bursts occur enough in about 90 percent of galaxies to sterilize planets, including worlds that would be ideal for life, a report in the Dec. 5 *Physical Review Letters* concludes. Earth itself has been zapped, the study suggests, perhaps contributing to mass extinctions.

Some scientists say the study doesn't properly account for the resilience of life, particularly life protected by an ocean or ice. Nonetheless, the sobering conclusions may temper recent optimism about the prospects for extraterrestrial life on Earth-sized planets orbiting distant stars.

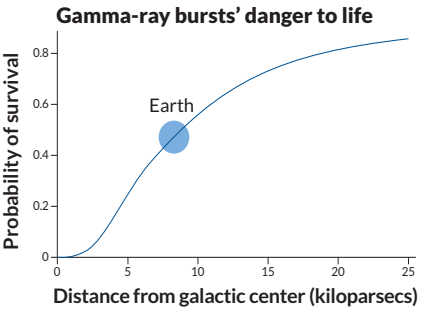
Gamma-ray bursts, or GRBs, are jets of the most energetic form of electromagnetic radiation, emitted by exploding massive stars or collisions of certain pairs of stars. NASA's Fermi Gamma-ray Space Telescope detects about one burst per day. "We see so many because they're so bright you can see them throughout the whole universe," says Neil Gehrels, an astrophysicist at the NASA Goddard Space Flight Center in Greenbelt, Md.

About 20 years ago, computer simulations showed that a zap of gamma radiation from a nearby burst would damage the Earth's ozone layer. Solar ultraviolet radiation could then harm DNA in surface organisms and exterminate much of the world's plankton, the base of the ocean food chain. "It's a potential major whammy for life on the planet," says Adrian Melott, an astrobiophysicist at the University of Kansas in Lawrence.

Raul Jimenez, a theoretical physicist at the University of Barcelona, and theoretical physicist Tsvi Piran of the Hebrew University of Jerusalem culled recent data on burst frequencies in various types of galaxies and reviewed estimates of the energy required to deliver a lethal blow. "We thought GRBs would have no influence whatsoever," Jimenez says.

To their surprise, he and Piran found that Earth has almost certainly experienced a lethal burst. And there's a 50-50 chance that a lethal burst struck within the last 500 million years, a period that has included five mass extinctions.

Yet Earth is well placed, about 28,000 light-years from the galactic core. GRBs occur far more often near the galaxy's core than in its outskirts. If Earth's distance to the center were halved, the planet would be sterile, the researchers conclude. "We are far enough away not to be completely wiped out," Jimenez says, "but not far enough for GRBs to not have any effect at all." ■



Chance of life Because sterilizing gamma-ray bursts occur more frequently near galactic centers, planets more distant from the Milky Way's core have a greater likelihood of evolving life, scientists have calculated.

COURTESY OF R. JIMENEZ, ADAPTED BY E. OTWELL

MATTER & ENERGY

Math depicts pedestrian behavior

Simulations mimic how real-world trajectories avoid collisions

BY ANDREW GRANT

Pedestrian behavior can seem unpredictable, especially in a big crowd. Yet scientists have developed an accurate mathematical representation of real-life pedestrian movement. By factoring in people's ability to anticipate collisions, the researchers created simulations in which pedestrians naturally form lanes to walk in opposing directions and slow in congested areas, just as real pedestrians do. "It's the most humanlike model that exists right now," says computer scientist Stephen Guy of the University of Minnesota, Twin Cities, who led the work.

The research, reported in the Dec. 5 *Physical Review Letters*, could help planners control crowds and design more pedestrian-friendly spaces. It also may inspire physicists to try quantifying other human interactions that seem too convoluted for mathematical simplification.

Previous crowd simulations treated people like electrons, which avoid collisions because of a repulsive force that depends on the distance separating the particles. But such simulations don't quite match real pedestrian movements.

So Guy and colleagues looked for patterns in a dataset of 1,500 pedestrian trajectories from various environments. The researchers realized that people behave differently from particles, says study coauthor Brian Skinner, a physicist now at Argonne National Laboratory in Illinois. The data showed no correlation between pedestrian separation and "interaction energy," a measure analogous to an electron's repulsive force (or for people, the level of discomfort). That makes sense, Skinner says, since the distance between people walking side by side shouldn't matter as much as the distance between people headed straight for each other.

Instead the researchers identified a key variable not identified in previous studies: the amount of time until an impending collision, which depends on people's ability to anticipate. Whether pedestrians were strolling through a wide-open campus quad or squeezing through a narrow doorway, their interaction energy would increase fourfold when their expected time until impact with another person was cut in half.

"It's brilliant," says Uri Alon of the Weizmann Institute of Science in Israel. "It gives a way to understand how people in crowds orient their motion." ■

See a video of the pedestrian simulation at **bit.ly/SN_walkers**

EARTH & ENVIRONMENT

California drought worst since A.D. 800

The ongoing California drought is the driest period in the state's history since before Charlemagne ruled the Holy Roman Empire, a new study concludes. Despite recent rainstorms, more than half of California remains in "exceptional" drought conditions, the most severe designation. The three-year period since 2011 is the driest in 120 years of recorded history, and a new survey of tree rings in blue oaks (pictured) shows that the current drought is the most extreme since before the year 800, researchers report December 3 in *Geophysical Research Letters*. They find that California's current lack of precipitation, while abnormal, isn't unprecedented even though the drought severity is. Severity is a product of both reduced rainfall and high temperatures; the researchers estimate that recent record highs probably exacerbated the dry spell's severity by about 36 percent. Rising temperatures from climate change will worsen future droughts, warns study coauthor Kevin Anchukaitis, a geochronologist at the Woods Hole Oceanographic Institution in Massachusetts. — *Thomas Sumner*

GENES & CELLS

Domestication did horses no favors

Horses have paid a genetic price for becoming human companions, a study of ancient equine DNA suggests. Modern domestic horses have more harmful genetic variants than ancient wild breeds did, researchers have found. Domesticated horses have no living ancestors, so Ludovic Orlando of the University of Copenhagen and colleagues sequenced the genomes of a 16,000-year-old and a 43,000-year-old horse, both excavated near Krasnoyarsk, Russia. Those ancient horses, which lived before horses were domesticated, are not direct ancestors of today's horses. Instead, they were on a branch in the equine family tree separate from the ancestors of domesticated breeds and of wild Przewalski's horses, Orlando and colleagues report December 15 in the *Proceedings of the National Academy of Sciences*. Comparing genetic variants from modern breeds with ancient horses, the researchers found that some traits that make for winning thoroughbreds have been around for tens of thousands of years. In general, though, domestic horses have more harmful genetic variants than the 43,000-year-old horse did. The buildup in detrimental DNA is not due only to inbreeding, the researchers found. It is the cost of domestication, in which humans have overridden natural selection by picking animals with desirable traits (as people see them) and unwittingly choosing damaged genes. — *Tina Hesman Saey*

LIFE & EVOLUTION

Warblers double as meteorologists

A freak of luck has let researchers document warblers fleeing their territories before local temperatures, air pressure or other signs foretold a storm approaching. Henry Streby of the University of California, Berkeley and colleagues had fitted simple lightweight data-collecting devices on tiny golden-winged warblers (*Vermivora chrysoptera*) in 2013 to see where the birds wintered. The devices were too simple to transmit data, so the team had to catch the same warblers in 2014 to recover any information. Just as the team was assembling for data catching, a storm triggering 84 tornadoes slashed through the southeastern United States in April, killing at least 35 people and causing extensive property damage. The warblers apparently sensed it coming. Five data-carrying birds had just returned to their Tennessee breeding grounds after flying hundreds of kilometers. Yet the warblers left again for storm-dodging trips that added as much as 1,500 more kilometers to the distance they had just flown. One bird even flew to Cuba and back, evading the storm. What tipped off the birds may have been the infrasound — sounds lower than the normal limit of human hearing — of the approaching storm, which can radiate for more than 1,000 kilometers, the researchers report December 18 in *Current Biology*. — *Susan Milius*

ATOM & COSMOS

Revived Kepler probe finds exoplanet

The Kepler space telescope has bagged its first confirmed planet since being benched in the summer of 2013 by a broken part used to steady the spacecraft (*SN: 9/21/13, p. 18*). The planet, named HIP 116454b, sits 180 light-years away in the constellation Pisces. Kepler detected the planet, which is about 2.5 times as wide as Earth, as a brief dip in starlight as HIP 116454b passed between its sun and the telescope. Follow-up observations at the Telescopio Nazionale Galileo, an Italian telescope on the Canary Islands, provided the planet's mass: roughly 12 times that of Earth. HIP 116454b is probably either a water world or a mini-Neptune, astronomers report in a paper posted online December 18 and accepted to the *Astrophysical Journal*. The discovery is the first for the K2 mission, Kepler's second chance at life (*SN: 6/28/14, p. 7*). After losing two of its reaction wheels, which balanced the spacecraft, Kepler could no longer stay steady enough to stare at stars and detect planets. Engineers proposed pointing Kepler's solar panel roof toward the sun and using the balanced pressure from sunlight to steady the spacecraft. HIP 116454b turned up in a February 2014 test run to see if the plan would work. — *Christopher Crockett*

DANIEL GRIFFIN

Jomira's Best Sellers. Great Items, Great Prices*

***But read this entire ad for an even better deal!**

The spy glass that made naval history…

ADMIRAL FARRAGUT'S TELESCOPE

(with table top tripod) from us only $69.95*

• The optics of Admiral Farragut's Telescope are 25x30. This means that you get 25x magnification and the great light-gathering capacity of a 30mm objective lens. The scope is fully chromed (over brass) for extra beauty, protection and durability.

When Admiral Farragut fought his legendary naval battles he used a telescope just like this to monitor the movements of the enemies' fleets. This beautiful optical instrument, a faithful replica of the famous original, is about 5" long in its collapsed position and 13" when extended to full operating length.

Enlargement is 25x, which means that it brings everything 25-times closer, and in needle-sharp focus, than if viewed with the unaided eye. ADMIRAL FARRAGUT'S TELESCOPE comes with a belt-loop vinyl carrying case. There is also a table-top tripod for extended observations.

The only universal optical instrument…

PANSCOPE

(the complete optical system) from us only $59.95*

• PANSCOPE is beautifully gift-boxed, comes with its neatly fitted leather case and with a plastic "tripod" for extended observations at 15x and 30x.

This is a little optical marvel. PANSCOPE (only 2" long) contains a complete optical system in its tiny body. You may use it as a 3x telescope or as a unique 3x telescope-loupe. In its magnifying mode, it delivers magnifiers and loupes at 5x, 10x, and 15x enlargement. And to top it all, it also functions as a 30x microscope of laboratory quality.

A special stand for long-term observation with 15x and 30x microscope is included.

This marvelous little instrument, developed in Wetzlar (Germany), home of famous Leica cameras, is the product of one of Asia's finest makers. Its coated optics are of superb quality, delivering the image with brilliant luminosity, in needle-sharp focus, with absolute clarity and with full chromatic correction.

Hold the whole world in your hand with…

JOMIRASCOPE

8 x 20 monocular from us only $59.95*

• The optics of jomirascope are 8x20 – 8x magnification with 20 mm objective lens. it comes in a neat zippered carrying case. The objective lens can be used as an 8x magnifier. A 25x microscope attachment ($29.95, 3 for $59.90) is also available.

JOMIRASCOPE is so small that it fits unobtrusively in a man's coat pocket or a lady's purse. Yet it packs a tremendous wallop in its tiny body. Its 8 x 20 fully prismatic and hard-coated optics give you 8x magnification, with a remarkable field of 430 ft. at 1,000 yds. Its 20 mm objective lens affords unusual light gathering even at dusk or dawn. What was that rustling in the bushes? With JOMIRASCOPE you'll discover that it was an ivory-billed woodpecker. Do you wish to explore every feature on the moon. JOMIRASCOPE will be your instrument of choice. Much smaller than even "pocket" binoculars and with greater magnification than most, JOMIRASCOPE should be your constant companion. And do consider the 25x microscope attachment of laboratory quality, which makes JOMIRASCOPE a complete optical system.

You have seen such zoom binoculars advertised nationally for $150…

6x to 18x JOMIRAZOOMS

from us only $99*

• JomiraZooms focus smoothly from 6x to 18x or anything in between, letting you see unexpected details. Porro prism construction and ruby-coated lenses are the best in optical construction. The 18mm objective lenses provide high light-gathering capacity. JomiraZooms come with a belt-looped carry case and strap.

JOMIRAZOOMS are the absolutely ultimate in binoculars. They fit in your hand and weigh less than 7 ozs. But they pack an enormous wallop in their small body. Porro roof-prism construction and ruby-coated lenses guarantee pinpoint sharpness at any distance. The 18mm objective lenses provide great light-gathering capacity making JOMIRAZOOMS utterly reliable even in the dim light of dawn or dusk. The zoom lever lets you smoothly change the magnification from 6x to 18x or anything in between. Are you watching the pitcher's windup on 6x? Zoom to 18x and you may be able to tell whether he is throwing a fastball or a slider. There can be nothing more useful for sports, nature watching, navigation, and so many other pursuits. JOMIRAZOOMS is an instrument that should be in every home.

Is this the famous Brand "X" watch that sells for over $1,000?

No, it is the Argonaut™ Watch – yours for only ~~$129~~* $69

In contrast to many highly advertised watches, the **Argonaut™** is not a mechanical watch. It is powered by an exquisite Japanese quartz movement. Besides the hands and the date disk, there are no moving parts. Nothing can go wrong or wear out. And no matter how many jewels they may have that inevitably happens with mechanical watches – sometimes as soon as within a year.

We guarantee the **Argonaut™** for three full years. It you treat it reasonably well it should last you a lifetime. The **Argonaut™** Watch is of solid stainless steel construction. It is guaranteed to be watertight to about 330 ft. You'll never dive that deep. Accuracy is guaranteed to 3 secs./month. You will need to change the battery in about two years. It shouldn't cost you more than $5. The **Argonaut™** Watch is a thing of rugged masculine beauty. It comes with a splendid adjustable stainless steel band.

And also: Buy three Argonaut™ Watches (for the price of two) and we'll send you this splendid Faux Fabergé Egg Pendent ($39.95 retail value) with our compliments – absolutely FREE!

An incomparable timepiece, an incomparable value…

RADIO-CONTROLLED CLOCK

Only $59.95*

• The sleek styling of R-C Clock makes it an adornment for any home or office. It works on one (included) AA-battery and is ready to go when you get it.

This beautiful clock is clad in brushed aluminum. Its sleek design makes it an adornment for any home or office. It measures 5-1/4"x 4" and can be set on your desk or hung on a wall. Time is displayed in inch-high digits. In addition to the time (hours, minutes, seconds), you also get the date, the day of the week, and the temperature in F (or in C). There is a melodious but insistent alarm, complete with snooze button for those extra winks. The clock is controlled by a radio signal emitted by a U.S. government department; that ensures up-to-the-second accuracy.

RADIO-CONTROLLED CLOCK works on one AA-battery (included, of course). It's ready to go when you get it. You don't even have to set it – it sets itself.

jomira

division of jomira/advance

470 3rd St., #211, San Francisco, CA 94107

*** And here is our "special deal": You may buy any three of these items -- mixed or matched -- for the price of two. The least expensive item is on the house -- absolutely FREE!**

You may order by toll-free phone, by mail, or by fax and pay by check or AMEX/Visa/MasterCard. Please give order code shown. Add $6.95 for ship./ins. for one and $9.90 for three items, except one JomiraZooms or one Adm. Farragut's Telescope is $9.90 and any three items containing one or more JomiraZooms or Adm. Farragut's Telescopes is $12.95. – plus sales tax for CA delivery. You have 30-day refund and one-year warranty. We do not refund postage.

For customer service or wholesale information, please call (415) 356-7801.

We ship the same day we receive your order. Please give order code Z295!

Order by toll-free phone: 1-800/600-2777, or (fastest!) by fax: 1-415/356-7804.
Visit our website at www.jomira.com

A coyote prowls downtown Chicago. Coyotes are a hidden but growing presence in the Windy City.

RON PERRILLO

THE CONCRETE JUNGLE

Ecologists go urban to study the impact of creatures large and small

By Kate Baggaley

Stanley Gehrt took a late-night drive to the cemetery on Chicago's South Side. Its gate was locked, so he jumped the fence. In the trap he had set earlier, Gehrt found a young male coyote. He drugged it and carried it away.

As he approached the fence, Gehrt spied two men trying to break into his truck. When they saw him leap over the fence and rush toward them, coyote lolling in his arms, the men yelled and ran.

Most people in his field don't need to worry about urban crime, says Gehrt, an ecologist at Ohio State University. But the hassles are worth it. Since 2000, Gehrt has equipped more than 850 Chicago-based coyotes with ear tags or microchips for identification. He follows the movements of more than 400 of these coyotes using radio and GPS collars.

"When we started, we didn't think there was going to be much of a study there," he says. Coyotes usually need large, natural areas to survive, so he expected they would be scarce on the streets of the Windy City. "We were wrong." He puts Chicago's coyote population at about 2,000, although he suspects that there are probably many more.

> "People still have a hard time seeing cities as burgeoning, thriving populations of wildlife that also need to be understood."
>
> **STANLEY GEHRT**

Gehrt is not the first scientist to be surprised by how wildlife can flourish in urban habitats. Most people associate living things with pristine lands far from subways and parking lots, and consider urban territory to be a degraded, beat-up version of nature. But cities are fully functioning ecosystems, and humans are not their only citizens.

While other, more remote environments are sculpted mainly by elements like heat and water, a city's identity depends largely on humans. People put streets, buildings and tunnels where they want them, and nature fills in the gaps. The resulting mix of habitats — a stand of trees in a park, a green roof on a high-rise, the subway, a sidewalk — is new territory for ecologists. First conceived in the 1970s but slow to gain traction, urban ecology seeks to understand the diversity of life within cities. "Maybe 10 years ago it was considered kind of rogue science," says Krista McGuire, an urban ecologist at Barnard College, Columbia University. The field is finally making some inroads.

As McGuire, Gehrt and others explore the world underfoot, dealing with would-be thieves and inquisitive onlookers, their research has revealed some unexpected creatures thriving on land that people consider their domain. A few even serve as model citizens, quietly contributing their cleaning services to the benefit of city dwellers.

On human turf

In the 14 years since he started tracking coyotes, Gehrt has followed them from the suburbs into the heart of downtown Chicago. "You have skyscrapers and tremendous traffic volume everywhere," he says. "There's just no escape from people or cars anywhere in that landscape." Yet the coyote population is thriving, and it has grown.

"They show us parts of the landscape that we never notice and never associate with wildlife habitat," says Gehrt. Those nooks and crannies, he says, "may be critical to their survival."

He has found coyotes navigating abandoned railway lines, waiting for a stoplight to change and traffic to pause at congested intersections before crossing, and raising kits on top of a parking garage in the shadow of Soldier Field, home of the Chicago Bears. Leery of humans, city coyotes must wait until night falls to venture out to forage. During those limited dark hours, they patrol home ranges more than four times larger than they would need in the suburbs. Clogged with human settlements, city land offers fewer spots to find food.

As he tracks coyotes' movements, Gehrt also studies their diets. Initially, his analysis of coyote scat indicated that the animals rarely gobble human food. Now, using a technique called stable isotope analysis, he is finding that individual coyotes' meals can vary. The Chicago coyotes still rely mostly on natural prey, such as rodents, other small mammals and wild fruits. However, discarded food is a larger part of some of their diets than earlier studies suggested, Gehrt's team reports in an upcoming issue of the journal *Oecologia*.

"In urban areas, the critical question is how much are they relying on human foods?" says Gehrt. What the coyotes are eating may help explain why they are drawn to certain habitats.

To do the isotope analysis, Gehrt snips a whisker off a captured coyote. That whisker contains a four- to six-month record of the coyote's food intake. Gehrt analyzes the strand for carbon signatures deposited in the growing whisker after the coyote digested and metabolized its meal.

Human foods are high in certain carbon compounds that are less common in coyotes' natural food. "The isotope stuff won't separate French fries from doughnuts or hamburgers, but it will separate all those items from prey or other natural coyote food," he says.

To do his measurements, Gehrt must capture a live coyote, a particularly difficult task in cities. And he can't lay the traps in areas where people or pets might trigger them.

"We're basically working in a fishbowl with 9 million people able to see what we're doing out there," he says of his studies in the Chicago metropolitan area. On farms or federal wildlife reserves, researchers can set snares and padded leghold traps without fearing that people will harass or try to free captured coyotes, he says.

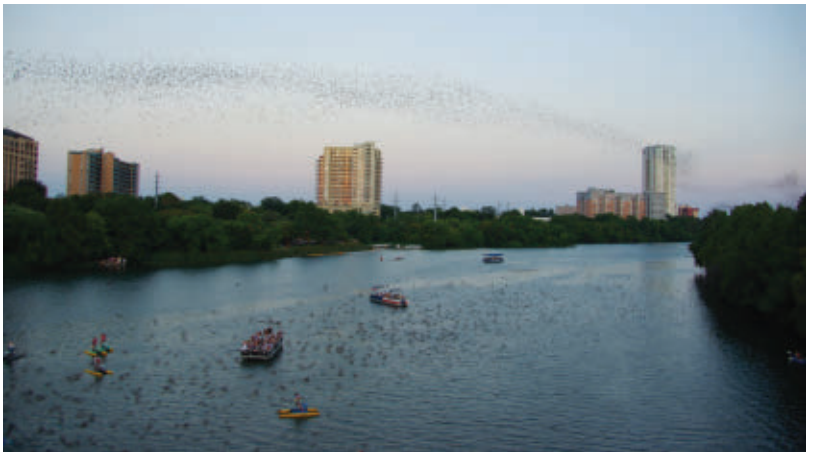
Getting funding for research on urban coyotes can also be difficult. State agencies are more eager to fund management of game species in forested areas, Gehrt says. "People still have a hard time seeing cities as burgeoning, thriving populations of wildlife that also need to be understood," he says. "They still, I think, view urban areas as wastelands for wildlife as opposed to opportunities for wildlife."

High-rise living

Like coyotes, bats have managed to thrive in cities, at least in Central Texas. Han Li, an ecologist at Baylor University in Waco, is investigating how bats use the varied urban landscape across the city. He records the bats' echolocation calls, films them, and occasionally catches them in skeins of fine mesh called mist nets. Within the one small metropolis of Waco, he has identified eight of the nine bat species that inhabit Central Texas.

Inside the city, bats find homes similar to their natural roosts, Li and a colleague reported in the December *Urban Ecosystems*. Cave-dwelling bats such as Mexican free-tailed bats (*Tadarida brasiliensis*) are drawn to the tall, old buildings in downtown, which are less carefully sealed than modern skyscrapers. The bats use the height of the buildings to drop into flight.

Bat species that roost in trees, such as evening bats (*Nycticeius humeralis*), seek out greener neighborhoods. Strangely, these forest-loving bats also gravitate to wealthy neighborhoods regardless of how green they are. Li speculates that landscaping



Bats fly over the Colorado River in Austin, Texas (left). Ecologists in Waco have found eight species of bat roosting in old, tall buildings and tree-lined suburbs. Mexican free-tailed bats (above) use the building height to drop headfirst and fly.

FROM LEFT: PIETER EDELMAN/FLICKR (CC BY-NC-ND 2.0); JAMES ST. JOHN/FLICKR (CC BY 2.0)

and a lack of hungry stray cats and dogs may be factors.

Like Gehrt, Li has found that people are present at every step of his fieldwork. "You cannot just go in and say, 'I want to catch bats,'" he says. He must clear his work with building owners and the police department, plus he's got to explain what he's doing to curious bystanders.

People see him working and pepper him with questions. "Usually by the end people are like, 'bats are pretty cute if you look at them closely,'" Li says. He even called on Waco's human denizens via local media to help him scout bat territory so that they could tell him where the bats are. "That helped a lot for me, to locate buildings and get permission to sample," he says.

Amy Savage, an ecologist at North Carolina State University in Raleigh, also sees the benefits of sharing fieldwork with city dwellers. "There are two schools of thought right now in urban ecology," she says. One says keep the experiment hidden or camouflaged. The other says, "make it as obvious as possible — put signs up, tell people that there's real science happening."

The openness approach leaves experiments vulnerable to vandalism. "But it meets another need of science, which is public communication," Savage says. Her team has already scouted several high school principals who are interested in hosting her experiments about how insects devour discarded food on school grounds. She's on the fence about whether to conceal or share her experiments with passersby. "I'm still trying to decide which approach is best," she says.

Cleanup crews

When most New Yorkers sit on a bench to enjoy a steaming hot dog or a bag of chestnuts, they don't think about what happens to the crumbs they inadvertently scatter on the ground. But ants and rodents devour much of the food dropped across the city; they may be earning their keep as a mini garbage service.

Savage found an interesting way to measure the impact of cleanup ants. She set up tiny cages in Manhattan covered with mesh to keep out rodents but let in ants and other arthropods. She and her colleagues littered hot dogs, cookies and potato chips both in the cages and on open ground. In parks and street medians, where food was fair game for all species, including rats, squirrels, raccoons and pigeons, more food disappeared from the open sites.

Ants devouring a potato chip offer a kind of trash removal service. In New York, such arthropods eat pounds of discarded food daily.

CAMILOTORRES/ISTOCKPHOTO

In some of the street-median cages, however, arthropods gobbled up almost as much food on their own as both rats and other critters and arthropods on the outside. The street-median arthropods also scarfed down two to three times as much food per day as those in parks.

These findings indicate that ants (especially the pavement ant, *Tetramorium* species E) and other arthropods are voracious and are key players in garbage disposal on ultraurban street medians. Rodents, on the other hand, eat more in parks, Savage reported in December in *Global Change Biology*. The ants may even be competing with rats and other pests for food. She and her team estimate that arthropods alone could devour up to 2,100 pounds of food waste per year just from Broadway and West Street's medians — the equivalent of about 19,000 hot dogs.

> "Anything that species living in cities can do to remove that food … is really going to help people."
>
> AMY SAVAGE

"Urban food waste is one of the biggest problems in cities, and the fact that animals living in cities help us with that has really been underappreciated," Savage says. Uneaten food ends up in landfills where it decomposes to produce the greenhouse gas methane, she says.

"Anything that species living in cities can do to remove that food … is really going to help people," she says. "It is exciting to consider that ants, which seem small, may have very strong influences on ecosystem process and that these effects may be particularly important inside cities."

Like Stanley Gehrt, Savage is using stable isotope analysis to find out how much the ants rely on human food. "Most of their carbon is coming from human food. That is not the case for the ones living in forests," she says.

New York also has tenants that are even easier to miss than ants, but might offer a different type of utility. McGuire, of Barnard College, has found a surprisingly wide diversity of microscopic fungi and bacteria on New York City's green roofs, where plants and soil insulate the buildings beneath them and absorb storm water before it becomes runoff.

Many of these microbes are beneficial to plants growing in stressful environments — such as the shallow, nutrient poor, sun-drenched soil on Manhattan rooftops. The beneficial fungi snuggle in and on plant roots, growing filaments that search the soil for nutrients the plants require. In turn, the plants

Green roofs insulate buildings and soak up storm water. They also harbor microbes that have the ability to break down pollutants.

K. MCGUIRE

provide their resident fungi with sugars from photosynthesis.

Some of the fungi that McGuire identified in the soil are also thought to protect plants from pathogens and drought. Other fungi she found, among them species of *Penicillium* and *Aspergillus*, have the capacity to degrade certain pollutants, such as the hydrocarbons in car and factory exhaust.

But whether the microbes are meeting their genetic potential remains to be seen. "Even though microbes may have DNA sequences for all these functional genes, it doesn't mean they're using that program," McGuire says. "We're trying to figure out if they're actually performing that function."

She is also cataloging the diversity of microbes in soil from additional green places across the city, including the popular High Line elevated park, and investigating whether microbes in ground-level green spaces are cleaning incoming storm water.

Slowly, ecologists like McGuire are beginning to fill in the gaps about how animals, plants and microbes share space with city-dwelling humans and provide services in return.

"The fact that we don't understand even the basics of patterns of diversity across cities is somewhat mind-boggling," Savage says. Urban ecology will become increasingly vital as our world becomes more and more developed. "More than half the world's population lives in cities and it's only projected to increase," McGuire says. "So it's pretty important to get a sense for what kind of diversity an urban environment can harbor."

In the 19th century, Charles Darwin and Alfred Russel Wallace embarked on trips across the seas to survey life in unfamiliar habitats. "We're kind of like the Darwins and Wallaces of the urban microbial environment," McGuire says.

Voyagers of a sort, urban ecologists are called back from the "pristine" areas traditionally prized by ecologists to chart habitats much closer to home. ■

Explore more

- Ian Douglas and Philip James. *Urban Ecology: An Introduction.* Routledge, 2014.

A different kind of laboratory

Skyscrapers and sidewalks don't provide the same breathtaking scenery as rainforests, mountains or deserts. But then again, big cities like New York are the only field sites where ecologists can gather data in the morning and catch a Broadway show in the evening.

"The historical perspective has been that you have to get away in a remote area to really get a good picture of ecology and appreciate the world around you," says Amy Savage of North Carolina State University in Raleigh. "But I like that I study a system that I can learn about when I walk to work in the morning."

Krista McGuire and her students at Barnard College, Columbia University sample microbes by taking a scoop of soil and freezing it before the genetic material can break down. In New York, McGuire can get her samples to the lab and process them the same day, instead of trying to keep them frozen during the trek back to the United States.

Her city work resonates with people she talks with as well. "When I talk to people about tropical rainforests, they are interested. They know deforestation is a problem — but it seems so far removed from their daily lives. This project is much more personal and close to home for people."

Plus fieldwork in cities lacks the dangers that come with more remote habitats. "In the tropics you have to worry about malaria and dengue and leeches and snakes," says McGuire, who also works in Malaysia and other tropical locales. "I've had amoebic dysentery and many giardia infections."

While some ecologists happily roam urban and remote terrain, others prefer to stay within city limits. Working in a city, surrounded by people, suits Han Li, an ecologist at Baylor University in Waco, Texas. "I don't get any pleasure from camping," he admits.

Jonathan Hogg agrees. "I grew up in cities — I'm not quite as hard-core as some of the other people I've known in wildlife biology who are more attuned to that Grizzly Adams sort of lifestyle," says Hogg, who has surveyed birds of prey in St. Louis' business parks for the University of Missouri.

"I think as people start to realize that there's more going on in our cities and urban areas, there will be a growing interest" in urban ecology, he says. "Especially for people like me who don't necessarily want to camp out for weeks at a time but are still interested in wildlife and conservation."

— Kate Baggaley

The demolition of the Glines Canyon Dam, seen here in May 2011 (left) and November 2012 (right), allowed Washington state's Elwha river to run free for the first time in nearly a century.

JOHN GUSSMAN

LET THE RIVER RUN

Removing two dams from the Elwha is a can't-miss restoration experiment

By Alexandra Witze

On a sun-dappled autumn day in the Pacific Northwest, Jeff Duda stands on the banks of a thundering river. He could not have picked a more glorious time to show off the Elwha River of Washington state. Its waters rush from the forested peaks of Olympic National Park, down through broad sweeping river bends, and out to meet the otters and salmon of the Strait of Juan de Fuca.

In the same spot just a few years earlier, Duda, an ecologist at the U.S. Geological Survey in Seattle, would have been submerged at the bottom of an unnaturally placid reservoir, ponded up behind a towering concrete dam.

Engineers built a pair of dams along the Elwha about a century ago to capture its waters and provide hydropower to a nearby timber and paper mill operation. Both dams were recently dismantled as part of a broader push, across the United States and elsewhere, to remove aging dams.

And science is benefiting, getting a front-row seat to ecosystem restoration on a mammoth scale. When the dams came tumbling down, they released a torrent of mud and silt. The sediment rushed downriver, reshaping the Elwha's banks and forming fresh sandbars where new grasses and shrubs are beginning to grow. Meanwhile, the spectacular native salmon are once again making their way upstream to spawn, pushing past the crumbled remnants of the dams that once blocked their way.

Think of it as the Elwha Experiment — a rare chance to watch a mighty river unleashed. "This is a once-in-a-lifetime opportunity," Duda says.

How the dams came down

In the last few decades, more than 1,100 dams have been removed in the United States, according to the conservancy

group American Rivers. (Another 75,000-plus remain.) Most of the demolished dams were modest structures, just a few meters high at most. But several dams taller than 15 meters have been torn down, including the two Elwha structures: Elwha Dam and Glines Canyon Dam.

The 33-meter-high Elwha Dam was finished in 1913, eight kilometers upriver from the ocean. The 64-meter-high Glines Canyon Dam was erected in 1927, another 14 kilometers upstream. Both were built over the objections of the Lower Elwha Klallam Tribe, whose nation sits at the mouth of the Elwha and once relied on the river's teeming salmon runs. Neither dam offered any way for fish to circumvent them, such as the fish ladders that are common in modern hydropower projects.

To the paper mill and power company employees, the dams worked great, providing a steady stream of electricity for local businesses. The tribal experience was very different, however. Once the dams went up, 90 percent of salmon habitat was cut off, and the fish populations plummeted. Where hundreds of thousands of salmon had once returned to spawn in the Elwha's waters, only a small fraction of that made their way up the truncated riverway.

For decades, the tribe fought to have the dams removed. The first real opening came in the late 1960s and early 1970s, when the dam operator applied for federal licenses to keep the structures running. Environmentalists joined the battle. After several roadblocks and paperwork delays, Congress passed a landmark act in 1992 allowing the federal government to acquire and demolish the dams and restore the Elwha's landscape and fisheries.

How a dam comes down can affect the final shape of the

Before the Elwha Dam, five species of native salmon raced up the river's waters to spawn each year. The dam blocked their path, as seen in this September 2010 image, and dramatically cut back their native habitat.

CLOCKWISE FROM TOP: JOHN GUSSMAN; STEVE RINGMAN/*THE SEATTLE TIMES*

restored river. In one approach, popularly known as "blow-and-go," engineers dynamite all the concrete at once and let the sediment and water pour out together. A second option is to take a dam out in stages, gradually lowering it from the top and letting water stream out in a more controlled fashion.

"Whether you instantaneously remove a structure or you take it down in stages turns out to be a huge determinant about the nature and mechanism of the downstream erosion," says Gordon Grant, a geomorphologist at the U.S. Forest Service's Pacific Northwest Research Station in Corvallis, Ore. "We sort of knew this, but we hadn't really explored and understood it. How does a river get its teeth back into all this stored sediment?"

Previous blow-and-go removals of dams provided some early clues to help guide the Elwha work. In 2007, when engineers took down the 15-meter-high Marmot Dam in Oregon, one-fifth of the sand and gravel that had been stored behind it washed away in the first 48 hours. In 2011, things moved even faster at the 38-meter-high Condit Dam in Washington, where the fine-grained sediment formed a slurry and squirted out as a high-speed debris flow, startling observers with its speed and force.

To avoid sediment overload, engineers opted for a combination of techniques for the Elwha dams. The lower dam, the Elwha Dam, was mostly taken out over a matter of months beginning in 2011. Engineers routed the water flow first to one side of the dam during demolition, then to the other side. The upriver Glines Canyon Dam came down in much more gradual stages over several years, as earth-moving equipment cut notches in the top of the concrete to allow the water to drain. The final blast came last August. Together, the two Elwha dams had trapped about 21 million cubic meters of sediment, or about 5 Wembley stadiums' worth.

After the first dam came down, the river began picking up that stored sediment and moving it downstream, particularly during winter storms. "The river basically took decades' worth of its own sediment supply and shoved 90 percent of it out to the river mouth," says Amy East, a USGS geomorphologist in Santa Cruz, Calif. People hadn't anticipated how efficient the river would be at moving its sediment downstream, she says.

The fine-grained silt that had been trapped behind the dams finally had a chance to spread out downriver. It formed large sandbars and caused the river to spread out in a complex system of braided channels, East and her colleagues reported in a paper that appeared in *Geomorphology* on January 1. The silt also filled in a riverbed that had been stripped down to large cobbles and little else. With fine-grained material now blanketing the river bottom as well, algae and other aquatic plants could begin to move in.

All that silt came with a price, however. So much rushed downstream that it temporarily clogged the intake filters at a water treatment plant that serves the nearby city of Port Angeles. The city had to rely for a short time on a limited supply of well water. In response, managers slowed the demolition of Glines Canyon Dam to reduce sediment flow.

The muddy plume

Today, just upstream from the treatment plant, USGS scientists are trying to make sure that sediment doesn't overtake the treatment plant again. At the "diversion" in the river where some of the Elwha's water is shunted to the treatment plant, researchers regularly take water samples to figure out how much sediment is muddying the flow.

In a cold October downpour, USGS technician James Starr visits every 24 hours to remove samples. On the banks of the raging river, atop a barren concrete platform, Starr unhooks a water pump festooned with tubes. Every hour on the hour for the past day, the pump has switched itself on and sucked up river water to fill a narrow vertical flask. Starr's job is to take these 24 flasks — each a different shade of muddy — and determine how much sediment they contain.

It's been raining for a couple of days, and several of the flasks are full of chocolate-brown fluid. "I captured the spike in turbidity yesterday, and it's still really high now," says Starr, wiping his hands clean. Knowing

Power versus habitats The Elwha River (shown in 2012, before the dams came down) runs to the Pacific Ocean past the Lower Elwha Klallam tribal lands. The dams formed reservoirs and provided electricity but salmon populations plummeted.

GOOGLE EARTH PRO, ADAPTED BY J. HIRSHFELD

how much silt is flowing through here, and how it changes over time, is helpful to scientists trying to protect the local water supply.

Eventually, most of the sediment flowing through this diversion will make it all the way to the ocean. As the dams started to come down, pilots flying over the coast photographed the huge muddy plume that poured out. The high levels of sediment began to affect the marine ecosystems just offshore from the river's mouth. The lush kelp forests that once covered the seabed began to die.

"You could see it right away," says Steve Rubin, a USGS biologist in Seattle who leads annual dive surveys to see how the dam removal is affecting marine life. "It was pretty dramatic."

Pink salmon (below), steelhead trout (right) and other native fish are making a strong return to the Elwha now that they have access to the full run of the river.

BOTH: JOHN MCMILLAN

Kelp need sunlight to photosynthesize, and the sheer amount of sediment in the water may have made it too dark for them to survive, Rubin says. In an early underwater trip just months after the first dam came down, Rubin and his dive team found themselves in water so pitch-black that they had to grab one another to communicate.

With time, the sediment is clearing, but the experience offers clues to what happens when rivers unleash sediment that's been pent up for decades behind dams.

For the salmon

The main argument for taking out the Elwha dams has always been the salmon. The river is one of the few that is home to all five native species of Pacific salmon that live part of their lives in freshwater and part in the ocean. They are born in rivers and lakes, then swim down to the sea and venture into the deep ocean. They eat rich marine food and grow much larger before they feel the call to return to their native streams to spawn. These big salmon then make their way upriver to mate near their birthplace.

Unless a dam blocks their way. Then they travel as far as they can, turn around and search for an alternate place to spawn. During the 2011 ceremony to mark the beginning of the dam removals, Duda and others standing atop Elwha Dam looked down at the river below and saw fish circling on the downstream side of the dam, as if awaiting the chance to finally break through and swim upriver.

When the dams came down, many fish began traveling upstream naturally from the ocean. Other salmon are raised in one of two local fish hatcheries and then physically transported up the Elwha. Conservationists have sued to stop this practice, saying that stocking the river with hatchery fish makes it harder for wild fish to survive. Legal battles continue.

The fish seem to be doing fine. As first the Elwha and then the Glines Canyon dams came down, the salmon surged past the old barrier and colonized the river above.

And they are reproducing there. Fresh sediment released from behind the dams fills in and enriches areas on the riverbed that had once been bare stones, turning them into a richer, more diverse environment where salmon can lay their eggs. In September, as Amy East was doing topographic surveys of the riverbed, she came across spawning nests, known as redds. "I had to be careful where I walked because I didn't want to disturb the redds they just created," she says. "We had never seen this before — it was so cool to see that it actually worked."

Tribal, state and federal experts now conduct snorkel surveys, along with sonar and radio tagging studies, to count the numbers and species of fish as they return. Full results are not yet out, but the populations are beginning to soar, says George Pess, a fisheries biologist at the National Oceanic and Atmospheric Administration in Seattle.

One measure of ecological success is the number of redds in the river, and surveys in certain river stretches found about 400 redds after the first dam came down. That number leaped to 800 in 2013 and nearly 1,100 in 2014. Biologists are also seeing successful matings between fish that have returned from the sea and fish that have not made it out of the Elwha watershed. "The cool thing is, we've seen these fish interacting with each other in a positive fashion," Pess says. "You can have a 15-pound female mate with a 12-inch male."

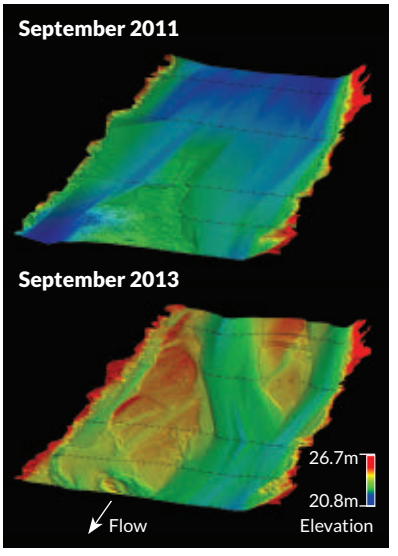
Researchers have seen different salmon species starting to colonize the areas with which they were historically associated before the dams were built. Sockeye salmon, for instance, typically like to live in lakes, and they are appearing in a tributary of the Elwha that leads to a mountain lake. The eel-like fish known as lamprey have moved into the middle section of the Elwha, between the two former dam locations, where they were once as populous as salmon.

Scientists plan to use what they learn from the Elwha to help those dealing with other dams. East has been working on a dam removal project on the Carmel River in California, where engineers want to drain the reservoir without flushing the sediment downstream. Data from the Elwha could help

those engineers figure out how much water they can safely release without carrying too much sediment, says East.

The work could even help engineers who are still building dams. Many places in East Asia are going through a massive dam-building phase. Duda recently took a group of Mongolian environmentalists around the Elwha, showing them the trees that drowned and the fish that were cut off when the dams went in. Understanding the changes that are likely to happen could help them better prepare, he says, to focus conservation efforts on species likely to suffer the most.

On the Elwha, the story will develop for decades to come. Geomorphologists will continue to survey the landscape, watching as new channels and sandbars form in a river still in flux. Biologists will count returning fish, along with the birds and other wildlife that will come to feast on the newfound salmon.



As the two dams came down, flowing sediment resculpted the Elwha's riverbed, forming new sandbars (lower river seen above).

Back on the riverbanks, the concrete remains of the former Glines Canyon Dam tower overhead like something out of a lost civilization in a Tolkien novel. All around Duda, tiny seedlings spread outward on the riverbanks. They have been planted in this former reservoir to encourage native trees to take hold and grow a fresh forest for the Elwha.

"We've got a lot of work to do here still," says Duda. "We're not nearly done yet." ■

Explore more

- J. Gussman and J. Plumb. *Return of the River.* www.elwhafilm.com.
- L.V. Mapes. *Elwha: A River Reborn.* Mountaineers Books, 2013.

'Locally extinct' fish discovered spawning in the Grand Canyon

The decline of a species whose habitat has been drastically altered by a dam can sometimes be reversed — even when the dam remains in place, according to recent findings in Grand Canyon National Park. After an extensive ecosystem restoration effort, biologists working in the park in April discovered newly hatched razorback suckers (*Xyrauchen texanus*). The endangered fish are endemic to the Colorado River and its tributaries but they were thought to be locally extinct in the Grand Canyon for the last two decades.

Distinguished by the narrow, bony keels on their glossy gray backs, razorback suckers "are spectacular fish," says biologist Mark McKinstry, of the U.S. Bureau of Reclamation in Salt Lake City. "They can live for 40 years and travel up to 1,000 kilometers upstream."

Razorback suckers, listed as endangered in 1991, are finding their way back to the Grand Canyon.

Once found throughout the Colorado River basin, razorbacks now exist in just a few isolated spots, including Lake Mohave in Arizona and Lake Mead, the reservoir downstream of the Grand Canyon. Glen Canyon Dam, completed just 24 kilometers upstream of the national park in the 1960s, has fundamentally changed the river's chemical, physical and biological environment in the Grand Canyon, boosting the number of nonnative predatory fish and sending the native fish populations into a tailspin. By 1991, the razorback sucker was listed as endangered.

When razorbacks manage to spawn, other fish eat the eggs and prey on surviving juveniles, so few offspring make it to adulthood. Following unsuccessful attempts to establish populations in other southwestern rivers, biologists were convinced the species' survival required "an extensive restocking effort," McKinstry says.

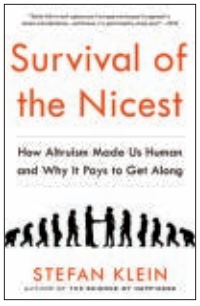
To assist with native fish recovery, the National Park Service removed predatory fish and the Bureau of Reclamation changed dam operations (designed to minimize "river tides," restrict minimum flows and mobilize sediment to rebuild crucial habitat). Yet despite these efforts, not a single razorback had been sighted in the Grand Canyon since 1995. That is, until 2012, when biologists captured an adult razorback sucker in the park.

Anticipating that the lower Grand Canyon might now host a population of these fish, researchers released nine razorbacks there in March. They hoped the fish, each carrying a sonic tag, would lead them to wild razorbacks and potential spawning grounds.

A month later, monitors detected several of the tagged "scouts" — plus the completely unexpected larval razorbacks.

"The findings of larvae this year, and a lot of them, suggest that more fish are using the river than originally thought," says McKinstry. — *Terri Cook*

FROM TOP: A. EAST *ET AL/GEOMORPHOLOGY* 2015; MARK MCKINSTRY



BOOKSHELF

Survival of the Nicest

Stefan Klein

It's comforting to assume that an altruistic nature has made us the civilized humans we are. But it's less easy to prove. After all, we evolved from hominids who had to fight and scratch — often each other — to get by. Natural selection would seem to favor a selfish type who lives to procreate.

In *Survival of the Nicest*, newly released in paperback, Klein offers a slew of evidence to the contrary, showing that inner altruism crops up consistently even at the expense of personal safety or profit. He maintains that humans are innately driven to cooperate, right down to the oxytocin that pours into the bloodstream when people witness acts of generosity. Oxytocin in turn promotes trust and good will, essential ingredients for sharing. We also come equipped with mirror neurons, brain cells that allow us to grasp and emulate others' emotions, laying the foundation for group responses aimed at the greater good.

There is wiggle room here. Some societies do more sharing than others. And altruism isn't a freebie. It's human nature to punish free riders who abuse shared public goods, such as drivers who park in express lanes during rush hour. Card-carrying altruists would approve of fines for tax dodgers or folks who sneak onto the subway, as psychological test-games have shown. Punishment, Klein notes, "is a powerful lever to maintain the norm of the group."

So most people, despite an inner altruistic bent, are hardly Mother Teresa. We are "provisional altruists" who help others within the constraints of what is just or deserved. We wouldn't hesitate to take in neighbors whose home has just burned down. But we might waver if they lost the house by gambling away their money.

The title makes the book sound lighter than it is. Klein documents his claims thoroughly, making this a dense read in parts. But one need only consider a human marvel — be it a rocket ship or Notre Dame — to see the effects of altruism. "All of this would be incomprehensible if individuals had only their own interests in view," Klein says. — *Nathan Seppa*

The Experiment, $15.95

BOOKSHELF

AIDS Between Science and Politics

Peter Piot

If by some marvel of medicine, doctors could instantaneously halt the spread of HIV, about 35 million people would still be infected with the virus. All of them would need expensive antiretroviral treatment for decades. And in that time frame, millions of kids would still be orphaned by AIDS.

The somber fantasy seems even more grim given that the virus is still spreading unabated through some high-risk populations, discrimination based on gender or sexual orientation still bolsters infection in many places, and making drugs available to patients requires seemingly never-ending fundraising. The fight against HIV and AIDS is far from over, writes Piot in his new book.

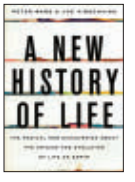
Despite the ongoing battles, there's much to celebrate, he writes. The global spread of the virus is slowing, and access to life-sustaining treatments continues to rise, with nearly 13 million people receiving treatment in 2013.

As an infectious disease researcher and the founding executive director of the Joint United Nations Programme on HIV/AIDS (UNAIDS), Piot is uniquely suited to examine the past and future of the medical, political and social responses to HIV and AIDS. He recalls how the global epidemic brought patients elbow to elbow with world-class health experts in deciding policies during the 1990s and 2000s, how it inspired unprecedented levels of government funding in the last 15 years, and how it continues to break down social stigmas.

Though soaked in statistics and lacking the colorful anecdotes of his 2012 book *No Time to Lose* (*SN: 8/25/12, p. 30*), Piot's new book is an enlightening account of how HIV and AIDS have shaped — and continue to shape — international public health policy. — *Beth Mole*

Columbia Univ., $29.95

BOOKSHELF

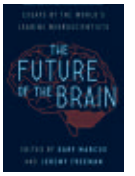


A New History of Life

Peter Ward and Joe Kirschvink

Two scientists argue for changes to the mainstream understanding of the history of life, including recognizing the evolution of ecosystems — not species — as the primary shaper of diversity.

Bloomsbury, $30

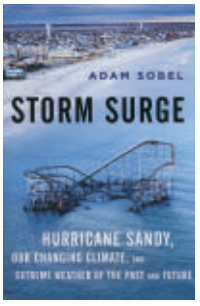


The Future of the Brain

Edited by Gary Marcus and Jeremy Freeman

A collection of essays by leading neuroscientists covers the frontiers of technology to study the brain and attempts to simulate its complexity.

Princeton Univ., $24.95



BOOKSHELF

Storm Surge

Adam Sobel

On October 28, 2012, Superstorm Sandy did something no Atlantic hurricane on record had ever done: The huge storm hooked sharply westward just before it slammed into the Eastern Seaboard. The storm — which technically lost hurricane status when it left the tropics but packed hurricane-force winds when it made landfall — killed 117 in the United States and caused up to $65 billion in damage. Arriving at high tide, Sandy flooded parts of New York City's subway system.

Storm Surge is a powerful account of Sandy's growth, evolution and aftermath, told by an atmospheric scientist who lives in New York City and experienced the storm firsthand. Artfully woven into Sobel's tale is a chronicle of the painstaking development of the computer simulations used to predict today's weather.

Without such models, meteorologists would have never prophesied Superstorm Sandy's unprecedented leftward jink, but simulations using atmospheric physics identified that possibility more than a week before the storm made its fateful swerve.

More than a tale of scientific success in storm path prognostication, *Storm Surge* potently illustrates the problems that will probably plague coastal regions worldwide in the future. Although scientists still disagree on whether climate change will increase the number or strength of hurricanes and their cyclonic kin in decades to come, there's no doubt that rising sea levels, brought about by water's expansion as it warms, will exacerbate coastal flooding. Indeed, in the not-so-distant future, higher sea levels will make it easier for strong storms, even those with onshore winds of less than hurricane strength, to inundate coasts as readily as Sandy did.

Storm Surge issues a clarion call to address our planet's inexorably rising tides. The question that remains is whether governments will rise to the occasion before the next disaster strikes.

— Sid Perkins

HarperCollins, $27.99

Buy Books Reviews on the *Science News* website include Amazon.com links that generate funds for Society for Science & the Public programs.

NOVEMBER 29, 2014

SOCIAL MEDIA

Penning captions for penguins

"Looks like a caption competition to me," tweeted **@benfriman** after seeing a photo of penguins regarding a researcher-devised robochick (*SN: 11/29/14, p. 16*). Some readers accepted the challenge.

"Jim, humans are trying to fool us again, do something."
@Cyborgwolf

"What the hell are you doing?"
"This is how I roll."
@AlfredTarski

"Make sure you have her home by dark. Oh wait, that's six months from now!"
@goblue1152

Join the conversation

E-MAIL editors@sciencenews.org

MAIL Attn: Feedback
1719 N St., NW
Washington, DC 20036

Connect with us

Teams need the right stuff

Successful long-term space journeys — like the one that awaits any astronauts heading to Mars — will hinge on good teamwork. ***Bruce Bower*** *described what it would take to handle the psychological pressures of an extended space mission in "Extreme teams"* (SN: 11/29/14, p. 22).

Elizabeth R. Hatcher is convinced that grasping group psychology is key to prepping astronauts for deep space travel. "Without the incorporation of such understandings into every step of project development, management and execution, I have difficulty imagining people traveling through space for months, deprived of everything tangible that they have ever cared about, interacting with each other throughout the mission and returning safely and sanely to planet Earth."

David M. Fishel said that the best teammates are those who can manage relationships, divvy up responsibilities and selflessly work toward common goals. "Let's see, based on human history and human nature, who of us is best suited for deep space exploration? Certainly not men! My wife would like to know from the various studies' authors just which of the above traits men exhibit in equal parts with women," he wrote. "As a male human being and a thinking person who's also well aware of his, shall we say, 'male foibles,' I'm forced to agree with my lovely wife, and conclude it's best for our species' future that we leave space exploration up to women!"

How oil spills lay low

Some of the oil from the 2010 Deepwater Horizon disaster is missing in action. Scientists may now know where it went, as ***Beth Mole*** *explained in "Oil from BP spill sits on seafloor"* (SN: 11/29/14, p. 16). Oil is less dense than water, so the idea of it settling near the bottom of the ocean confused some readers. "Shouldn't it float?" asked **Gary Baker**.

Two major factors kept some of the Deepwater Horizon oil from surfacing, says lead author **David Valentine** of the University of California, Santa Barbara. First, oil shot out of the well with such force that some of it fragmented into tiny droplets. They were too small to push through the cohesive forces that hold water molecules together and were trapped below the surface. Second, some components of the oil are water-soluble and simply dissolved in the surrounding ocean.

Fracking under debate

Soil-dwelling bacteria, and not leaky gas wells, are the culprits behind methane that's seeping into groundwater in an Ohio county, ***Thomas Sumner*** *reported in "Fracking not linked to contamination"* (SN: 11/29/14, p. 11).

Some readers were cautiously optimistic at the news: "Finally, we have some real science," wrote **Marcus Landry**. "Hysteria has ruled over the last few years and it's nice to see some sanity brought into the mix. This doesn't mean 100 percent of all the fracked wells are clean, but it does mean that a leaking well is a rare thing, just as I had suspected all along."

Others called for more research. "People need to be careful not to read into this more than what it says. It gives a good baseline for this particular situation and that is very important. Drawing widespread applications or predictions from this would be as premature as calling an acorn an oak tree," wrote commenter **Sukie**.

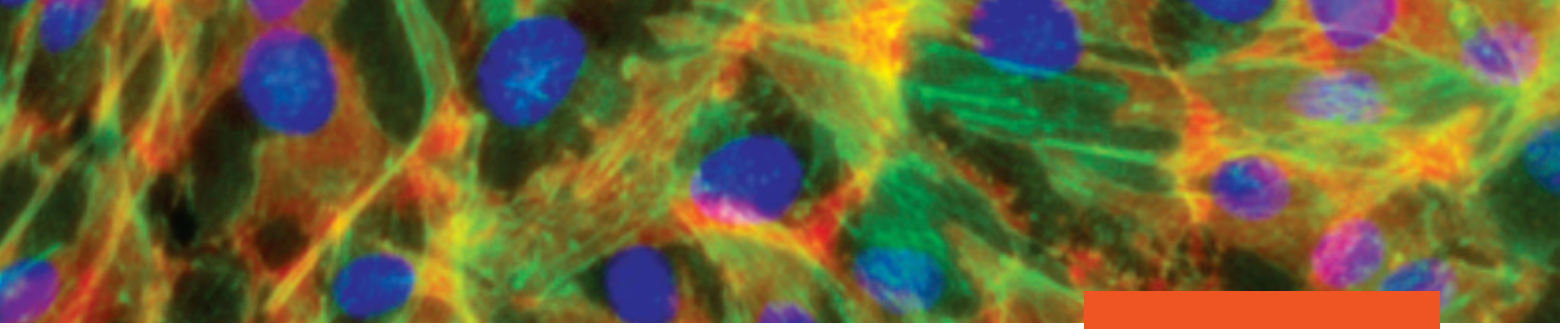
But some, like **ru899091**, don't view the study as evidence that fracking is safe. "To me, the most important issue is that when fracking goes wrong, are we capable of fixing the problems? I say we are not."

Corrections

"Not-so-sweet sweeteners" (*SN: 11/29/14, p. 30*) described sucrose, also known as table sugar, as a mixture of glucose and fructose. Reader **Ronald Swager** correctly pointed out that sucrose is a compound, not a mixture.

The fuzzy rodent shown in the photo that accompanies "Young blood aids old brains" (*SN: 12/27/14, p. 21*) is a rat, not a mouse as the caption suggests.

Y. LE MAHO *ET AL*/*NATURE METHODS* 2014



THE NATIONAL ACADEMIES

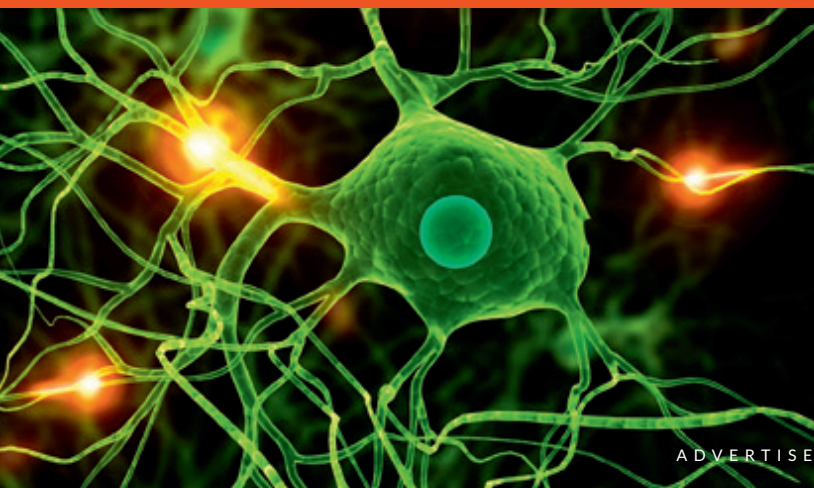
Communication

2015 AWARDS

2015 Call for Nominations open January 7th

FOUR $20,000 PRIZES to individuals or teams who have developed creative, original work that addresses issues and advances in science, engineering and/or medicine for the general public. Nominations are accepted in four categories: Book; Film/ Radio/TV; Magazine/Newspaper; and Online.

For more information or to nominate please go to **http://keckfutures.org/awards/nominate.html**

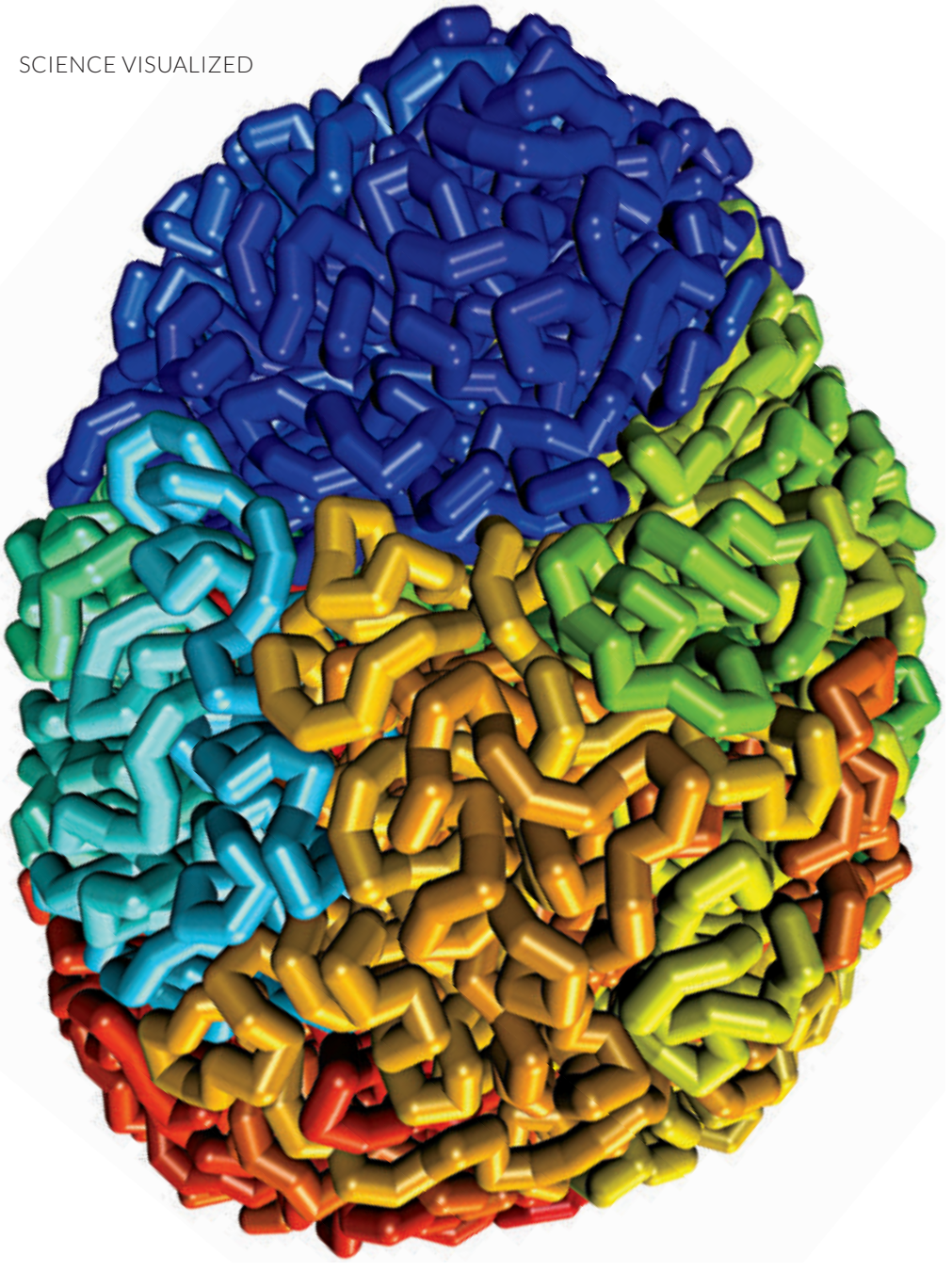


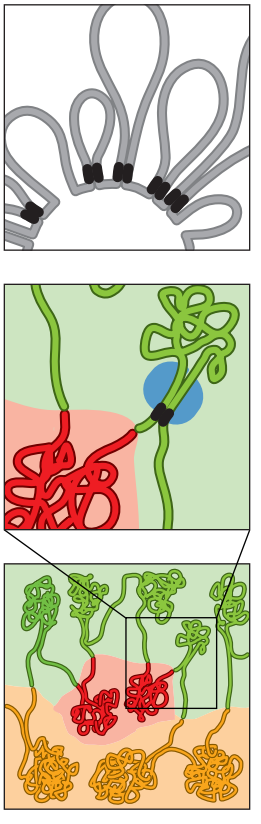
Congratulations to the 2014 Winners

Book • **Dan Fagin**
Film/Radio/TV • **Rob Stein** and NPR
Magazine/Newspaper • **Dennis Overbye**
Online • **Craig Welch** and **Steve Ringman**

Finalists
Book • **David Epstein**
Magazine/Newspaper • **Lisa Jarvis**

For more information, visit **www.keckfutures.org**





The art of DNA folding

If packing a vacation's worth of clothes into a small carry-on bag seems daunting, consider a cell's task. Nearly every cell in the body carries 6 billion DNA base pairs. When stretched out, the DNA would extend about two meters. Cells must compress all that genetic material into a nucleus that measures only about 5 micrometers across. That's like packing a thread the length of two football fields into a sphere no wider than the point of a pin.

To accomplish the feat, cells make loops in the DNA. Scientists used to think there must be hundreds of thousands or even millions of loops, but a new study shows that there are only about 10,000 nonoverlapping loops in each cell. Each loop (gray, top right) is anchored by small stretches of DNA (black) where proteins called transcription factors bind (blue, middle right). The loop crumples into a blob and gets coated with one of several chemical tags (red, orange and green, bottom right) that tell the cell whether to turn genes on or off.

Coated loops group together in subcompartments with other loops bearing the same coating, a team including structural biologist Suhas Rao of Baylor College of Medicine in Houston and computational biologist Miriam Huntley of Harvard University report in the Dec. 18 *Cell*.

A computer simulation shows one way a stretch of 5 million DNA bases may fold inside the nucleus (main image). Each type of cell may pack the DNA slightly differently, much the way an origami artist can fold a piece of paper into many shapes. — *Tina Hesman Saey*

MAIN: A. SANBORN AND E.L. AIDEN; INSETS: S.S.P. RAO *ET AL*/*CELL* 2014, ADAPTED BY S. EGTS

Watch a video of DNA origami at **bit.ly/SN_DNAfold**

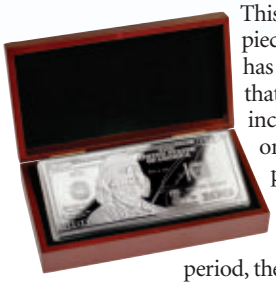
Limited Mintage Striking...

WORLD'S FIRST
The 2015 $100 SILVER PROOF

Collectible 2015 date | Mirrored proof background | Larger Franklin portrait | Liberty Bell, quill pen & July 4th date | Minted in one Troy ounce of .999% fine silver

Actual size is 6" x 2½"

GovMint.com Announces the Limited Mintage Striking of an Extraordinary Silver Proof —the Newest United States $100 Bill Struck in 99.9% Pure Silver. Discount Price $99



This extraordinary piece of pure silver has a surface area that exceeds 15 square inches... and it contains one Troy ounce of pure silver!

And now, during a limited strike period, the very first Year 2015 $100 Silver Proof is available fromGovMint.com at a special discount price—only $99!

Exquisite Detail

The historic 2015 $100 Silver Proof is an exquisite adaptation of the United States Treasury's recently redesigned $100 Federal Reserve Note—only the third new $100 bill design in 100 years. It is a true artistic masterpiece that will always be treasured.

99.9% Silver

Best of all, this stunning Silver Proof is even more beautiful than the original, because it's struck in precious silver!

It is a landmark in proof minting, combining unprecedented weight with extraordinary dimension. The specifications for this colossal medallic proof are unparalleled.
Each one:

- Is Individually Struck from Pure .999 Silver.
- Weighs one Troy ounce.
- Has a Surface Area That Exceeds 15 Square Inches.
- Contains 31.10 Grams (480 Grains) of Pure Silver.
- Is Individually Registered and Comes With a Numbered Certificate of Authenticity.
- Is Fully Encapsulated to Protect Its Mirror-Finish.
- Includes a Deluxe Presentation Case.

Advance Strike Discount

The price for the 2015 $100 Silver Proof will be set at $129 per proof.

However, if you place your order now, you can acquire this giant silver proof at the special advance strike discount price—only $99.

NOTE TO COLLECTORS: *When you place your order for the $100 silver proof, it will be processed immediately, and the earliest orders will receive the coveted lowest registration numbers.*

Additional Discounts

Substantial additional discounts are available for serious collectors who wish to acquire more than one of these exquisite silver proofs.

Year 2015 $100 Silver Proof
1-4 proofs - $99 each + *s/h*
5-9 proofs - $95 each + *s/h*
10+proofs - $89 each + *s/h*

There is a limit of twenty $100 Silver Proofs per order, and all orders are subject to acceptance by GovMint.com.

Only 9999 Available

GovMint.com will limit striking to only 9999 One Troy Ounce Silver Proofs for the year 2015. Once the edition is sold out, no more 2015 silver proofs can ever be struck.
Orders only will be accepted on a strict first-come, first-served basis according to the time and date of the order. Call today for fastest order processing.

For fastest service call today toll-free

1-800-514-6468

Offer Code FRN141-01
Please mention this code when you call.

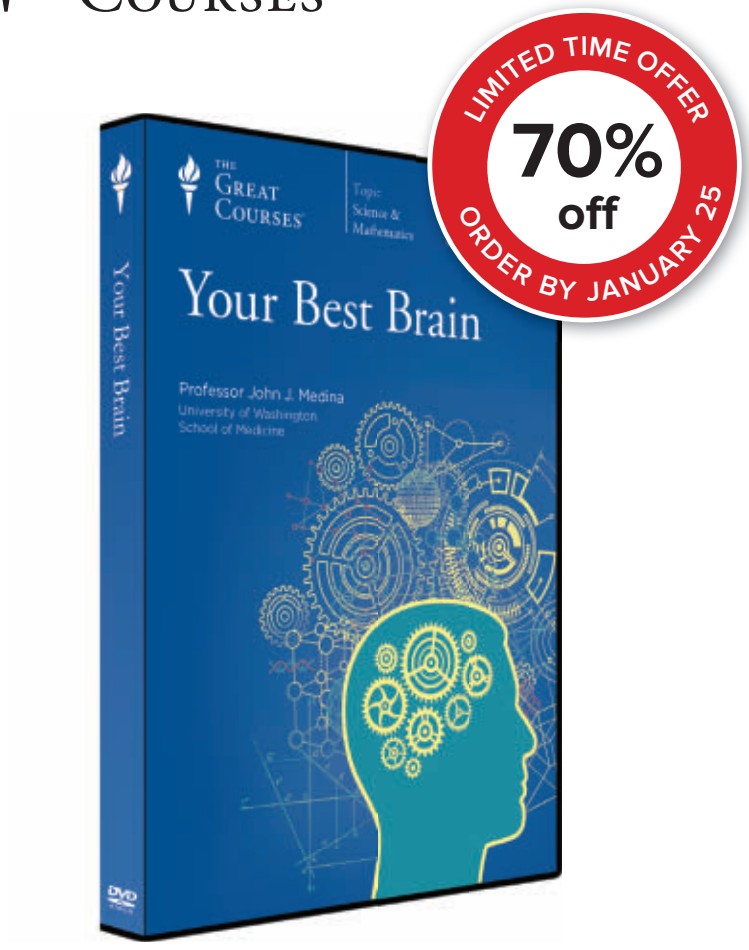
GovMint.com • 14101 Southcross Dr. W. Dept. FRN141-01 • Burnsville, Minnesota 55337

Prices and availability subject to change without notice. Past performance is not a predictor of future performance.
NOTE: GovMint.com® is a private distributor of worldwide government coin and currency issues and privately issued licensed collectibles and is not affiliated with the United States government. Facts and figures deemed accurate as of October 2014 ©2015 GovMint.com.

GOVMINT.COM®

THE BEST SOURCE FOR COINS WORLDWIDE™

THE GREAT COURSES®



A Remarkable Journey into Your Amazing Brain

Inside your head sits the most complex object in the known universe—the human brain. We all have a basic conception of how our brains function, but when did you last dive into the fascinating world of neuroscience to truly understand the inner workings of your mind?

In **Your Best Brain**, Professor John J. Medina—an award-winning scientist, *New York Times* best-selling author, and leading advocate for brain research—delivers 24 exciting lectures that probe the origins of consciousness, memory, emotion, attention, intelligence, and much, much more. You will gain a thorough understanding of the science behind your best brain, and in many lectures, you'll be able to practice scientifically proven methods for improving your memory, boosting your creativity, and keeping your mind sharp for years to come.

Offer expires 01/25/15

THEGREATCOURSES.COM/6SN

1-800-832-2412

Your Best Brain

Taught by Professor John J. Medina
UNIVERSITY OF WASHINGTON SCHOOL OF MEDICINE

LECTURE TITLES

1. How Your Brain Works
2. Your Unique Thinking Abilities
3. Damaged Brain, Damaged Function
4. Neuroplasticity—Your Flexible Brain
5. How Your Brain Uses Memory
6. The Advantages of Forgetting
7. Creativity and Fluid Intelligence
8. How Your Brain Uses Your Senses
9. Seeing with Your Brain—Vision
10. Feeling with Your Brain—Emotion
11. How Emotion Drives Attention
12. Pleasure and Your Brain
13. What Makes You Happy
14. How Your Brain Manages Stress
15. Your Social Brain
16. How Infant Brains Work
17. How Adolescent Brains Work
18. Sex and Your Brain
19. How Your Brain Ages
20. How Your Brain Copes with Grief
21. How Self-Control Works
22. The Power of Exercise
23. Improving Your Memory
24. Why Your Brain Needs Sleep

Your Best Brain
Course no. 1606 | 24 lectures (30 minutes/lecture)

SAVE UP TO $190

DVD ~~$269.95~~ **NOW $79.95**
CD ~~$199.95~~ **NOW $59.95**

+$10 Shipping, Processing, and Lifetime Satisfaction Guarantee
Priority Code: 108498

For 24 years, The Great Courses has brought the world's foremost educators to millions who want to go deeper into the subjects that matter most. No exams. No homework. Just a world of knowledge available anytime, anywhere. Download or stream to your laptop or PC, or use our free mobile apps for iPad, iPhone, or Android. Over 500 courses available at www.TheGreatCourses.com.