We are not alone. Humans’ vast inner and outer spaces teem with a menagerie of microbes that stand poised to alter conceptions of what and who we are.

Traditionally, microbes have been viewed as insidious invaders that make people sick or as freeloaders in the human gut. That view is beginning to change. In 2013, scientists amassed substantial evidence that people and other animals form a unit with their resident bacteria, archaea, fungi and viruses — the collection of microbes known as the microbiome. In fact, only about 10 percent of a person’s cells are human; microbes make up the other 90 percent.

Many researchers point out that ultimately, every species is out for itself. Nevertheless several new studies argue in favor of considering animals as superorganisms composed of host and microbes. Some scientists even advocate lumping a host organism’s genes with those of its microbes into one “hologenome.”

Treating a host, such as the human body, and its resident bacteria as a unit — or at least as an ecosystem with intimately interconnected parts — offers various benefits, scientists say. The superorganism approach may help researchers better understand how diet, chemicals and other environmental factors shape the microbiome and, in turn, the health of hosts.
factors affect health, for instance. Everyone, including identical twins, carries a slightly different microbial mix. Strong evidence indicates that some differences stem from diet or habitat. But even mice raised under uniform lab conditions still have individualized microbiomes. In October, two groups presented research suggesting that host genes play a role in selecting which microbes are allowed to settle in and on the body (SN: 11/30/13, p. 11). Immune system genes may be especially important in screening suitable microbial companions.

People with immune system problems have more types of bacteria and fungi on their skin. New research shows that some of those microbes may contribute to eczema-like rashes. That finding supports the idea that the immune system grants visas to friendly microbes while keeping out dangerous interlopers.

Newborns rein in their own immune systems to allow bacteria to take hold, one study found (SN: 12/14/13, p. 10). Previously, researchers thought that babies’ immune systems were just too immature to control microbes. But the new work shows that in mice and human umbilical cords, blood cells carry an immune-suppressing protein that prevents defenders from fighting off beneficial bacteria.

In mice, pups of stressed moms picked up a different mix of bacteria during birth than those born to non-stressed moms, researchers reported at the Society for Neuroscience meeting in November. Those bacteria may affect early brain development and possibly contribute to disorders such as autism and schizophrenia (SN: 12/14/13, p. 13).

A study reported in December may strengthen the link between autism and gut microbes (SN Online: 12/5/13). Caltech researchers found that mice with autism-like symptoms have a different mix of gut microbes than normal mice do. Those microbes make chemicals that leak from the intestines into the bloodstream (and perhaps the brain), producing behavioral changes. Treating the mice with the beneficial bacterium Bacteroides fragilis improved some symptoms, suggesting that altering the microbial mix might help some children with autism.

Once established, friendly bacteria shield their hosts from harmful invaders and may keep the immune system from overreacting. Harvard researchers discovered that some intestinal microbes make immune-calming molecules that can help reduce the kind of inflammation that afflicts the bowels in diseases like colitis (SN: 8/10/13, p. 14).

Even friendly bacteria put their own needs first, though. Another Harvard group found that some strains of a common gut microbe called Eggerthella lenta can rob heart patients of a drug called digoxin if the bacteria don’t get enough protein from their hosts (SN Online: 7/19/13). Some microbes change chemicals in meat into artery-cloggers (SN: 5/18/13, p. 14) or cause pain all on their own (SN: 10/5/13, p. 16).

Microbiomes not only alter the biochemical milieu in individuals, but can also influence relationships between entire species. Or even the course of evolution. A study of jewel wasps, for instance, suggests that their microbiomes can prevent two species from successfully breeding with one another (SN: 8/10/13, p. 13).

Hybrid male offspring of the two species die as larvae, an effect long explained as incompatibility between the species’ genes. But when Seth Bordenstein of Vanderbilt University and his colleague Robert Brucker removed microbes from the hybrid larvae, the wasps survived. That finding indicates that microbes in the wasps’ guts and not just the wasp genes contribute to keeping the two species from interbreeding.

The microbial momentum continues to build. Ongoing research is sure to find other ways in which microbes and their hosts interact, for good and ill. “It’s not just a one-way street,” says dermatologist Heidi Kong of the National Institutes of Health in Bethesda, Md. “The microbes are doing something to us and we are doing things to our microbes.”

About a thousand species of bacteria reside in the human gut, some of which are displayed in this hand-colored scanning electron micrograph.
Baron Victor von Frankenstein would have admired the bounty of body parts scientists crafted in the lab this year.

Lab-grown lumps of liver, bits of brain and clumps of heart, kidney and retinal cells can now mimic the functions of organs grown the old-fashioned way.

Scientists have no plans to assemble a monster, of course. Artificial organs may instead one day help repair or even replace a person’s damaged tissues. But that day is still many years away, says retinal cell researcher Robin Ali of University College London. “Making a neuron in a dish is exciting, but it’s not a therapy,” he says.

In the last few years, researchers have learned how to turn embryonic stem cells into all sorts of different cell types, such as skin cells, heart cells and neurons (nerve cells). These cells are good research tools: Scientists can watch how lab-grown neurons behave in a culture dish and test their responses to drugs.

But to be clinically useful, the cells need to team up and form tissues and organs that researchers can transplant into patients. Getting cells to organize into these three-dimensional structures is tricky. In the lab, cells often stretch out in flat sheets stuck to the surface of a dish.

This year, several research groups tackled the problem using a clever trick: They grew cells in structural scaffolds made of gel or the hollowed-out shells of real organs. The scaffolds can cue cells to grow and give them a physical framework to hook up in three dimensions.

“When cells are bound to just each other, they’re very fragile — they will fall apart,” says tissue engineer Shay Soker of Wake Forest School of Medicine in Winston-Salem, N.C.

The scaffold technique helped drive this year’s bioengineering boom. As part of a recipe to grow human brain tissue, researchers at the Austrian Academy of Sciences in Vienna and colleagues injected stem cells into droplets of gelatinous protein goo. The goo balls grew into primitive brain buds about the size of BB pellets. Neurons inside the buds could mimic some abilities of human brain tissue, such as transmitting electrical signals (SN: 9/21/13, p. 5).

Gel scaffolds also helped researchers craft mini-livers from stem cells. After transplantation into mice, the tiny organs could hook up to the blood supply and break down drugs (SN: 8/24/13, p. 16). Ali and colleagues used similar scaffolds to transform stem cells into rudimentary retinas. Primitive retinal cells injected into mice’s eyes linked up with the optic nerve and developed into mature light-sensing tissue (SN: 8/24/13, p. 16).

Gel-based frameworks are good for supporting small clusters of cells, Soker says. But to make bigger clumps of tissue, scientists need to figure out how to re-create the large-scale architecture of organs. This year two research groups took a crack at the challenge by borrowing structures from existing organs.

By stripping the innards from rat kidneys and mouse hearts, and then loading the husks with new cells, researchers bioengineered organs similar to the originals (kidney shown below). The renovated organs could filter waste or spontaneously contract (SN: 5/18/13, p. 14; SN Online: 8/15/13).

Still, refilling the shells of organs with fresh cells is like taking an apartment building and swapping out the tenants, Soker says. Eventually, tissue engineers want to erect an entire organ without relying only on existing frameworks. One day scientists may be able to 3-D print these frameworks, or weave them together using technologies from the textile industry, Soker says.

But before people with damaged livers or kidneys receive transplants crafted from scratch, patients might see simpler artificial tissue replacements with lab-grown bone, skin and cartilage, Ali predicts. He thinks these replacements could happen within the next 10 years. Now, he says, “The cutting edge is to work on the biology of transplantation.” Safely transferring artificial organs into people’s bodies might inspire more than just mad scientists to shout, “It’s alive!”

By Meghan Rosen

New techniques produce mimics of brain, liver, heart, kidney, retina

Bioengineers make headway on human body parts

February 2013 | SCIENCE NEWS TOP 25

A cross section of an immature lab-grown approximation of a human brain reveals neurons (green) and neuron-producing stem cells (red).
Planck refines cosmic history
Satellite hints at slower expansion rate for universe
By Andrew Grant

In October, astronomers said good-bye to the European Space Agency’s Planck satellite, breaking off contact with the source of the most precise measurements yet of the universe’s oldest light.

Planck had finished its mission to measure the Big Bang’s remnant radiation, which today constitutes an invisible bath of microwaves permeating the cosmos. This ancient radiation has cooled over time to less than 3 kelvins (degrees above absolute zero). Its precise temperature varies ever so slightly from point to point across the sky.

With 25 times the sensitivity of its predecessor, NASA’s Wilkinson Microwave Anisotropy Probe, Planck was able to identify temperature variations as small as a millionth of a degree. Those temperature fluctuations reflect tiny density differences in the infant universe. As the young universe expanded, matter in the higher-density regions clumped together to form intricate clusters of galaxies.

In March, Planck scientists released data that largely confirmed the standard view of the cosmos and its evolution. An improved estimate for the age of the universe, 13.82 billion years, is slightly older than the previous one but within its range of uncertainty (SN: 4/20/13, p. 5).

Planck data also suggested that the universe contains a higher proportion of matter than earlier estimates had indicated—both the ordinary kind of matter found on Earth and the perplexing invisible “dark” variety that affects the motion of galaxies. The probe’s wide-angle view of dark matter distribution throughout the cosmos complements underground experiments, such as the CDMS project in Minnesota and the LUX detector in South Dakota, which are designed to identify individual particles of dark matter (SN: 5/18/13, p. 10).

Planck also measured a slower expansion rate for the universe than other methods have found. “This is one of the most exciting parts of the data,” says Martin White of the University of California, Berkeley.

Scientists who measure the brightness of stellar explosions at large distances calculate an expansion rate considerably higher than Planck’s. As physicists work to determine how quickly the universe is expanding now, they are also trying to measure whether the strength of dark energy, which causes the expansion rate to accelerate, has changed over time (see Page 31). Such changes would have major implications for understanding what the universe looked like in the past as well as for predicting its ultimate fate.

Planck also confirmed a strange finding by the Wilkinson probe that one side of the sky contains more extreme temperature fluctuations on average than the other. That’s a confounding observation, since most experts agree that the universe began as a smooth ball of energy that then expanded uniformly in all directions. Dozens of papers have proposed explanations for the asymmetry, including the possibility that other universes have collided with ours and left behind discernible distortions.

Although communication with Planck has now ended, not all of the satellite’s data have been released. Over the next two years, mission scientists plan to produce enhanced maps of the Big Bang afterglow that could provide a window into inflation, a brief burst of extremely rapid expansion of the universe that most experts believe took place in the instant immediately after the Big Bang.
New discoveries reshape debate over human ancestry

By Bruce Bower

Human evolution appears poised for a scientific makeover, as unexpected and provocative findings have raised new questions this year about two poorly understood periods leading to the emergence of *Homo sapiens*.

The biggest conundrum comes courtesy of the oldest known DNA sample from a member of the human evolutionary family — a 400,000-year-old leg bone previously found in a cave in northern Spain. A nearly complete sample of maternally inherited mitochondrial DNA linked the bone to the Denisovans, mysterious genetic cousins of Neandertals who lived in Siberia at least 44,000 years ago (see Page 8).

Paleogeneticist Matthias Meyer of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, and colleagues wrung DNA from a fossil found at Sima de los Huesos, or pit of bones, a site where the remains of at least 28 Stone Age individuals have been excavated. Many researchers classify these finds as *Homo heidelbergensis*, a species regarded as an ancestor of Neandertals and perhaps also of *Homo sapiens*.

It would have been no shock to find mitochondrial DNA links between the Sima fossil and Neandertals, a species that has yielded partial samples of mitochondrial DNA from as early as 100,000 years ago. Now, however, scientists must try to figure out how a genetic connection formed between *H. heidelbergensis* in western Europe and presumably later-evolving Denisovans in Asia.

Several evolutionary scenarios have been suggested. Ancestors of Sima hominids in Europe and of Denisovans in Asia could have mated with members of another humanlike species, such as *Homo erectus*, which transmitted common mitochondrial DNA segments to both populations. Or ancient Denisovan ancestors may have occupied parts of Europe as well as Asia and passed on the same genetic traits to the Sima population and eventually to the Denisovans.

Meyer’s team will now try to wrest biparentally inherited nuclear DNA from a Sima fossil in hopes of getting a better look at how evolution played out among populations that set the stage for *H. sapiens*’ appearance around 200,000 years ago.

Questions also came up this year about the origins of the *Homo* genus, a group of upright-walking species that led to people today. New analyses of recently unearthed skeletons highlighted opposing views about how the *Homo* line evolved between 3 million and 2 million years ago.

One controversial idea, championed by paleoanthropologist Lee Berger of the University of the Witwatersrand in Johannesburg, South Africa, holds that an odd-looking member of the human evolutionary family living in southern Africa 2 million years ago was the ancestor of the first *Homo* species. Most researchers suspect that the *Homo* genus emerged in eastern Africa.

Berger’s team studied two partial skeletons excavated since 2008 in a cave at South Africa’s Malapa site. These finds come from a previously unknown species, *Australopithecus sediba* (skull shown), that walked on two legs awkwardly and had a small brain (SN: 8/10/13, p. 26). The nearly 2-million-year-old Malapa fossils share some key traits with the *Homo* genus, including round brain cases and long, inward-curving lower backs. *A. sediba* could have originated hundreds of thousands of years earlier and evolved into *H. erectus*, a species that also appeared in Africa around 2 million years ago, Berger argued.

But discoverers of a 1.8-million-year-old *H. erectus* skull in western Asia said that the fossil and four other skulls previously found at the same site sink Berger’s southern scenario. The Asian fossils display enough variation in early *Homo* fossils from eastern Africa — including one from 2.3 million years ago — also belonged to *H. erectus* (SN: 11/16/13, p. 6). David Lordkipanidze, a paleoanthropologist of the Georgian National Museum in Tbilisi, concluded that *H. erectus* probably evolved across parts of Asia and Africa, while *A. sediba* eventually went extinct.

From Spain to Siberia and from the South Caucasus to South Africa, scientific understanding of human ancestry seems poised for some evolution of its own.
Outbreaks of two deadly viruses captured the world’s attention in 2013, but neither turned into the global pandemic expected to strike one of these years.

One of the viruses, known as MERS, causes Middle East respiratory syndrome. The other, H7N9, is a new bird flu virus from China. Each virus has infected fewer than 200 people, but both kill a sizable number of the people who contract them. Although the viruses have not spread far from where they started, the scientific effort to decipher and combat them has had global reach.

The MERS virus was first isolated from a patient in Saudi Arabia by an Egyptian physician who sent the sample to the Netherlands to be tested. There researchers in the lab of Ron Fouchier (who made headlines in 2012 for work on the bird flu virus H5N1) deciphered the MERS virus’s genetic makeup. It turned out that MERS is a coronavirus related to SARS, a virus identified in 2003 as the cause of severe acute respiratory syndrome (SN: 3/23/13, p. 5).

Since it first appeared in people in 2012, MERS has sickened 163 people, killing 71. Most of the victims live in Saudi Arabia, Qatar or the United Arab Emirates, or had recently traveled to the Arabian peninsula.

H7N9, a new strain of avian influenza, began circulating in China in February. The outbreak peaked by early April, nearly halting after Chinese officials closed live poultry markets. Still, sporadic cases appeared in the summer and fall, raising concerns that the virus could make a resurgence in the coming flu season (SN Online: 10/15/13). By early December, of the 139 people with confirmed H7N9 infections, 45 had died.

It came as a surprise that this type of bird virus was seriously sickening and killing people. Experts have been worried for a long time that the H5N1 bird flu would sweep the globe as the 1918 Spanish flu did. If H5N1 gained the ability to spread from person to person through the air while retaining its potency, it could potentially kill millions. But until this year, no serious human infections with H7N9 had ever been recorded.

As more and more cases of MERS and H7N9 infection appeared, scientists and health workers scrambled to investigate basic questions about the viruses: Where did they come from? How did they get into humans? How do they infect cells? And perhaps most important, do they spread easily from person to person, becoming a candidate for a pandemic? Only partial answers have emerged, and some are not comforting.

Researchers found molecular handles on human cells that the MERS virus grasps during infection (SN Online: 3/13/13). One study revealed that H7N9 can grow well in human lung cells (SN Online: 7/3/13). Studies of ferrets revealed that H7N9 can spread through the air from one of the animals to another, raising the possibility that it might also pass from person to person that way (SN Online: 5/23/13). But so far, the virus hasn’t been easily transmitted between people. A few people may have spread the virus to their relatives, but most people probably caught it from chickens, ducks, pigeons or other birds at live poultry markets (SN Online: 4/12/13, 4/15/13).

But the MERS virus does spread from person to person, particularly among people who are elderly or have other health problems. Hospital dialysis wards proved important for at least one big outbreak (SN Online: 6/19/13).

Researchers have been using DNA data and old-fashioned health sleuthing to track down the source of the MERS virus. It probably originated in bats and may have spread to camels and other animals before infecting humans (SN: 9/21/13, p. 18; SN Online: 8/8/13, 10/9/13). Whatever its origin, MERS probably made the leap from animals to people multiple times (SN: 10/19/13, p. 16). New cases of the virus continue to emerge, and there is ongoing concern that it could become a worldwide problem. —

www.sciencenews.org | December 28, 2013 23
Tracer dyes (green, red) show where cerebrospinal fluid floods into the brain when a mouse is asleep. The fluid helps cleanse the brain of waste products that can build up and damage brain cells. Fluid flow nearly stops when the mice are awake.

Sleep clears the cluttered brain
Gunk between cells is cleansed during slumber

By Tina Hesman Saey

Sleep showers away cellular grime that builds up while the brain is awake — just the sort of process that could have made sleep a biological imperative, scientists reported in October (SN: 11/16/13, p. 7).

People have long puzzled over the evolutionary pressures that led animals to need sleep even though it leaves them vulnerable to predators and other dangers. Rinsing off the brain and disposing of waste proteins and other gunk might help explain why sleep evolved.

Many other things that sleep does, such as strengthening memories, are important. But they are probably bonuses to the real reason that slumber is necessary, says Suzana Herculano-Houzel of the Federal University of Rio de Janeiro.

Researchers led by Maiken Nedergaard of the University of Rochester Medical Center in New York stumbled upon sleep’s cleansing function while studying how the brain disposes of waste products.

The brain pushes fluid in between its cells to flush out buildup products, such as protein pieces that form plaques in people with Alzheimer’s disease, the team had found. After training mice to sit quietly on a microscope stage, the researchers could measure the fluid flow while the rodents were awake and asleep. Space between cells increased by at least 60 percent when the animals fell asleep, allowing cerebrospinal fluid to gush in and hose away buildup. When the animals woke up, some brain cells — probably ones called astrocytes — swelled up, narrowing the crevices separating the cells.

With the drainage system clogged, waste from hardworking nerve cells begins to pile up. Sleep deprivation or damage to the irrigation system may make it impossible for sleep to fully wash away the by-products, eventually contributing to neurodegenerative disorders such as Alzheimer’s and Parkinson’s diseases, the researchers speculate.

High court rules against gene patents
Justices open way for choices in DNA testing

By Tina Hesman Saey

A Supreme Court decision in June to strike down a company’s patent on genes linked to breast cancer could have far-reaching consequences for biotechnology and medical research.

In a rare unanimous decision, the justices ruled that naturally occurring genes may not be patented. That ruling came in a case in which many scientists, activist groups and others sued Myriad Genetics. That company had previously patented the BRCA1 and BRCA2 genes. When mutated, those genes can greatly increase the risk of breast cancer.

Myriad’s patent gave that company the exclusive right to conduct tests based on those two genes. The court’s decision means that Myriad’s patent is invalid and other companies may now offer BRCA tests. Several companies, including medical testing giant Quest Diagnostics, have already started offering such tests.

Patient advocacy groups, doctors and academic scientists embraced the decision, predicting that it would pave the way for cheaper, more readily accessible tests for inherited cancer risk.

Some people, though, warned that biotechnology companies would stop doing genetic research if gene patents aren’t allowed. But the Supreme Court included a carrot along with the stick. Part of the decision included a provision that allows for patents of versions of genes known as cDNAs. Scientists cried foul at the justices’ incorrect assertion that cDNAs don’t occur naturally, but that provision could allow companies to patent certain aspects of their research (SN Online: 6/14/13). □
Language learning starts before birth

Babies seem familiar with vowels, words heard while in womb

By Laura Sanders

Parents are usually careful to watch their language around young children. Maybe parents-to-be ought to watch what they say, too. Not only do babies slurp up language skills in the first few years of life, but new research also suggests that this precocious language learning starts in the womb.

In the later months of pregnancy, fetuses can detect and remember songs, native vowel sounds and entire words. These surprisingly sophisticated linguistic feats offer a new perspective on early learning. The results also raise the possibility of taking steps during pregnancy to help babies at risk for language problems.

Toward the end of pregnancy, sounds from the outside world can seep into a developing fetus’s brain. Young babies show a clear preference for the sounds of their mothers’ voices, familiar nursery rhymes and soothing lullabies, for instance. Four months after birth, babies who had heard “Twinkle, Twinkle Little Star” while in the womb remembered the lullaby, cognitive neuroscientist Eino Partanen of the University of Helsinki and colleagues reported in the Proceedings of the National Academy of Sciences (SN: 10/5/13, p. 15).

In the later months of pregnancy, fetuses can detect and remember songs, native vowel sounds and entire words. Such knowledge about fetal learning could one day lead to specially designed audio tracks that could boost language skills in fetuses at risk for language impairments such as dyslexia. Carefully crafted auditory cues played during pregnancy might stimulate the growing brain in a way that aids language skills.

The new work also draws attention to the importance of the acoustical environment for a fetus. Because the fetal brain is sensitive to sounds, constant exposure to a noisy environment might be problematic. Loud, unstructured noise could mask this early language acquisition and interfere with normal brain development.

Top exoplanet discoveries of 2013

With the addition this year of 180 new worlds to the Paris Observatory’s list of confirmed exoplanets, there are now more than 1,000 known planets orbiting stars other than the sun. Here are some of the year’s most notable finds:

1. The Earliest
   Kepler-78b is most similar to Earth in mass, diameter and composition; it could be made of rock with an iron core. But it’s no Earth analog, whizzing around its star in 8.5 hours, with temperatures exceeding 2,000° Celsius.

2. The wettest
   HR 8799c’s atmosphere lacks methane, which could signal life, but does have water and carbon monoxide. Water has also been found in the atmospheres of WASP-17b, HD209458b, WASP-12b, WASP-19b and XO-1b.

3. The rogue
   Planetary candidate PSO J318.5-22 has no parent star. The object is roughly six times the mass of Jupiter, has features similar to other directly imaged exoplanets, including HR 8799c, but floats through space all alone.

4. The runt
   Kepler-37b is the littlest planet found to date. At 3,860 kilometers across, the exoplanet is about 30 percent of the diameter of Earth or 80 percent the width of Mercury.

— Ashley Yeager

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Caffeine triggers cloning advance

Human embryonic stem cells copied successfully

By Meghan Rosen

With a tweak to the technique that cloned a sheep in 1996, scientists have generated stem cells in the lab that genetically match those found in human embryos.

The feat pumps life into a sputtering field. Until now, researchers had to harvest the cells from embryos left over from in vitro fertilization, or tinker with ways to turn adult cells into embryonic ones, a task riddled with technical challenges.

Embryonic stem cells are so prized because they can transform into any type of cell in the body. This boundless potential carries the promise of personalized medicine: Doctors could one day dose patients with new, healthy cells made from patients’ own bodies. Though scientists had previously cloned cells from frogs, sheep and even monkeys, no one had figured out how to perfect the procedure in human cells.

The cloning procedure, called somatic cell nuclear transfer, requires scientists to remove the DNA-containing nucleus from an egg and replace it with one taken from an adult cell. Under the right conditions, the egg reprograms its new nucleus and develops into an embryonic stem cell. Because each animal’s cells have their own quirks, scientists have to tailor the procedure for different creatures.

To successfully clone human cells, eggs must be dunked in caffeine, study leader Shoukhrat Mitalipov of the Oregon National Primate Research Center in Beaverton and colleagues found (SN: 6/15/13, p. 5). This and other technical changes give researchers a new recipe for creating embryonic stem cells in the lab. And because the recipe doesn’t rely on leftover embryos, it may sidestep some of the ethical issues surrounding stem cell research.

CO₂ levels pass milestone

Panel affirms humans’ role in warming

By Erin Wayman

Even as skeptics continued to doubt human-caused climate change, scientists grew more confident than ever this year that people are driving global warming.

In September, the Intergovernmental Panel on Climate Change reported that it is 95 to 100 percent certain that human activity — largely fossil fuel burning — is the main cause of rising temperatures since the 1950s (SN Online: 9/27/13). The IPCC also dismissed a common argument that the apparent slowdown in global warming over the last 15 years is evidence that humans aren’t altering climate.

The IPCC noted that small slices of time aren’t good indicators of longer trends. And researchers at the Scripps Institution of Oceanography in La Jolla, Calif., determined that the recent global warming “hiatus” may be linked to natural fluctuations in sea surface temperatures in the tropical Pacific (SN: 10/5/13, p. 14).

Although scientists are confident about humankind’s role in climate change, they still have a lot to learn about the magnitude and timing of future climate shifts. Some researchers are looking to the past for guidance. Many say the Pliocene epoch, 5.3 million to 2.6 million years ago, may be the best analog for Earth’s future.

Back then, average global temperatures were a few degrees warmer, sea levels were higher and atmospheric carbon dioxide concentrations were about 400 parts per million — an amount the world will soon surpass. Last year, the Arctic hit the 400 ppm mark, and this year the atmosphere above the long-running Mauna Loa Observatory in Hawaii reached that milestone as well (SN: 6/1/13, p. 20). Scientists predict that the global average will rise to 400 ppm within a few years.
Putting kids at risk
Parents lax on vaccinations
By Nathan Seppa

The tenet that “doctor knows best” is taking a beating. U.S. parents increasingly are delaying their children’s vaccinations, basing such decisions on sources other than their pediatricians, researchers reported in 2013. Nearly half of U.S. babies born from 2004 to 2008 fell behind on at least one vaccination (SN: 2/23/13, p. 11).

Many parents cite concerns about the 23 shots babies now get in the first two years of life, says epidemiologist Jason Glanz of Kaiser Permanente in Denver. “You can see the parents’ perspective,” he says.

Vaccination schedules have been fine-tuned to protect children at a vulnerable age, doctors point out, but they can’t force the issue. Glanz and colleagues examined the records of 320,000 kids under age 2, finding that 49 percent got at least one shot more than a month late. That proportion has been rising for five years. Overall, 20 percent of kids spent more than 100 days unprotected against a disease because of late shots.

Vaccine fears arose over a decade ago when some people blamed shots for health problems, claims later shown to be unfounded. A 2013 study debunked more recent claims that vaccination can cause Guillain-Barré syndrome, a nerve-damaging disorder. A review of 3 million people in the Kaiser database showed no connection between the disorder and getting any vaccine (SN: 7/27/13, p. 16).

Putting off shots might be grounded in parents’ desire to make safe choices for their child, say University of Pennsylvania physicians Kristen Feemster and Paul Offit, writing in JAMA Pediatrics in October. But in reality, “it offers no clear benefit,” they say. Such parents may be well-meaning, but in this case doctors really may know best.

Voyager 1 reaches interstellar space
Planetary probe is first to pass beyond heliosphere
By Andrew Grant

When Caltech’s Ed Stone watched the launches of Voyager 1 and Voyager 2 from Cape Canaveral in 1977, he had only a glimmer of hope that either probe would survive to reach interstellar space. “The space age was only 20 years old,” says the missions’ principal investigator. “We had no idea how long spacecraft could last.”

Thirty-six years later, Stone announced that Voyager 1 had become the first human-made object to pass beyond the heliosphere, the giant invisible bubble inflated by subatomic particles from the sun, and enter the space between the stars (SN Online: 9/12/13). Based on measurements from the probe’s instruments, Voyager made its exit in August 2012.

But only in September of this year did Stone and his team, many of them original Voyager scientists, decide that they had enough evidence to confirm the crossing. The announcement carried a sense of déjà vu because multiple scientists had made the case in previous months that the milestone had been reached.

Now astronomers are digging into the probe’s latest observations, the first from a region of space teeming with speedy protons and electrons expelled in the violent explosions of distant stars. Scientists have studied plenty of these particles with space-based detectors, but never in a pristine environment largely free of radiation and magnetic interference from the sun. “We’re left with decades of interesting work ahead of us,” says Gary Zank, a space physicist at the University of Alabama in Huntsville.
Death of a planet hunter
Kepler ends successful mission
By Andrew Grant

When NASA’s Kepler space telescope launched in March 2009, astronomers had no proof that any star other than the sun harbored an Earth-sized planet (with a diameter within 25 percent of Earth’s). By May 2013, when the telescope suffered a mechanical failure that ended its planet hunt, Kepler scientists had discovered 10 such worlds and identified hundreds of yet-to-be-confirmed Earth-sized candidates.

Kepler’s death blow came when the second of four wheels used to orient the telescope failed. The spacecraft requires three wheels to home in on a patch of sky and search for planets that block out some of the light of their stars. Mission engineers tried to repair the wheels but gave up in August (SN: 9/21/13, p. 18).

While the telescope is probably done hunting planets, its data will keep astronomers busy for at least several years. William Borucki, Kepler’s principal investigator, speculates that data not yet analyzed contain signals of the ultimate catch: Earth-sized worlds in the habitable zones of sun-like stars that could possibly support life. Already scientists have found intriguing worlds such as Kepler-62e and Kepler-62f, two planets slightly larger than Earth that could harbor liquid water on their surfaces (SN: 5/18/13, p. 5).

When Kepler was at full health, Borucki claimed that it was the greatest unmanned mission NASA has ever flown. That’s up for debate — fans of the Hubble Space Telescope can make a strong case — but there’s no question that Kepler has changed the way scientists view the galaxy. Statistical calculations based on Kepler data suggest that the Milky Way contains hundreds of billions of planets. And in April NASA approved the Transiting Exoplanet Survey Satellite mission, due for launch in 2017, to find the nearest ones to Earth.

Below absolute zero, but hot
Lab trickery achieves negative temperature
By Andrew Grant

Ulrich Schneider must be a hit at cocktail parties. The physicist at Ludwig Maximilians University of Munich can tell awed guests that he is responsible for creating both the world’s hottest substance and lowest temperature — at the same time.

Schneider’s substance — a gas consisting of about 100,000 potassium atoms — reached a temperature below absolute zero, about –0.000000001 kelvins.

Unlike Fahrenheit and Celsius temperatures, where the zero point is arbitrary, absolute temperature (measured in kelvins) supposedly can go no lower than zero. And in fact, nothing can get colder than absolute zero. But a negative absolute temperature, though technically below zero, is actually infinitely hot.

That’s because a positive or negative sign on the kelvin scale describes the energy distribution of a substance’s particles. Usually, most particles within a system have relatively low energies; only a few occupy the highest rungs of the energy range. In such situations temperature is always positive.

Schneider and colleagues reversed that distribution in their gas of potassium atoms. They used lasers and magnets to confine the atoms to a narrow band of energies. At first, most of the atoms possessed energies at the lower end of that band. But by altering the lasers and magnetic field, the researchers flipped the atoms’ energy distribution. Suddenly most of the atoms were at the upper limit of the allowed energy. In that situation the gas had a negative temperature (SN: 2/9/13, p. 10).

At the same time, the gas was hotter than any substance with a positive temperature. Because of the glut of high-energy atoms, heat would flow from the gas to any substance with a positive temperature. And heat always flows from hotter to colder, by decree of the laws of thermodynamics.

Schneider’s experiment offers scientists the rare opportunity to study a system that gets more orderly with increasing energy — adding energy causes more atoms to cluster at the high-energy limit. The researchers also noted that the potassium atoms, which should have collapsed toward each other, remained stable at negative temperatures. This repulsion might provide insight into dark energy, the mysterious component of the universe that counteracts gravitational attraction and causes the cosmos to expand at an accelerating rate.
DSM-5’s controversial debut
Diagnostic manual updates disorder criteria
By Bruce Bower

When the American Psychiatric Association released the fifth edition of its Diagnostic and Statistical Manual of Mental Disorders in May, big changes had already begun in the controversial business of defining mental disorders.

Psychiatrists involved in DSM-5 had hoped to link mental ailments, from schizophrenia to depression, to specific biological markers. But scientists failed to find such markers. So the psychiatric manual set out roughly 300 disorders that were ratified, as in previous editions, by consensus in groups of clinicians and researchers (SN: 6/29/13, p. 5).

Some DSM-5 adjustments provoked controversy. In particular, a tightened definition of autism and related conditions raised fears that some children would mistakenly go undiagnosed and be denied special school services. An allowance for classifying severe mourning as major depression was criticized for turning normal grief into an illness.

Still, DSM-5’s revisions were restrained compared with some planned for the World Health Organization’s upcoming 11th edition of the International Classification of Diseases. WHO’s diagnostic manual will simplify the current definition of post-traumatic stress disorder and add a severe form of the condition triggered by long-lasting or frequent distressing experiences. Those changes are aimed at improving the ability of mental health workers — especially the growing number of nonprofessional psychotherapists outside the United States — to treat victims of conflict and natural disasters.

Meanwhile, the U.S. National Institute of Mental Health has launched a 10-year effort to redefine mental disorders based on behavioral and brain findings. Dubbed the Research Domain Criteria, or RDoC, this federal program reflects researchers’ exasperation with imprecise DSM-5 diagnoses. RDoC intends to illuminate different underlying problems presumably afflicting people with the same DSM-5 ailments.

Psychiatrists had similar aspirations for DSM-5. If they’re lucky, DSM-6 won’t need to mention anything about Diagnostic Overreach Disorder.

DSM-5 eliminates subtypes such as paranoid and catatonic from the schizophrenia definition, replaces gender identity disorder with gender dysphoria, and adds several new disorders, including premenstrual dysphoric disorder, hoarding disorder, gambling disorder and excoriation disorder, in which people compulsively pick at themselves.

Obama unveils brain initiative
Project to seek secrets of thinking, learning
By Laura Sanders

A proposal to accelerate brain research may someday mark 2013 as the dawn of a golden era in neuroscience. In April, President Obama announced an ambitious plan to reveal the human brain’s secrets (SN: 5/4/13, p. 22).

“There is this enormous mystery waiting to be unlocked,” Obama said in a speech, “and the BRAIN Initiative will change that by giving scientists the tools they need to get a dynamic picture of the brain in action and better understand how we think and how we learn and how we remember.”

The effort will be funded by the U.S. National Institutes of Health, the Defense Advanced Research Projects Agency and the National Science Foundation, along with a host of private foundations and companies.

Scientists and policy experts are still skirishing over the focus and scope of the BRAIN Initiative, but some details are emerging. After a series of meetings with scientists around the country, a panel of neuroscientists settled on nine preliminary research priorities, ranging in scope from individual nerve cells to the entire brain (SN Online: 9/18/13).

The BRAIN Initiative will also fund scientists who develop new techniques to illuminate the coordinated behavior of large groups of nerve cells. Projects focusing on these initial nine priorities, which were approved by the NIH on September 16, are anticipated to receive $40 million of NIH funding in fiscal year 2014.

And the United States–based BRAIN initiative is not alone. On January 28, the European Commission awarded 1 billion euros to the Human Brain Project, an effort by 130 research institutes to develop the most precise model of the human brain yet.
Methane shortage on Mars
Trace of gas not enough to be sign of life

By Erin Wayman

After months of searching, the NASA rover Curiosity detected no appreciable methane in Mars’ atmosphere, disappointing scientists who had hoped to find a strong sign of life on the Red Planet.

On Earth, microbes have churned out as much as 95 percent of all atmospheric methane, so finding that gas in Mars’ air would have been solid circumstantial evidence of life. Instead, the rover measured no more than a trace of methane, with an average concentration of a mere 0.18 parts per billion (SN: 10/19/13, p. 7).

Many planetary scientists had expected that Curiosity would catch a whiff of methane. Over the last decade, researchers have measured fluctuating methane levels on Mars using Earth-based instruments and spacecraft. Some scientists have proposed that microbes buried beneath the planet’s frozen ground produced the gas, which could have been unleashed during a seasonal thaw and then somehow quickly removed from the atmosphere. With more time, Curiosity might still discover such a methane release, says Michael Mumma of NASA’s Goddard Spaceflight Center in Greenbelt, Md., who is not a member of the Curiosity team.

But even if such a discovery never happens, that wouldn’t necessarily mean that Mars is barren. Microorganisms that don’t generate methane might dwell on Mars, and the planet might have hosted now-extinct life at some time in the past. In March, NASA announced that Curiosity had uncovered evidence of an ancient, hospitable aquatic environment, home to energy-rich minerals that could have fueled life-forms (SN Online: 3/12/13). Those hospitable conditions lasted millions of years and ended as recently as 3.5 billion years ago, researchers reported in December (SN Online: 12/9/13).

Although the findings are enticing, the rover has yet to find organic compounds, the building blocks of life. □

The concentration of methane in the Martian atmosphere measured by the rover Curiosity is one ten-thousandth that on Earth. High levels of methane on Mars would have been a compelling indication of life there.

0.18 parts per billion
Atmospheric methane concentration on Mars

1,800 parts per billion
Atmospheric methane concentration on Earth
Canine genealogy
Competing clues confuse story of dog domestication

By Meghan Rosen

The ancient lineage of man’s best friend is kind of a tangled mess. But scientists made some progress this year in identifying dogs’ ancestors and in estimating the timeline of canine domestication.

Dogs may have descended from a now-extinct wolf species, Adam Freedman of Harvard and colleagues reported in June (SN: 7/13/13, p. 14). They date dog domestication to between 11,000 and 16,000 years ago, before the rise of agriculture.

But not all the new clues tell the same story. Archaeologists have unearthed fossils from doglike animals in both Europe and Siberia that date to more than 30,000 years ago. And in November, Olaf Thalmann of the University of Turku in Finland and colleagues used DNA from the fossils to trace domestic dogs’ origins to Europe between 18,000 and 32,000 years ago (SN: 12/14/13, p. 6).

In January, though, a team analyzing canine genes proposed that dogs became domesticated about 10,000 years ago. Other geneticists examining dog and wolf DNA have placed dogs’ origin in both the Middle East and East Asia.

Freedman’s work relies on genetic evidence from an Australian dingo, a Basenji, a golden jackal and wolves from Croatia, Israel and China — regions where experts have proposed that domestication occurred. The new data all but rule out modern-day wolves as dogs’ ancestors. Still, the location and timing of dogs’ domestication remain uncertain.

Because Freedman’s and Thalmann’s studies tap into a bigger pool of genetic data than previous work, though, their findings may offer better tools for scientists trying to untangle dogs’ lineage.

Dark energy gets more confusing
New data raise prospect of ‘Big Rip’ destroying cosmos

By Gabriel Popkin

New measurements of light from distant exploding stars were supposed to illuminate the dark energy that is pushing the cosmos apart. Instead they have further shrouded the universe’s fate.

Dark energy first made headlines in 1998, when researchers found that light from faraway supernovas was dimmer than expected, suggesting that the universe is expanding at a faster and faster pace. To explain this acceleration, scientists surmised the existence of dark energy, which pushes space outward (SN: 4/7/01, p. 218). Most physicists suspect that dark energy is a form of vacuum energy known as the “cosmological constant” because its strength never varies. If so, a number called $w$, which relates the pressure pushing space apart to the density of dark energy, must equal $-1$.

But this year, scientists using a powerful new telescope in Hawaii, part of a project called Pan-STARRS, arrived at a different value for $w$. By combining the supernova data with previous results from other studies, the researchers calculated $w$ to be $-1.186$.

This value, if confirmed, would force cosmologists to pursue more complicated theories in which dark energy’s strength increases over time. If it does, the universe might ultimately be torn apart in what scientists call the Big Rip (SN: 11/30/13, p. 8).

So far, though, nobody is writing off the cosmological constant. The researchers say they and other groups must first look for sources of measurement error, starting with the telescopes they use to study far-off parts of the universe. Even slight discrepancies in how telescopes gather starlight that has traveled billions of light-years can introduce sizable differences in the data the instruments collect.

In two years, when cosmologists have more precisely calibrated their instruments and analyzed more data, they may know whether the cosmological constant needs to be scrapped. For now, says study coleader Armin Rest of the Space Telescope Science Institute in Baltimore, “My hunch is that $w$ is $-1$."

Genetic analyses of various populations of living wolves from around the world suggest that modern dogs descend from a species of wolf that is now extinct.
20 Slain king’s bones dug up
Richard III’s skeleton reveals fatal wounds
By Rachel Ehrenberg

It was reported 528 years late, but the top news from 1485 seems to be that King Richard III may have been killed by a blade thrust upward into his skull or an axe-whack to the back of his head.

Researchers at the University of Leicester in England performed the autopsy on the slain king after an excavation in one of the city’s parking lots unearthed parts of Grey Friars Church, where he was buried. A genetic analysis confirmed the skeleton’s identity; a descendant on the king’s mother’s side possesses mitochondrial DNA matching the victim’s (SN: 3/9/13, p. 14).

Forensic details revealed by the skeleton generally conformed to the historical record. The well-preserved skeleton showed Richard to be a slight man with scoliosis — his spine curved like a question mark — though he wasn’t quite “the foul bunch-back’d toad” that Shakespeare described. Richard’s scoliosis would have reduced his height and caused one shoulder to stand higher than the other.

Richard’s violent death occurred at the Battle of Bosworth on August 22, 1485. A few days later he was dumped into a hastily dug grave at the church in Leicester. The position of the skeleton’s hands indicates they were tied at burial. The researchers discovered 10 wounds, several apparently inflicted after death.

Two of the wounds had the potential to be fatal. One gaping wound in the back of his head may have been from an axelike bladed pole known as a halberd. The other was caused by a blade that penetrated the skull at the base.

21 Progress made toward twin prime proof
Surprising advance sparks flurry of work on mathematical conjecture
By Dana Mackenzie

Some pan for gold, some pan for prime numbers. Yitang “Tom” Zhang may have found both.

Zhang, a mathematician at the University of New Hampshire, stunned the mathematical world in May when he reported a major step toward solving one of the oldest outstanding problems in number theory, called the twin prime conjecture (SN: 10/19/13, p. 38).

For more than 100 years, mathematicians have known that prime numbers — such as 7 or 17, with no divisors except for themselves and 1 — get sparser and sparser as the numbers get larger. They are like flecks of gold in a stream that is gradually running out of gold.

Nevertheless, mathematicians believe you can always find two prime “gold nuggets” in the same pan no matter how far downstream you go. If the separation between the primes is 2, they are called twin primes. Examples are 17 and 19, or 1,607 and 1,609. The twin prime...
22Visitor from the Oort cloud
Comet ISON meets demise in solar flyby
By Gabriel Popkin

Comet ISON was an ordinary-sized comet with an extraordinary story. It started out millions of years ago in the faraway Oort cloud (SN: 10/19/13, p. 19), where remnants of the early solar system hang out in deep freeze. A passing star may have given one of these remnants a nudge, launching it on a journey that would bring it to within 1.2 million kilometers of the sun in 2013.

Two astronomers with the International Science Optical Network discovered the remnant in September 2012, while it was still outside Jupiter’s orbit. Scientists quickly realized that ISON would be the first known Oort cloud object to pass near the sun. The sun’s light and heat would vaporize this fossil of the primordial solar system layer by layer, in full view of the world’s most powerful telescopes.

From early observations, scientists learned that ISON was already throwing off lots of dust and ice. This finding further confirmed that ISON was on its first trip to the inner solar system; a regular visitor like Halley’s comet would have lost its surface ice long ago (SN:11/16/13, p. 14).

But the real spectacle came around Thanksgiving. As ISON rounded the sun, solar observatories got a close look at the comet. By December 3, most astronomers agreed that ISON had lost its nucleus, and all that remained of the comet was dust.

Though initial forecasts that ISON would outshine the full moon went unfulfilled, the combination of the comet’s unique trajectory, its early discovery and today’s sophisticated telescopes made ISON one of history’s most studied comets.

The year in genomes
Scientists continue to decode the genetic blueprints of the planet’s myriad flora and fauna — both alive and long dead — shedding light on biology, evolution and disease. Highlights from 2013 include:

1. Comb jellies A genomic analysis of comb jellies confirmed that the squishy marine predators are the new oldest animals, bumping the much simpler sea sponges from the base of the animal evolutionary tree (SN: 5/18/13, p. 20).

2. Ancient horse The oldest genome yet sequenced came from a horse’s foot bone dating to between 780,000 and 560,000 years ago that was excavated in Canada’s Yukon. The feat revealed that horse ancestors originated 2 million years earlier than previously thought (SN: 7/27/13, p. 5).

3. Big cats Genome sequencing of a Siberian tiger, Bengal tiger, African lion, white African lion and snow leopard identified genes behind the carnivores’ ferocious metabolism and powerful pouncing skills (SN: 10/19/13, p. 6).

4. Duck The mallard duck genome gave researchers clues about how flu viruses that can infect humans develop in waterfowl.

5. Spruce With nearly seven times the DNA of the human genome, the Norway spruce tree has the largest genome yet decoded (SN Online: 5/22/13).

6. Coelacanth The prehistoric-looking, lobe-finned fish’s genome revealed that it is not the closest living relative to land-traversing tetrapods — lungfish take that title (SN: 5/18/13, p. 18).

—Beth Mole

www.sciencenews.org | December 28, 2013 33
For a few weeks in 2013, a chorus of headlines about the raucous reproduction of periodical cicadas just about drowned out the real cicada news.

This was the year for a cohort of big, reckless, ruby-eyed bugs to break out of the soil for their first and only chance to mate after 17 years of sucking plant roots in the dark. Synchronized generations of three *Magicicada* species designated as Brood II reliably emerge every 17 years in a swath of the U.S. East Coast from the southern Appalachians to New York (SN: 7/13/13, p. 26).

In just about any year, one of the 15 numbered *Magicicada* broods emerges somewhere. But Brood II is big and pops out in cities with major news outlets. The 2013 breakout would have been really big science news only if it hadn’t happened.

Still, a synchronized emergence of *Magicicada* species is one of the great spectacles of nature. These are not the annual or dog-day cicada species, which appear each year in late summer. Out of several thousand cicada species on the planet, only the seven kinds of *Magicicada*, which live just in the eastern and central United States, make their loud, synchronized appearances at 13- or 17-year intervals. Broods don’t overlap much in any particular grove of trees. So a chance to experience the surging chorus of a particular backyard’s periodical cicadas comes only a few times in a human life.

What actual scientific cicada news there was in 2013 didn’t get much media attention. Chris Simon of the University of Connecticut in Storrs and colleagues pooled DNA data collected during 30 years to create a bizarre but beautiful genealogical tree of *Magicicada*’s evolutionary history.

It’s a long, strange story, almost musical in the way patterns echo each other in independent branches. One example: Roughly 4 million years ago, *Magicicada* ancestors started splitting into three distinctive forms (Decim, Cassini and Decula), the researchers reported in April. Then each of these groups split into both 17-year and 13-year forms.

Brood II, like most other broods, mixes splinter populations of all three original groups, even though they don’t breed with each other. It’s evolutionary weirdness that the well-trained ear can hear. Cassini-type males rev like electric carving knives. Deculas cough out rasps. Decims whistle-drone like B-movie spaceships. Anyone who missed the distinction this time can hear it all again in 2030. 

### Gift of steroids keeps on giving

Mouse muscles stay juiced long after doping ends

By Tina Hesman Saey

Once a cheater, always a cheater, a mouse study found—at least when it comes to steroids. The result, reported in October, strongly implies that anabolic steroids like testosterone give doping athletes a competitive advantage for years—perhaps even decades—after they stop taking the drugs. If antidoping agencies were to revise steroid bans based on the results, those caught cheating might effectively face lifetime

### Meteorite makes an impact

Space rock fires a warning shot

By Andrew Grant

This meteorite, weighing more than 570 kilograms, was recovered from a Russian lake in October.
In the experiment, female mice dosed with testosterone bulked up their muscles considerably. Along with increasing the size of muscle fibers, the steroid-treated animals boosted the number of nuclei in their muscle cells by up to 66 percent, Kristian Gundersen of the University of Oslo and colleagues reported October 28 in the Journal of Physiology (SN: 11/30/13, p. 7). Nuclei, which skeletal muscle cells naturally possess multiple copies of, store the bulk of a cell's genetic information. More nuclei make it possible to build more of the proteins that give muscle fibers their strength.

When the drugs were stopped, steroid-pumped mouse muscles shrank back to normal size. But they didn’t lose the extra nuclei, Gundersen’s team found. Three months later (which translates to about a decade of human life span) the muscle fibers were still hanging on to their ill-gotten nuclei. And the former dopers’ muscles bulked up 31 percent with six days of exercise. The same regimen added about 6 percent of muscle mass in mice that never got steroids.

There is currently no way to safely and ethically conduct a comparable study in people. But human and mouse muscles probably react similarly to steroids. “The implication,” says Lawrence Schwartz, a cell biologist at the University of Massachusetts Amherst, “is once you have these nuclei, you never lose them.”

When a known asteroid passed within 28,000 kilometers of Earth on February 15, astronomers hoped it would serve as a wake-up call about the danger of meteorite impacts. As it turned out, astronomers got more than they had bargained for. On that same day, a 19-meter-wide space rock plowed through the atmosphere and exploded over southwestern Russia near Chelyabinsk, shattering windows and causing more than 1,600 injuries. The largest recorded meteor since 1908 spurred scientists and government officials to reevaluate impact risks and increase monitoring and preparation for future events.

In November, researchers led by planetary scientist Peter Brown of Canada’s University of Western Ontario analyzed the last two decades of impact data and concluded that rocks the size of the one responsible for the Russian meteor probably strike Earth once every 30 years or so (SN: 11/30/13, p. 6). The previous estimate, based on ground-based telescope surveys that count up nearby space rocks of various sizes, was once every 120 years. Ground-based telescopes can spot giant, civilization-threatening asteroids in Earth’s orbital neighborhood but identify only a tiny fraction of rocks tens of meters wide.

Scientists hope a series of new ventures will increase their understanding of impact threats. In August, NASA announced that it would revive a decommissioned space probe, the Wide-field Infrared Survey Explorer, to conduct a three-year survey of near-Earth objects. Meanwhile, the private B612 Foundation plans to launch a telescope by 2017 that would spot nearby asteroids as small as 30 meters across. And in October the United Nations approved an International Asteroid Warning Network to keep a census of potentially dangerous rocks and a Space Missions Planning Advisory group to consider ways to deflect an incoming asteroid.