

SCIENCE NEWS

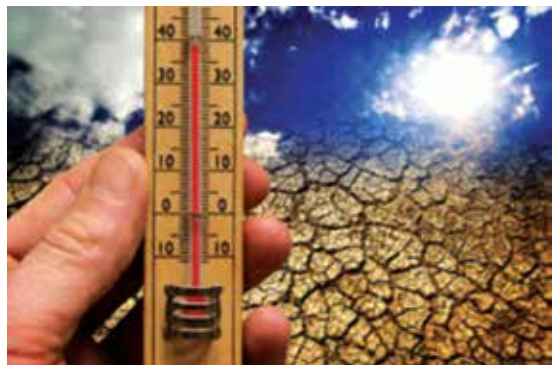


Human Influence on Climate Clear, IPCC Report Says

Human influence on the climate system is clear. This is evident in most regions of the globe, a new assessment by the Intergovernmental Panel on Climate Change (IPCC) concludes.

It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. The evidence for this has grown thanks to more and better observations, an improved understanding of the climate system response and improved climate models.

Warming in the climate system is unequivocal and since 1950 many changes have been observed throughout the climate system that are unprecedented over decades to millennia. Each of the last three decades has been successively warmer at Earth's surface than any preceding decade since 1850, reports the Summary for Policymakers of the IPCC Working Group I assessment report, *Climate Change 2013: The Physical Science Basis*, approved by



A new assessment by the IPCC finds that warming in Earth's climate system is unequivocal and since 1950 many changes have been observed throughout the climate system that are unprecedented over decades to millennia. Each of the last three decades has been successively warmer at Earth's surface than any preceding decade since 1850. (Credit: © Meryll / Fotolia)

member-governments of the IPCC in Stockholm, Sweden.

"Observations of changes in the climate system are based on multiple lines of independent evidence. Our assessment of the Science finds that the atmosphere and ocean have warmed, the amount of snow and ice has diminished, the global mean sea level has risen and the

concentrations of greenhouse gases have increased," said Qin Dahe, Co-Chair of IPCC Working Group I.

Thomas Stocker, the other Co-Chair of Working Group I said: "Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions."

"Global surface temperature change for the end of the 21st century is projected to be likely to exceed 1.5°C relative to 1850 to 1900 in all but the lowest scenario considered, and likely to exceed 2°C for the two high scenarios," said Co-Chair Thomas Stocker. "Heat waves are very likely to occur more frequently and last longer. As Earth warms, we expect to see currently wet regions receiving more rainfall, and dry regions receiving less, although there will be exceptions," he added.

Projections of climate change are based on a new set of four scenarios of future greenhouse gas concentrations and aerosols, spanning a wide range of possible futures. The Working Group I report assessed global and regional-scale climate change for the early, mid- and late 21st century.

"As the ocean warms, and glaciers and ice sheets reduce, global mean sea level will continue to rise, but at a faster rate than we have experienced over the past 40 years," said Co-Chair Qin Dahe. The report finds with high confidence that ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 per cent of the energy accumulated between 1971 and 2010.

Co-Chair Thomas Stocker concluded: "As a result of our past, present and expected future

emissions of CO₂, we are committed to climate change, and effects will persist for many centuries even if emissions of CO₂ stop."

Rajendra Pachauri, Chair of the IPCC, said: "This Working Group I Summary for Policymakers provides important insights into the scientific basis of climate change. It provides a firm foundation for considerations of the impacts of climate change on human and natural systems and ways to meet the challenge of climate change." These are among the aspects assessed in the contributions of Working Group II and Working Group III to be released in March and April 2014. The IPCC Fifth Assessment Report cycle concludes with the publication of its Synthesis Report in October 2014.

"I would like to thank the Co-Chairs of Working Group I and the hundreds of scientists and experts who served as authors and review editors for producing a comprehensive and scientifically robust summary. I also express my thanks to the more than one thousand expert reviewers worldwide for contributing their expertise in preparation of this assessment," said IPCC Chair Pachauri.

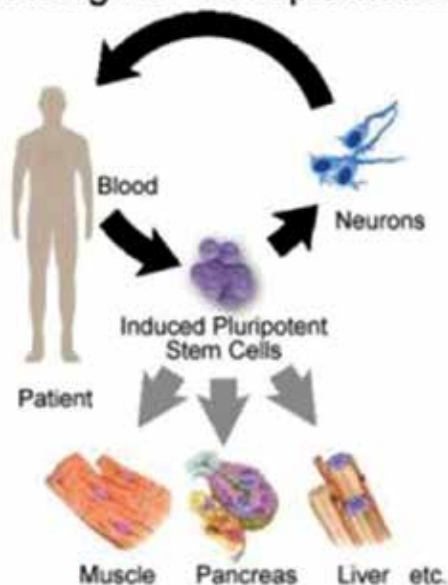
Patient's Own Cells Might be Used as Treatment for Parkinson's Disease

Induced pluripotent stem cells (iPSCs) taken from a patient hold great therapeutic potential for many diseases. However, studies in rodents have suggested that the body may mount an immune response and destroy cells derived from iPSCs. New research in monkeys refutes these findings, suggesting that in primates like us, such cells will not be rejected by the immune system. In the paper published in *Stem Cell Reports*, iPSCs from non-human primates successfully developed into the neurons

depleted by Parkinson's disease while eliciting only a minimal immune response. The cells therefore could hold promise for successful transplantation in humans.

iPSCs are cells that have been genetically reprogrammed to an embryonic stem-cell-like state, meaning that they can differentiate into virtually any of the body's different cell types. iPSCs directed to differentiate into specific cell types offer the possibility of a renewable source of replacement cells and tissues to treat ailments, including Parkinson's disease, spinal cord injury, heart disease, diabetes and arthritis.

Autologous Transplantation



This illustration shows the image of autotransplantation. The paper shows evidence only for neural cells and the brain, not for other organs. Immunogenicity in other organs needs to be explored. (Credit: *Stem Cell Reports*, Morizane et al.)

Studies in rodents have suggested that iPSC-derived cells used for transplantation may be rejected by the body's immune system. To test this in an animal that is more closely related to humans, investigators in Japan directed iPSCs taken from a monkey to develop into certain neurons that are depleted in Parkinson's disease patients. When they were injected into the same monkey's brain (called an autologous transplantation), the neurons elicited only a minimal immune response. In contrast, injections of the cells into immunologically unmatched recipients (called an allogeneic transplantation) caused the body to mount a stronger immune response.

"These findings give a rationale to start autologous transplantation — at least of neural cells — in clinical situations," says senior author Dr Jun Takahashi, of the Kyoto University's Center for iPS Cell Research and Application. The team's work also suggests that transplantation of such neurons into immunologically matched recipients may be possible with minimal use of immunosuppressive drugs.

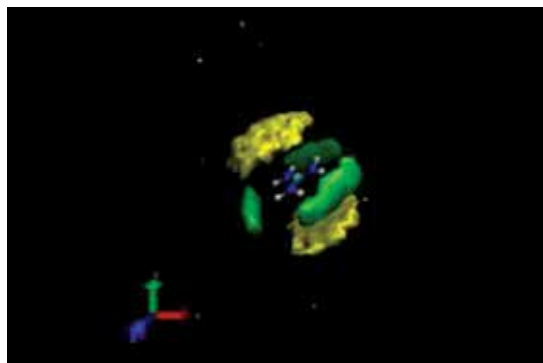
In Water as in Love, Likes Can Attract

At some point in elementary school, you were shown that opposite charges attract and like charges repel. This is a universal scientific truth — except when it isn't. A research team led by Berkeley Lab chemist Richard Saykally and theorist David Prendergast, working at the Advanced Light Source (ALS), has shown that, when hydrated in water, positively charged ions (cations) can actually pair up with one another.

"Through a combination of X-ray spectroscopy, liquid microjets and first principles" theory,

we have observed and characterised contact pairing between guanidinium cations in aqueous solution," Saykally says. "Theorists have predicted this cation-to-cation pairing but it has never been definitively observed before. If guanidinium cations can pair this way, then other similar cation systems probably can too."

Guanidinium is an ionic compound of hydrogen, nitrogen and carbon atoms whose salt — guanidinium chloride — is widely used by scientists to denature proteins for protein-folding studies. This practice dates back to the late 19th century when the Czech scientist Franz Hofmeister observed that cations such as guanidinium can pair with anions (negatively charged ions) in proteins to cause them to precipitate. The Hofmeister effect, which ranks ions on their ability to 'salt-out' proteins, became a staple of protein research even though its mechanism has never been fully understood.



This model of the guanidinium chloride salt (blue and silver) in solution shows carbon (yellow) and water (green) surrounding the cations and demonstrates cation-cation pairing. (Credit: Image courtesy of DOE/Lawrence Berkeley National Laboratory)

In 2006, Kim Collins of the University of Maryland proposed a 'Law of Matching Water Affinities' to help explain 'Hofmeister effects.' Collins' proposal holds that the tendency of

a cation and anion to form a contact pair is governed by how closely their hydration energies match, meaning how strongly the ions hold onto molecules of water. Saykally, who is a faculty scientist in Berkeley Lab's Chemical Sciences Division and a professor of Chemistry at the University of California Berkeley, devised a means of studying both the Law of Matching Water Affinities and Hofmeister effects. In 2000, he and his group incorporated liquid microjet technology into the high-vacuum experimental environment of ALS beamlines and used the combination to perform the first X-ray absorption spectroscopy measurements on liquid samples. This technique has since become a widely used research practice.

"The XAS spectrum is generally sensitive to the changes in the local solvation environment around each atom, including potential effects of ion-pairing," Saykally says. "However, the chemical information that one can extract from such experimental data alone is limited, so we interpret our spectra with a combination of molecular dynamics simulations and a first principles theory method."

Development of this first principles theory method was led by Prendergast, a staff scientist in the Theory of Nanostructures Facility at Berkeley Lab's Molecular Foundry. Computational resources were provided by the National Energy Research Scientific Computing Center (NERSC). The Molecular Foundry and NERSC, as well as the ALS, are all U.S. Department of Energy national user facilities hosted at Berkeley Lab.

With the liquid microjet technology, a sample rapidly flows through a fused silica capillary shaped to a finely tipped nozzle with an opening only a few micrometers in diameter. The resulting liquid beam travels a few centimetres in a vacuum chamber and is intersected by an X-ray beam then collected and condensed out. In analysing their current results, which

were obtained at ALS Beamline 8.0.1, the Berkeley Lab researchers concluded that the counterintuitive cation–cation pairing observed is driven by water-binding energy, as predicted by theory.

Orion Shih, a recent graduate of Saykally's research group, is the lead author of a paper describing this study in the *Journal of Chemical Physics*. The paper is titled 'Cation–cation contact pairing in water: Guanidinium'. Saykally is the corresponding author. Other co-authors are Alice England, Gregory Dallinger, Jacob Smith, Kaitlin Duffey, Ronald Cohen and Prendergast.

"We found that the guanidinium ions form strong donor hydrogen bonds in the plane of the molecule, but weak acceptor hydrogen bonds with the pi electrons orthogonal to the plane," Shih says. "When fluctuations bring the solvated ions near each other, the van der Waals attraction between the pi electron clouds squeezes out the weakly held water molecules, which move into the bulk solution and form much stronger hydrogen bonds with other water molecules. This release of the weakly interacting water molecules results in contact pairing between the guanidinium cations. We believe our observations may set a general precedent in which like charges attract becomes a new paradigm for aqueous solutions."

Are Nanodiamond-Encrusted Teeth the Future of Dental Implants?

UCLA researchers have discovered that diamonds on a much, much smaller scale than those used in jewellery could be used to promote bone growth and the durability of dental implants.

Nanodiamonds, which are created as byproducts of conventional mining and refining operations,

are approximately four to five nanometers in diameter and are shaped like tiny soccer balls. Scientists from the UCLA School of Dentistry, the UCLA Department of Bioengineering and Northwestern University, along with collaborators at the NanoCarbon Research Institute in Japan, may have found a way to use them to improve bone growth and combat osteonecrosis, a potentially debilitating disease in which bones break down due to reduced blood flow.



Nanodiamonds. (Credit: Courtesy of UCLA School of Dentistry)

When osteonecrosis affects the jaw, it can prevent people from eating and speaking; when it occurs near joints, it can restrict or preclude movement. Bone loss also occurs next to implants such as prosthetic joints or teeth, which leads to the implants becoming loose or failing.

The implant failures necessitate additional procedures, which can be painful and expensive, and can jeopardize the function the patient had gained with an implant. These challenges are exacerbated when the disease occurs in the mouth, where there is a limited supply of local bone that can be used to secure the prosthetic tooth, a key consideration for both functional and aesthetic reasons.

The study, led by Dr Dean Ho, professor of oral biology and medicine and co-director of the Jane and Jerry Weintraub Center for Reconstructive Biotechnology at the UCLA School of Dentistry, appears online in the peer-reviewed *Journal of Dental Research*.

During bone repair operations, which are typically costly and time-consuming, doctors insert a sponge through invasive surgery to locally administer proteins that promote bone growth, such as bone morphogenetic protein.

Ho's team discovered that using nanodiamonds to deliver these proteins has the potential to be more effective than the conventional approaches. The study found that nanodiamonds, which are invisible to the human eye, bind rapidly to both bone morphogenetic protein and fibroblast growth factor, demonstrating that the proteins can be simultaneously delivered using one vehicle. The unique surface of the diamonds allows the proteins to be delivered more slowly, which may allow the affected area to be treated for a longer period of time. Furthermore, the nanodiamonds can be administered non-invasively, such as by an injection or an oral rinse.

"We've conducted several comprehensive studies, in both cells and animal models, looking at the safety of the nanodiamond particles," said Laura Moore, the first author of the study and an M.D., Ph.D. student at Northwestern University under the mentorship of Dr Ho. "Initial studies indicate that they are well tolerated, which further increases their potential in dental and bone repair applications."

"Nanodiamonds are versatile platforms," said Ho, who is also professor of bioengineering and a member of the Jonsson Comprehensive Cancer Center and the California NanoSystems

Institute. "Because they are useful for delivering such a broad range of therapies, nanodiamonds have the potential to impact several other facets of oral, maxillofacial and orthopedic surgery, as well as regenerative medicine."

Ho's team previously showed that nanodiamonds in preclinical models were effective at treating multiple forms of cancer. Because osteonecrosis can be a side effect of chemotherapy, the group decided to examine whether nanodiamonds might help treat the bone loss as well. Results from the new study could open the door for this versatile material to be used to address multiple challenges in drug delivery, regenerative medicine and other fields.

"This discovery serves as a foundation for the future of nanotechnology in dentistry, orthopedics and other domains in medicine," said Dr No-Hee Park, dean of the School of Dentistry. "Dr Ho and his team have demonstrated the enormous potential of the nanodiamonds toward improving patient care. He is a pioneer in his field."

Other authors of the study were Professor Eiji Osawa of the NanoCarbon Research Institute in Japan, and Ho-Joong Kim, a postdoctoral research scholar who was previously in Dr Ho's laboratory and is currently an assistant professor of chemistry at Chosun University in South Korea.

Harnessing the Sun's Energy with Tiny Particles

Engineers at Sandia National Laboratories, along with partner-institutions Georgia Tech, Bucknell University, King Saud University and the German Aerospace Center (DLR), are using a falling particle receiver to more efficiently convert the Sun's energy into electricity in large-scale, concentrating solar power plants.



Joshua Mark Christian working with the falling particle receiver, which more efficiently converts the Sun's energy into electricity in large-scale, concentrating solar power plants. (Credit: Randy Montoya)

Falling particle receiver technology is attractive because it can cost-effectively capture and store heat at higher temperatures without breaking down, which is an issue for conventional molten salts. The falling particle receiver developed at Sandia drops sand-like ceramic particles through a beam of concentrated sunlight, and captures and stores the heated particles in an insulated container below. The technique enables operating temperatures of nearly 1,000 degrees Celsius. Such high temperatures translate into greater availability of energy and cheaper storage costs because at higher temperatures, less heat-transfer material is needed.

Central receiver systems use mirrors to concentrate sunlight on a target, typically a fluid, to generate heat, which powers a turbine and generator to produce electricity. Currently, such systems offer about 40 per cent thermal-to-electric efficiency. The falling particle receiver enables higher temperatures and can work with higher-temperature power cycles that can achieve efficiencies of 50 per cent or more.

"Our goal is to develop a prototype falling particle receiver to demonstrate the potential for greater than 90 per cent thermal efficiency, achieve particle temperatures of at least 700 degrees Celsius, and be cost competitive," said the project's principal investigator, Sandia engineer Cliff Ho. "The combination of these factors would dramatically improve the system performance and lower the cost of energy storage for large-scale electricity production."

The project is funded up to \$4 million by the Department of Energy's SunShot Initiative, which aims to drive down solar energy production costs and pave the way to widespread use of concentrating solar power and photovoltaics.

Falling particle receiver technology was originally studied in the 1980s, and Sandia researchers are working to address challenges that hindered greater acceptance of the concept. Among the issues are mitigating particle loss, maintaining the stability of falling particles, increasing the residence time of the particles in the concentrated beam and reducing heat losses within the receiver cavity.

Ho and his colleagues at Sandia have been working to address these issues by studying the effect of an added air curtain, created by a series of blower nozzles, to help particles fall in a stable pattern and reduce convective losses. Adjusting the particle size and how sand is dropped has also helped, ensuring more of the sand gets heated in a pass and makes it to the collection bin at the bottom. Researchers are also investigating the benefits of using an elevator to recirculate particles through the aperture a second time to increase their temperature.

"Given our unique facilities at the National Solar Thermal Test Facility, we have the capability

of developing prototype hardware and testing the concepts we've simulated, which include innovations such as air recirculation and particle recirculation. Advanced computing lets us do complex simulations of the falling particle receiver to understand the critical processes and behaviour," Ho said. "We're very encouraged by our progress and look forward to further developing this enabling technology."

Falling particle receiver technology is expected to lead to power-tower systems capable of generating up to 100 megawatts of electricity.

Snake Robot on Mars?

The ESA wants its operations on other planets to have greater mobility and manoeuvrability. SINTEF researchers are looking into whether snake robots could be the answer.

So far, NASA has landed four rovers on Mars. These are solar-powered robots with six wheels and robotic arms that can take soil samples and operate cameras. Sojourner landed in 1997, Spirit and Opportunity in 2003, while the more advanced Curiosity was landed in 2012. "Manoeuvrability is a challenge. The Spirit rover was lost after it became stuck in the sand on Mars. The vehicles just cannot get to many of the places from which samples have to be taken," say Pål Liljebäck and Aksel Transeth at SINTEF ICT.

The researchers are busy working on a feasibility study assigned to them by the ESA. The ESA and the researchers believe that by combining a rover that can navigate over large distances with a snake robot that can crawl along the ground and can get into inaccessible places, so many more possibilities could be opened up.

At the moment, soil samples from Mars are analysed on board the rover itself, and the results are communicated back to Earth.



The researchers envisage using the rover to navigate over large distances, after which the snake robot can detach itself and crawl into tight, inaccessible areas. (Credit: Image courtesy of SINTEF)

However, the ESA also wants to examine options that could allow samples to be returned to Earth. Snake robots could assist with collecting such samples, since they enable access to tight spots that the rovers cannot reach.

An Arm becomes a Snake Robot

"We are looking at several alternatives to enable a rover and a robot to work together. Since the rover has a powerful energy source, it can provide the snake robot with power through a cable extending between the rover and the robot. If the robot had to use its own batteries, it would run out of power and we would lose it," explains Aksel Transeth.

"One option is to make the robot into one of the vehicle's arms, with the ability to disconnect and reconnect itself, so that it can be lowered to the Paraground, where it can crawl about independently."

The researchers envisage using the rover to navigate over large distances, after which the snake robot can detach itself and crawl into tight, inaccessible areas. A cable will connect the robot to the vehicle. The cable will supply

power and tractive power, i.e., it can be winched back to the rover. Communication between the pair will be facilitated via signals transmitted down the cable.

"The connection between the robot and the rover also means that the snake robot will be able to assist the vehicle if the latter gets stuck," says Liljebäck. "In such a situation, the robot could lower itself to the ground and coil itself around a rock enabling the rover pull itself loose by means of the cable winch, which the rover would normally use to pull the snake robot towards the rover."

Report to the ESA "At the Department of Applied Cybernetics, we have been working closely with the Norwegian University of Science and Technology's (NTNU's) Department of Engineering Cybernetics on snake robots for many years, and our teams have had some ideas about this for a long time," say Transeth and Liljebäck. "It is only now that we are starting to see some actual applications, and it is wonderful to be given this opportunity to provide the ESA with information about future technologies in this field. What we hope is that our ideas will trigger the ESA into initiating a targeted development process around this kind of system."

Videos: <http://robotnor.no/research/serpentine-robots-for-planetary-exploration-serpex/>

So far, NASA has landed four rovers on Mars: Sojourner in 1997, Spirit and Opportunity in 2004, and Curiosity in 2012. The latter is highly advanced and comes with a built-in laboratory. The ESA has new missions planned for 2016 and 2028.

After the Storms, a Different Opinion on Climate Change

Extreme weather may lead people to think more seriously about climate change, according to a new research. In the wake of Hurricanes Irene and Sandy, New Jersey residents were more likely to show support for a politician running on a 'green' platform, and expressed a greater belief that climate change is caused by human activity.

This research, published in *Psychological Science*, a journal of the Association for Psychological Science, suggests that traumatic weather events may have the power to shift people's automatic attitudes — their first instincts — in favour of environmentally sustainable policies.

Though scientists are in near-unilateral agreement that human activity contributes to climate change, the relationship is not as clear to many politicians and citizens. This translates into lackluster support for environmental policies, especially when the short-term consequences amount to higher taxes.

"Americans tend to vote more from a self-interested perspective rather than demand that their government affect change," says lead researcher Laurie Rudman of Rutgers University.

In 2010, Rudman and her colleagues Meghan McLean and Martin Bunzl surveyed over 250 Rutgers undergraduate students, measuring their attitudes towards two politicians, one who favoured and another who opposed environmental policies that involve tax increases. The researchers asked the students whether they believed that humans are causing climate change, and they also had the students complete



Hurricane Sandy destruction. In the wake of Hurricanes Irene and Sandy, New Jersey residents were more likely to show support for a politician running on a 'green' platform, and expressed a greater belief that climate change is caused by human activity. (Credit: © Leonard Zhukovsky / Fotolia)

a test intended to reveal their automatic, instinctual preferences towards the politicians.

Though most students said they preferred the green politician, their automatic preferences suggested otherwise. The automatic-attitudes test indicated that the students tended to prefer the politician who did not want to raise taxes to fund environment-friendly policy initiatives.

After Hurricanes Irene and Sandy devastated many areas on the Eastern Seaboard in 2012, Rudman and her colleagues wondered whether they would see any differences in students' attitudes towards environmental policies.

"It seemed likely that what was needed was a change of 'heart,'" Rudman explains. "Direct, emotional experiences are effective for that."

In contrast with the first group, students tested in 2012 showed a clear preference for the green politician, even on the automatic attitudes test. And those students who were particularly affected by Hurricane Sandy — experiencing power outages, school disruptions, even

damaged or destroyed homes — showed the strongest preference for the green politician.

"Not only was extreme weather persuasive at the automatic level, people were more likely to base their decisions on their gut-feelings in the aftermath of Sandy, compared to before the storm," Rudman explains.

While they don't know whether the first group of students would have shown a shift in attitudes after the storms, the researchers believe their findings provide evidence that personal experience is one factor that can influence instinctive attitudes towards environmental policy. If storms do become more prevalent and violent as the climate changes, they argue, more people may demand substantive policy changes.

Waiting for severe storms to shift the public's opinions on policy changes might be a sobering reality, but Rudman and her colleagues are more optimistic.

"Our hope is that researchers will design persuasion strategies that effectively change people's implicit attitudes without them having to suffer through a disaster," Rudman concludes.

Four New Species of 'Legless Lizards' Discovered Living on the Edge

California biologists have discovered four new species of reclusive legless lizards living in some of the most marginal habitat in the state. "This shows that there is a lot of undocumented biodiversity within California," said Theodore Papenfuss, a reptile and amphibian expert, or herpetologist, with UC Berkeley's Museum of Vertebrate Zoology, who discovered and identified the new species with James Parham of California State University, Fullerton. The

discoveries raise the number of California legless lizard species from one to five.

The herpetologists named the new snake-like lizards after four legendary UC Berkeley scientists: museum founder Joseph Grinnell, paleontologist Charles Camp, philanthropist and amateur scientist Annie Alexander and herpetologist Robert C. Stebbins, at 98 the only one of the group still alive.



One of four newly discovered species of legless lizard is from Bakersfield and has a purple belly and yellow sides. UC Berkeley and Cal State-Fullerton biologists named it *Anniella grinnelli* after Joseph Grinnell, founder of UC Berkeley's Museum of Vertebrate Zoology. This species today ranges from downtown Bakersfield in the southern San Joaquin Valley to the Carrizo Plain National Monument 30 miles to the west. (Credit: Alex Krohn)

"These are animals that have existed in the San Joaquin Valley, separate from any other species, for millions of years, completely unknown," said Parham, who obtained his doctorate from Berkeley and is now curator of paleontology at the John D. Cooper Archaeology and Paleontology Center. "If you want to preserve biodiversity, it is the really distinct species like these that you want to preserve."

Papenfuss and Parham reported their discovery this month in the journal *Breviora*, a publication of the Museum of Comparative Zoology at Harvard University.

"Legless lizards, represented by more than 200 species worldwide, are well-adapted to life in loose soil", Papenfuss said. Millions of years ago, lizards on five continents independently lost

their limbs in order to burrow more quickly into sand or soil, wriggling like snakes. Some still have vestigial legs. Though up to eight inches in length, the creatures are seldom seen because they live mostly underground, eating insects and larvae, and may spend their lives within an area the size of a dining table. Most are discovered in moist areas when people overturn logs or rocks.

Herping the Central Valley

For the past 15 years, Papenfuss and Parham have scoured the state for new species, suspecting that the fairly common California legless lizard (*Anniella pulchra*), the only legless lizard in the U.S. West, had at least some relatives. They discovered one new species — yellow-bellied like its common cousin — under leaf litter in protected dunes west of Los Angeles International Airport. They named that species *A. stebbinsi*, because Stebbins grew up and developed an early interest in natural history in the nearby Santa Monica Mountains.

Because many sandy, loamy areas, including dunes and desert areas, offer little cover for lizards if they emerge, Papenfuss distributed thousands of pieces of cardboard throughout the state in areas likely to host the lizard. He returned year-after-year to see if lizards were using the moist, cool areas under the cardboard as resting or hunting grounds.

This led to the discovery of a silver-bellied species near Fellows in the oil fields around Taft, which they named *A. alexandrae* after Annie Alexander, who endowed the UC Berkeley museum in 1908 and added 20,000 specimens to its collections. The herpetologists found another species in three isolated, arid canyons on the edge of the Mojave Desert just below and east of Walker Pass in the Sierra Nevada and named it *A. campi* after Charles Camp,

because of his early-career discovery of the Mt. Lyell salamander in the Sierra. The purple-bellied fourth was found in three vacant lots in downtown Bakersfield, though only one of those lots remains: the others have been bulldozed and developed. The biologists named that species *A. grinnelli* after Joseph Grinnell, who in 1912 first noted habitat destruction around Bakersfield from agriculture and oil drilling.

Interestingly, all these species had been collected before and were in collections around California, but when preserved in alcohol, the lizards lose their distinctive colour and look identical. Papenfuss and Parham identified the species through genetic profiling, but they subsequently found ways to distinguish them from one another via belly colour, number and arrangement of scales, and number of vertebrae. However, two species — the previously known common legless lizard of Northern California and the newly named southern species found at LAX and apparently broadly distributed south of the Tehachapi Mountains—remain indistinguishable except by genetic tests or, now, the location where they are found.

Species of Special Concern

Papenfuss and Parham are working with the California Department of Fish and Wildlife (CDFW) to determine whether the lizards need protected status. Currently, the common legless lizard is listed by the state as a species of special concern.

"These species definitely warrant attention, but we need to do a lot more surveys in California before we can know whether they need higher listing," Parham said.

Papenfuss noted that two of the species are within the range of the blunt-nosed leopard

lizard, which is listed as an endangered species by both the federal and state governments.

"On one hand, there are fewer legless lizards than leopard lizards, so maybe these two new species should be given special protection," he said. "On the other hand, there may be ways to protect their habitat without establishing legal status. They don't need a lot of habitat, so as long as we have some protected sites, they are probably OK."

Papenfuss says they are not yet in danger of going extinct, since he has found some of the lizards in protected reserves operated by the CDFW, the U.S. Bureau of Land Management and a private water reserve outside Bakersfield, in addition to the El Segundo Dunes near LAX.

Barriers to HIV Vaccine Response Explored by Researchers at The Scripps Research Institute (TSRI)

Barriers to HIV vaccine response explored by the researchers at The Scripps Research Institute (TSRI) discovered that an antibody that binds and neutralises HIV likely also targets the body's own 'self' proteins. This finding could complicate the development of HIV vaccines designed to elicit this protective antibody, called 4E10, and others like it, as doing so might be dangerous or inefficient.

"We developed two new mouse models that allow us to visualise the fate of the rare B cells that can see HIV and we thought could be stimulated by vaccines to produce neutralising antibodies — the type of antibodies we seek to produce in response to a vaccine," said David Nemazee, Ph.D. professor in the Department of Immunology and Microbial Science at TSRI and senior author of the study. "We were able to

study vaccine responses of B12, an antibody that sees the CD4 binding site of HIV, but, surprisingly to us, not 4E10, an antibody that sees the stem of the HIV envelope protein."

Nemazee and his team went on to discover that cells with the potential to produce 4E10 antibodies trigger several natural safeguards that shut down the production of any antibody that might recognise and destroy the body's own tissues. They concluded that 4E10 cross-reacts with host tissues in this way, prompting its removal before it can do any harm or good. The study was recently published in *The Journal of Immunology*.

HIV Vaccine Development

4E10 antibodies were originally isolated from a human HIV patient. The antibodies specifically recognise and bind an HIV surface protein called gp41. The virus uses gp41 like a long spike to poke holes in its host's immune cells. But when 4E10 antibodies clog up gp41, the virus is neutralised and host cells are protected.

4E10 especially interests HIV researchers because the antibody recognises and binds to gp41 on the surface of many different strains of the virus, not just the one strain with which the patient was most recently infected. If a vaccine could be made to specifically and safely stimulate 4E10-like production, recipients would likely be protected against multiple HIV strains.

In humans, HIV slowly destroys the immune system, leading to Acquired Immune Deficiency Syndrome (AIDS). According to the Center for Disease Control and Prevention, more than 1.1 million people in the U.S. are living with HIV infection. While treatments developed in the past decade can keep the virus in check for many years, there is no vaccine and there is no cure.

Proceeding with Caution

In several ongoing studies, the TSRI team and others are working out how to make a vaccine that stimulates the production of 4E10, b12 and other broadly neutralising anti-HIV antibodies. However, this latest study indicates that this approach might be complicated by unwanted self-reactivity. Antibodies that cross-react with host tissue — like 4E10 has now been shown to do — are associated with auto-immune diseases such as multiple sclerosis and lupus.

The TSRI study also raises the question of how 4E10 was generated in the first place. According to Nemazee, 4E10 may be a fluke, cropping up in an HIV patient who was also prone to autoimmune diseases. Alternatively, the autoreactive antibody could have arisen in the patient as a consequence of the disease perhaps the body's normal mechanism for weeding out such antibodies failed, allowing the serendipitous production of an anti-HIV antibody.

Despite this new concern, there is still hope for 4E10's role in HIV vaccine development. A companion paper published in the same issue of *The Journal of Immunology* (<http://www.jimmunol.org/content/191/6/3179.long>) found that another potent, broadly neutralising anti-HIV antibody, b12, was not self-reactive and could respond to a candidate vaccine preparation provided by Richard Wyatt, TSRI Professor of Immunology and Director of Viral Immunology at the International AIDS Vaccine Initiative Neutralizing Antibody Center.

"It's still possible that we could safely elicit the 4E10-like antibody in order to protect against HIV," Nemazee said. "We just have to think about how to generate the best antibodies without causing other problems. We have a lot of questions. And now we have a good model to help us answer them."

Blood Pressure Cuff may Save Lives in Patients with Acute Heart Attack

In patients with an acute heart attack, remote ischemic conditioning — intermittent inflation of a blood pressure cuff to cut off blood flow to the arm during transportation to hospital for acute balloon dilatation — reduces subsequent cardiac symptoms and mortality after acute heart attack. The results are presented by researchers from Aarhus University Hospital and Aarhus University in *European Heart Journal* on-line 12 September 2013.

Activating the Body's Defense Mechanism

Lack of oxygen for short periods of time in a distant organ by intermittently stopping blood flow to a limb, can protect another organ (i.e., the heart), during a prolonged period of lack of oxygen as it is the case during a heart attack. Professor Hans Erik Bøtker and his research team have previously demonstrated that remote ischemic conditioning reduces cardiac tissue damage on average 30 per cent in patients undergoing acute balloon treatment for a heart attack. In patients treated with conditioning, a blood pressure cuff was placed around the upper arm and inflated to 200 mmHg for 5 minutes to cut off blood flow, and then released. The arm then rested for 5 minutes, and then the blood pressure cuff was re-applied. This procedure was repeated 4 times.

The rate of complications is halved

The researchers have now followed 251 patients assigned to receive conditioning or no conditioning in addition to usual care during transportation to the heart centre for up to 4 years. During the follow-up period the initial salvage of heart tissue by conditioning was translated into a clinical benefit for the patients.

The occurrence of new heart symptoms was reduced by 51 per cent in the conditioning group compared to the control group. The total number of deaths was low and the deaths caused by heart disease was reduced by 61 per cent.

The underlying mechanisms are thought to involve activation of endogenous protective systems that induce resistance towards tissue damage in the heart during a heart attack and in particular when re-opening the occluded heart vessel by balloon dilatation. Ph.D. student Astrid Drivsholm Sloth, who conducted the present study, characterises the treatment as promising and predicts that it will have widespread potential in the treatment of heart attacks. However, larger studies are required to confirm the clinical implications of this smaller pilot trial such that it can be clarified whether the new intervention can reduce mortality and the development of heart failure after a heart attack.

How Lethal Bird Flu Viruses Evolved

Deadly H7N9 avian flu viruses infected many people, but little is known about how they evolved to become harmful to humans. In a study published in *Cell Host & Microbe*, an in-depth evolutionary analysis of whole-genome sequences of different types of avian flu viruses has revealed that new H7N9 viruses emerged from distinct H9N2 viruses in a two-step process, first occurring in wild birds and then continuing in domestic birds.

"A deep understanding of how the novel H7N9 viruses were generated is of critical importance for formulating proper measures for surveillance and control of these viruses and other potential emerging influenza viruses," says senior study author Taijiao Jiang of the Chinese Academy of Sciences.

First detected in people in late March, H7N9 viruses have resulted in more than 130 human infections and at least 44 deaths. Most of these infections occurred after exposure to infected poultry or contaminated environments rather than person-to-person contact, but these viruses could evolve to become more readily transmissible among humans. This possible threat highlights the importance of understanding the evolutionary history of H7N9 viruses for developing appropriate strategies to monitor and control outbreaks.

To address this problem, Jiang teamed up with Daxin Peng of Yangzhou University and their collaborators to analyse whole-genome sequences of avian flu viruses from humans, poultry and wild birds from China. They discovered that H7N9 viruses are genetically diverse, suggesting that complex genetic events were involved in their evolution.

Their analysis revealed that the new H7N9 viruses emerged through a two-step process involving the exchange of genetic material between distinct viruses. In the first step, which took place in wild birds, genetic material from H9N2 viruses and unspecified H7 and N9 viruses was mixed to create precursor H7N9 viruses. The second step, which occurred in domestic birds in eastern China early last year, involved the exchange of genetic material between the precursor H7N9 viruses and other H9N2 viruses to create new, genetically diverse H7N9 viruses.

"Our work not only re-enforces the important role of wild birds in the emergence of novel influenza viruses but also highlights the necessity of integrating data from infections in humans, poultry, and wild birds for effective influenza surveillance," Jiang says.

'Jekyll-and-Hyde' Protein Offers a New Route to Cancer Drugs

The researchers in Britain, with collaborators in Singapore and the USA, carried out a comprehensive biological study of the protein E2F, which is abnormal in the vast majority of cancers. They were able to explain the dual nature it can take up in cells in the body, and indicate how it could be a potent target for developing new cancer drugs.

The Oxford University scientists have since carried out a drug-discovery screen, and shown that compounds which block the protein's change into 'Mr Hyde' result in the death of cancer cells.

"This mechanism for switching a key protein is very novel. Nothing else I've come across behaves like it," says Professor Nick La Thangue of the Department of Oncology at Oxford University, who led the work. Subtle changes in terms of the chemistry of the protein have dramatic and polar opposite effects on the tumour cell, either allowing them to continuously grow or switching them to cell death mode.

"We are excited by this new discovery, which provides a new and very important approach to developing new types of cancer drugs. We have much work to do," says Professor La Thangue.

The researchers from the University of Oxford, the Genome Institute of Singapore and the University of Texas' MD Anderson Cancer Centre in the USA report their findings in the journal *Molecular Cell*. The study was part-funded by the UK Medical Research Council and Cancer Research UK.

Cells in the body go through cycles of growth and division, pauses and death in a highly regulated

way. Cancer involves the breakdown of these controls leading to unlimited expansion of the cells in a growing tumour.

The protein E2F is inextricably linked to cancer. It is normally tightly controlled in the cell cycle, but in most if not all cancer cells the processes E2F oversees go awry so that it keeps cells growing.

Puzzlingly, while it can be a factor driving cancer, on other occasions E2F is protective and removes damaged cells. When normal cells experience damage, E2F is involved in switching the cell towards cell death in a process called apoptosis. This helps prevent the build up of DNA errors and the development of cancer.

It's this dual Jekyll-and-Hyde nature of E2F that the researchers have been able to explain for the first time.

The researchers show that two enzymes compete to attach a molecular label, or flag, on different parts of the E2F protein. The flag in one position sees E2F act to cause cell death and the same flag in another position sees E2F boost cell growth and proliferation.

Professor La Thangue says: "It's like there's an angel and a devil competing to get on each shoulder of the protein. Which one gets the upper hand is able to whisper in the ear of the protein and tell it what it should do. With the molecular flag on one shoulder, E2F goes into cell kill mode. With the flag on the other, it goes into cell growth mode. The challenge is to mimic this process with drugs, and reinstate the death pathway in tumour cells."

In cancer cells, E2F gets stuck with the flag boosting growth and division, helping drive the tumour's growth. The researchers identified another protein in the cell which looks for the presence of this flag.

"Blocking this protein means the devil's whispers never get heard and E2F doesn't transform into Mr Hyde," says Professor La Thangue. Instead, E2F switches over to cell-death mode and the cancer cells die out.

"We've identified compounds — drug candidates — that do exactly that," he explains.

Dr Shunsheng Zheng, first author of the study and a graduate student on the joint A*STAR-University of Oxford D.Phil. scholarship programme, said: "E2F is a tricky protein to work with. Normal cells use it for growth, cancer cells need it for hypergrowth, but too much of it seems to drive cancer cells into suicidal mode."

Dr Kat Arney, science information manager at Cancer Research UK, which part-funded the work, said: "Cancer is a complex biological problem, and getting to grips with the molecules that drive it is essential if we're to find new cures. Although there's a lot more work to be done before this new discovery could become a treatment for patients, this research is an important step forward in understanding E2F's 'split personality' in both driving and destroying cancer cells."

New Teaching Method Improves Maths Skills, Closes Gender Gap in Young Students

When early elementary maths teachers ask students to explain their problem-solving strategies and then tailor instruction to address specific gaps in their understanding, students learn significantly more than those taught using a more traditional approach. This was the conclusion of a year-long study of nearly 5,000 kindergarten and first-grade students conducted by researchers at Florida State University.

The researchers found that 'formative assessment,' or the use of ongoing evaluation of student understanding to inform targeted instruction, increased students' mastery of foundational maths concepts that are known to be essential for later achievement in mathematics and science.

Their results corroborated those of two earlier pilot projects indicating that implementation of the Mathematics Formative Assessment System (MFAS) can markedly improve academic performance in mathematics. The findings further suggested that MFAS may help close the gender gap that often develops by third grade.

"The results of the most recent study conducted in schools across Florida are exciting," said Laura Lang, principal investigator who directed development and testing of MFAS. "The randomised field trial showed that students in K-3 classes where teachers used MFAS were well ahead of other students taught by teachers using more traditional approaches. As one of the elementary principals of a participating school put it, MFAS is a real 'game changer' in terms of student engagement and success in maths."

MFAS was created through the efforts of researchers at the Florida Center for Research in Science, Technology, Engineering and Mathematics (FCR-STEM) who received \$2.9 million in competitively awarded grant funds from the Florida Department of Education's Race to the Top programme to pursue the project. MFAS is fully aligned with the Common Core State Standards adopted in Florida and many other states.

The randomised field trial was conducted in partnership with 31 schools and 301 teachers in three Florida districts across the state — one urban, one sub-urban and one rural. Schools were randomly assigned to either the MFAS

treatment group or to a group that used a more typical approach to maths instruction.

Comparing average annual gains in maths on nationally normed tests to the results, learning was accelerated when teachers integrated MFAS in their day-to-day instruction.

"In kindergarten, we can infer that students learned at a rate equivalent to an extra six weeks of instruction," Lang said. "In first grade, the gains were even greater — two months of extra instruction. It was as if we extended the school year without actually adding any more days to it."

In constructing MFAS, Lang and her team drew upon research demonstrating that the learning of mathematics is facilitated when teachers gain deeper insights into what their students already know and are able to do as well as what students do not know and are unable to do. Teachers gather these insights through careful observation and by engaging students in discussions of their mathematical thinking.

"Formative assessment is a process, not a test," Lang said, "and feedback is a key element".

The approach enables teachers to address each child's instructional needs. Teachers can avoid holding back those who are ready to advance, while efficiently helping those who are struggling. This contrasts sharply with current practice in many elementary classrooms.

"Based on our classroom observations over the past four years, teachers typically rely heavily on a maths textbook to guide the planning of day-to-day instruction and often provide students feedback only on whether their answers are correct," Lang said. "Teachers integrating formative assessment in instruction not only ask students to do maths tasks but also to explain their reasoning and to justify their solutions. As

a result, teachers are better equipped to identify misconceptions, determine gaps in understanding and adjust their instruction accordingly.”

Students play a key role in the formative assessment process. MFAS actively engages students, encouraging them to monitor and regulate their own learning. Students also evaluate each other’s work and provide productive feedback, working as a team.

“MFAS also has potential long-term effects on closing the gender gap in mathematics”, Lang said. Studies show that even though both boys and girls enter school with a fundamental number sense, by the third grade, boys tend to do better in mathematics.

The results of a pilot study conducted in second- and third-grade classrooms suggest that, in

classrooms where MFAS was used, by third grade, the girls showed no statistically significant difference in mathematics achievement from boys, according to Mark LaVenita, methodologist on the MFAS team. However, in classrooms with more conventional instruction, girls continued to lag behind boys in maths achievement.

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