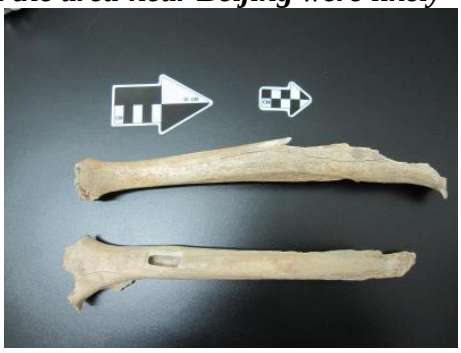
http://www.eurekalert.org/pub_releases/2013-01/m-ar_1012113.php

A relative from the Tianyuan Cave

Ancient DNA has revealed that humans living some 40,000 years ago in the area near Beijing were likely related to many present-day Asians and Native Americans



An international team of researchers including Svante Pääbo and Qiaomei Fu of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, sequenced nuclear and mitochondrial DNA that had been extracted from the leg of an early modern human from Tianyuan Cave near Beijing, China. Analyses of this individual's DNA showed that the Tianyuan human shared a common origin with the ancestors of many present-day Asians and Native Americans. In addition, the researchers found that the proportion of Neanderthal and Denisovan-DNA in this early modern human is not higher than in people living in this region nowadays.

The leg of the early modern human from Tianyuan Cave was used for the genetic analysis as well as for carbon dating.
MPI for Evolutionary Anthropology

Humans with morphology similar to present-day humans appear in the fossil record across Eurasia between 40,000 and 50,000 years ago. The genetic relationships between these early modern humans and present-day human populations had not yet been established. Qiaomei Fu, Matthias Meyer and colleagues of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, extracted nuclear and mitochondrial DNA from a 40,000 year old leg bone found in 2003 at the Tianyuan Cave site located outside Beijing. For their study the researchers were using new techniques that can identify ancient genetic material from an archaeological find even when large quantities of DNA from soil bacteria are present.

The researchers then reconstructed a genetic profile of the leg's owner. "This individual lived during an important evolutionary transition when early modern humans, who shared certain features with earlier forms such as Neanderthals, were replacing Neanderthals and Denisovans, who later became extinct", says Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology, who led the study.

The genetic profile reveals that this early modern human was related to the ancestors of many present-day Asians and Native Americans but had already diverged genetically from the ancestors of present-day Europeans. In addition, the Tianyuan individual did not carry a larger proportion of Neanderthal or Denisovan DNA than present-day people in the region. "More analyses of additional early modern humans across Eurasia will further refine our understanding of when and how modern humans spread across Europe and Asia", says Svante Pääbo.

Parts of the work were carried out in a new laboratory jointly run by the Max Planck Society and the Chinese Academy of Sciences in Beijing.

Qiaomei Fu, Matthias Meyer, Xing Gao, Udo Stenzel, Hernán A. Burbano, Janet Kelso, Svante Pääbo DNA analysis of an early modern human from Tianyuan Cave, China PNAS, Online Early Edition, January 21, 2013

http://www.eurekalert.org/pub_releases/2013-01/jaaj-ssl011713.php

Study suggests link between regular aspirin use, increased risk of age-related macular degeneration

Regular aspirin use appears to be associated with an increased risk of neovascular age-related macular degeneration

CHICAGO – Regular aspirin use appears to be associated with an increased risk of neovascular age-related macular degeneration (AMD), which is a leading cause of blindness in older people, and it appears to be independent of a history of cardiovascular disease and smoking, according to a report published Online First by JAMA Internal Medicine, a JAMA Network publication.

Aspirin is one of the most widely used medications in the world and is commonly used in the prevention of cardiovascular disease, such as myocardial infarction (heart attack) and ischemic stroke. While a recent study suggested that regular aspirin use was associated with AMD, particularly the more visually devastating neovascular (wet) form, other studies have reported inconsistent findings. Smoking is also a preventable risk factor for AMD, the authors write in the study background.

Gerald Liew, Ph.D., of the University of Sydney, Australia, and colleagues examined whether regular aspirin use (defined as once or more per week in the past year) was associated with a higher risk of developing AMD by conducting a prospective analysis of data from an Australian study that included four examinations during a 15-year period. Of 2,389 participants, 257 individuals (10.8 percent) were regular aspirin users. After the 15-year follow-up, 63 individuals (24.5 percent) developed incident neovascular AMD, according to the results. "The cumulative incidence of neovascular AMD among nonregular aspirin users was 0.8 percent at five years, 1.6 percent at 10 years, and 3.7 percent at 15 years; among regular aspirin users, the cumulative incidence was

1.9 percent at five years, 7 percent at 10 years and 9.3 percent at 15 years, respectively," the authors note. "Regular aspirin use was significantly associated with an increased incidence of neovascular AMD."
The authors note that any decision concerning whether to stop aspirin therapy is "complex and needs to be individualized."
"Currently, there is insufficient evidence to recommend changing clinical practice, except perhaps in patients with strong risk factors for neovascular AMD (e.g., existing late AMD in the fellow eye) in whom it may be appropriate to raise the potentially small risk of incident neovascular AMD with long-term aspirin therapy," the authors conclude. *(JAMA Intern Med. Published online January 21, 2013. doi:10.1001/jamainternmed.2013.1583.)*
Editor's Note: This study was supported by project grants from the National Health & Medical Research Council Australia. Please see the article for additional information, including other authors, author contributions and affiliations, financial disclosures, funding and support, etc.
Commentary: Relationship of Aspirin Use with Age-Related Macular Degeneration
In an invited commentary, Sanjay Kaul, M.D., and George A. Diamond, M.D., of Cedars-Sinai Medical Center, Los Angeles, write: "This study has important strengths and limitations. It provides evidence from the largest prospective cohort with more than five years of longitudinal evaluation reported to date using objective and standardized ascertainment of AMD."
"The key limitation is the nonrandomized design of the study with its potential for residual (unmeasured or unobserved) confounding that cannot be mitigated by multivariate logistic regression or propensity score analysis," the authors continue.
"From a purely science-of-medicine perspective, the strength of evidence is not sufficiently robust to be clinically directive. These findings are, at best, hypothesis-generating that should await validation in prospective randomized studies before guiding clinical practice or patient behavior," the authors conclude. "However, from an art-of-medicine perspective, based on the limited amount of available evidence, there are some courses of action available to the thoughtful clinician. In the absence of definitive evidence regarding whether limiting aspirin exposure mitigates AMD risk, one obvious course of action is to maintain the status quo."
(JAMA Intern Med. Published online January 21, 2013. doi:10.1001/jamainternmed.2013.2530.)

http://bit.ly/10XfN5P

Tractor Beams 'Pull' Tiny Particles Backward

Scientists have now made a real tractor beam

Jan 21, 2013 09:13 AM ET // by Jesse Emspak

In space opera, it's not uncommon for the hero's ship to be snagged by a tractor beam that pulls him towards the enemy -- think of the famous scene in Star Wars where Darth Vader's Death Star captures Hans Solo's spaceship, the Millennium Falcon in an invisible grasp. Scientists have now made a real tractor beam, that while not capable of snaring spacecraft yet, is able to tug on tiny particles.
Pavel Zemanek and his colleagues at the Institute of Scientific Instruments of the Academy of Sciences of the Czech Republic built a laser that moves tiny spheres of polystyrene floating in water. Changing the way the light is polarized changes the direction the spheres move. They also found that at certain sizes, the spheres arrange themselves into neat rows as they move, bound by the light itself.
"We used a relatively simple setup easily adaptable to any optical microscope and found that it works!" Zemanek told Discovery News via email. In fact Zemanek said it was so simple, one could build the tractor beam setup. All you'd need is a good microscope, a laser, tiny styrofoam balls and distilled water.
This kind of 'tractor beam' can't be scaled up to spaceships – the laser power needed to do that would end up vaporizing the intended target. But the beam could be used to assemble parts in very small robots, move around tiny particles in laboratory experiments and advance medical diagnostics.
"NASA also is actively investigating possible uses of optical tractor beams for sampling comet tails and planet surfaces. What the present paper makes clear is that tractor-beam technology also opens new avenues for lab-on-a-chip material processing that could be very useful for medical diagnostics and related applications," said David Grier, a professor of physics at New York University. Grier wasn't involved in this study.
Scientists have known for a century that light exerts pressure. About a decade ago, theoretical calculations showed that a particle could move against the direction of a light beam, but no one had demonstrated it in the real world without using a complex arrangement of lenses and mirrors.
Zemanek and his team got it to work using laser beams and a simple setup. They fired a laser through a lens, which then went to a mirror that bounced the beam back. The reflected beam interfered with the incoming beam. Meanwhile, the scientists suspended polystyrene spheres in water directly in the path of the laser beams. The beams held the spheres in place vertically, and any pulling or pushing force moved the spheres to the left or to the right.

The effect worked because the particles were small enough to scatter photons of light. The photons got pushed ahead of the particles and since the photons had momentum, the particles got a slight kick backwards.
Grier, who has himself experimented with tractor beams (http://physics.nyu.edu/grierlab/conveyor7c/) , noted that this is the first time anyone has shown that the pulling force was due to the scattering and that you could use it to manipulate objects this way. "It's just a beautifully clear demonstration," he said.
By changing the polarization of the light beam, the scientists could move objects in any direction. Zemanek's team found something else, though: the particles sorted themselves by size, with larger ones going to the left and smaller ones going to the right.
The sorting happens because how the light scattered by the particle depends on its size. At a given wavelength small particles will scatter light more than large ones. The light scatters in several directions, and at certain specific particle sizes, Zemanek said the tiny spheres acted like lenses, with some of the light making a kind of focus on one side.
The areas of focused light created a zone where the light's potential energy was at a minimum. This was a "well" where nearby particles would tend to fall. "It's like the cups for eggs in a carton." Zemanek said. A sphere would fall into the well, and as one was pulled along, it drags another behind it. Meanwhile other spheres fell in line, provided they were the same size.
Zemanek noted that if one were assembling a tiny robot, this would be a good way to move the parts around to where they are needed. Since the movement is done with light, it doesn't mater if the particles are metallic or not, or if they are susceptible to electric fields.
Grier said that the future work should focus on extending the range of the tractor beams to more than the micrometer scales. He noted that right now it seems that the object to be moved has to be smaller than the diameter of the beam. "Whether or not that's right, or how stringent a limit it sets, remains to be seen," he said.
The work was published in the Jan. 20 issue of Nature Photonics.

http://bit.ly/11XMeQW

Let's be clear on health risks from radiation

Should Californians have had iodine after Fukushima? In Radiation Robert Peter Gale and Eric Lax clear up the confusion over radiation and health

Gerry Thomas, contributor

CIGARETTE smokers have three times the amount of polonium-210 in their blood as non-smokers. Some medical uses of radiation expose us to a higher dose in one go than smokers get in a year, yet many are happy to accept these radiation risks.
Compare this with the global alarm following the Fukushima disaster in 2011. As Robert Peter Gale and Eric Lax tell us in Radiation, Californians reacted to the news by buying iodine tablets, which in the circumstances were "as useful as Californians buying raincoats to protect them from rain falling in Barcelona".
Humans are ill-equipped to deal with uncertainty, and we know too much about the uncertainties around data on health risks from radiation. Gale is a doctor specialising in treating patients exposed to high doses of radiation, and Lax is a scientific writer. Touring through various scenarios, from nuclear accidents to irradiated food, they show how our inability to put risk into context can have serious consequences.
They start with an account of an incident in Goiania, Brazil. In 1987, radiotherapy equipment was stolen and the thieves, tempted by the alluring blue glow inside, dismantled it carelessly. Because they didn't know how to handle and contain radiation many people were exposed to variable doses of caesium-137, some with fatal consequences.
Mishandling is not the only danger that flows from a dearth of proper knowledge about radiation. Confusion over the risks to health, both on the part of the public and politicians, can lead to societal stress and stagnation in energy policy.
The book navigates this troublesome territory without bias. The authors summarise health risks associated with various non-nuclear options, suggesting that energy policy should take into account all the possible health risks of a given strategy. Surprisingly, one conclusion is that the fly ash from coal power stations actually generates more radiation than is emitted by a nuclear power plant.
Gale and Lax aim to fill in the gaps in public understanding of all things nuclear, and they are adept at doing so. Throughout the book they present a host of interesting facts and figures in humorous and accessible prose, and their explanation of the biological effect of internal radiation is excellent.
These days we can measure radiation incredibly accurately, but are not good at putting health risks from radiation into perspective with all of the other risks that threaten our health. This book does a good job at explaining radiation and what it does, both good and bad. Radiation is integral to our planet and its use will shape our future here. In Radiation, Gale and Lax help us understand how and why.

Gerry Thomas is a molecular pathologist at Imperial College London

http://phys.org/news/2013-01-watery-science-jackpot-curiosity.html

Watery science 'jackpot' discovered by Curiosity

The Curiosity rover hit the science "jackpot" and has discovered widespread further evidence of multiple episodes of liquid water flowing over ancient Mars

The Curiosity rover hit the science "jackpot" and has discovered widespread further evidence of multiple episodes of liquid water flowing over ancient Mars billions of years ago when the planet was warmer and wetter, scientists announced. The watery evidence comes in the form of water bearing mineral veins, cross-bedded layering, nodules and spherical sedimentary concretions.

Any day now NASA's mega robot will be instructed to drill directly into veined rocks where water once flowed, the team announced at a media briefing this week. Delighted researchers said Curiosity surprisingly found lots of evidence for light-toned chains of linear mineral veins inside fractured rocks littering the highly diverse Martian terrain – using her array of ten state-of-the-art science instruments. Veins form when liquid water circulates through fractures and deposit minerals, gradually filling the insides of the fractured rocks over time.

Sometime in the next two weeks or so, NASA's car sized rover will carry out history's first ever drilling inside a Martian rock that was "percolated" by liquid water – an essential prerequisite for life as we know. A powdered sample will then be delivered to the robots duo of analytical chemistry labs (CheMin & SAM) to determine its elemental composition and ascertain whether organic molecules are present.

The drill target area is named "John Klein" outcrop, in tribute to a team member who was the deputy project manager for Curiosity at JPL for several years and who passed away in 2011.

"We identified a potential drill target and are preparing to do drill activities in the next two weeks. We are ready to go," said Richard Cook, the project manager of NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif. "Drilling [into a rock] is the most significant engineering activity since landing. It is the most difficult aspect of the surface mission, interacting with an unknown surface terrain, and has never been done on Mars. We will go slowly. It will take some time to deliver samples to CheMin and SAM and will be a great set of scientific measurements." "The scientists have been let into the candy store," said Cook referring to the unexpected wealth of science targets surrounding the rover at this moment. "There is a high diversity of rocks types here to characterize," added Mike Malin, Mastcam principal investigator of Malin Space Science Systems (MSSS). "We see layering, veins and concretions. The area is still undergoing some changes."

Curiosity is just a few meters away from 'John Klein' and will drive to the site shortly from her location inside 'Yellowknife Bay' beside the 'Snake River' rock formation. To see where Curiosity is in context with 'John Klein' and "Snake River', see our annotated context mosaic (by Ken Kremer & Marco Di Lorenzo) as the rover collects data at a rock ledge.

The white colored veins were discovered over the past few weeks- using the high resolution mast- mounted imaging cameras and ChemCam laser firing spectrometer -at exactly the vicinity where Curiosity is currently investigating ; around a shallow basin called Yellowknife Bay and roughly a half mile away from the landing site inside Gale Crater.

"This lowest unit that we are at in Yellowknife Bay, the very farthest thing we drove to, turns out to be kind of the 'jackpot' unit here," said John Grotzinger, the mission's chief scientist of the California Institute of Technology. "It is literally shot through with these fractures and vein fills."

Shortly after landing the team took a calculated gamble and decided to take a several months long detour away from the main destination of the towering, sedimentary mountain named Mount Sharp, and instead drive to an area dubbed 'Glenelg' and home to 'Yellowknife Bay', because it sits at the junction of a trio of different geologic terrains. Glenelg exhibits high thermal inertia and helps put the entire region in better scientific context. The gamble has clearly payed off. "We chose to go there because we saw something anomalous, but wouldn't have predicted any of this from orbit," said Grotzinger.

The Chemistry and Camera (ChemCam) instrument found elevated levels of calcium, sulfur and hydrogen. Hydrogen is indicative of water. The mineral veins are probably comprised of calcium sulfate – which exists in several hydrated (water bearing) forms. "The ChemCam spectra point to a composition very high in calcium. These veins are likely composed of hydrated calcium sulfate, such as bassinite or gypsum, depending on the hydration state," said ChemCam team member Nicolas Mangold of the Laboratoire de Planétologie et Géodynamique de Nantes in France. "On Earth, forming veins like these requires water circulating in fractures and occur at low to moderate temperatures."

The newly found veins appear quite similar to analogous veins discovered in late 2011 by NASA's Opportunity rover – Curiosity's older sister – inside Endeavour crater and nearly on the opposite side of Mars. See our Opportunity vein mosaic featured at APOD on Dec. 11, 2011 to learn more about veined rocks.

"What these vein fills tell us is water moved and percolated through these rocks, through these fracture networks and then minerals precipitated to form the white material which ChemCam has concluded is very likely a calcium sulfate, probably hydrated in origin," Grotzinger explained.

"So this is the first time in this mission that we have seen something that is not just an aqueous environment, but one that also results in precipitation of minerals, which is very attractive to us."

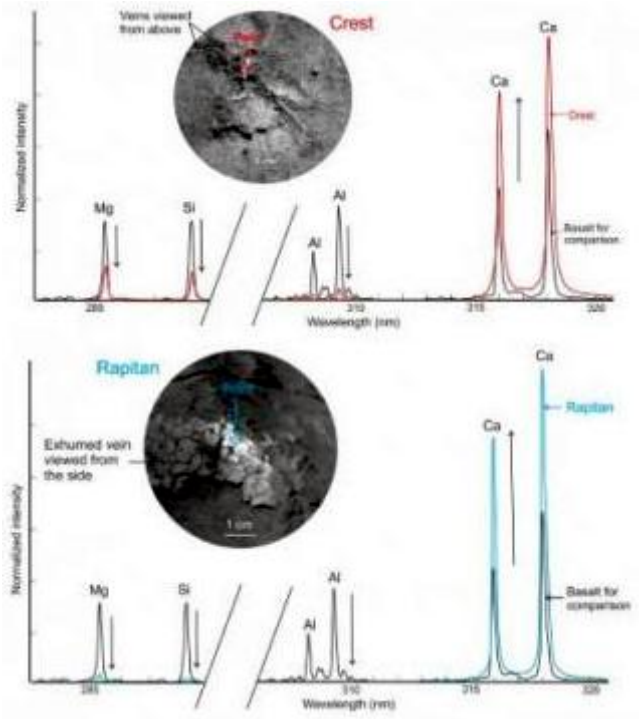
Yellowknife Bay and the 'John Klein' drilling area outcrop are chock full of mineral veins and sedimentary concretions.

"When you put all this together it says that basically these rocks were saturated with water. There may be several phases to this history of water, but that's still to be worked out."

"This has been really exciting and we can't wait to start drilling," Grotzinger emphasized.

Curiosity can drill about 2 inches (5 cm) into rocks. Ultimately a powdered sample about half an aspirin tablet in size will be delivered to SAM and CheMin after a few weeks.

All rover systems and instruments are healthy, said Cook.



Calcium-Rich Veins in Martian Rocks. This graphic shows close-ups of light-toned veins in rocks in the "Yellowknife Bay" area of Mars together with analyses of their composition. The top part of the image shows a close-up of the rock named "Crest," taken by the remote micro-imager (RMI) on Curiosity's Chemistry and Camera (ChemCam) instrument above the analysis of the elements detected by using ChemCam's laser to zap the target. The spectral profile of Crest's light-colored vein is shown in red, while that of a basaltic calibration target of known composition is shown in black. The bottom part of the image shows ChemCam's close-up of the rock named "Rapitan" with the analysis of its elemental composition. The spectral profile of Rapitan's light-colored vein is shown in blue, while that of a basaltic calibration target of known composition is shown in black. These results suggest the veins are unlike typical basaltic material. They are depleted in silica and composed of a calcium-bearing mineral. **Credit: NASA/JPL-Caltech/LANL/CNES/IRAP/LPGNantes/CNRS**

Grotzinger said that Curiosity will be instructed to drive over the veins to try and break them up and expose fresh surfaces for analysis. Then she will drill directly into a vein and hopefully catch some of the surrounding material as well. "This will reveal the mineralogy of the vein filling material and how many hydrated mineral phases are present. The main goal is this will give us an assessment of the habitability of this environment."

As the rover has driven down the shallow depression to deeper stratigraphic layers, the units are older in time. After the first drill sample is fully analyzed, Grotzinger told me that the team will reevaluate whether to drill into a second rock.

The team doesn't yet know whether the flowing water from which the veins precipitated was a more neutral pH or more acidic. "It's too early to tell. We need to drill into the rock to tell and determine the mineralogy," Grotzinger told me. Neutral water is more hospitable to life.

How long the episodes of water flowed is not yet known and it's a complex history. But the water was at least hip to ankle deep at times and able to transport and round the gravel. "There are a broad variety of sedimentary rocks here, transported from elsewhere. Mars was geologically active in this location, which is totally cool !," said Aileen Yingst, MAHLI deputy principal investigator. "There are a number of different transport mechanisms in play."

Drilling goes to the heart of the mission and will mark a historic feat in planetary exploration – as the first time that an indigenous sample has been cored from the interior of a rock on another planet and subsequently analyzed by chemical spectrometers to determine its elemental composition and determine if organic molecules are present . The high powered hammering drill is located on the tool turret at the end of the car-sized robots 7 foot (2.1 meter) long mechanical arm . It is the last of Curiosity's ten instruments that remains to be checked out and put into action.

Curiosity landed on the Red Planet five months ago inside Gale Crater to investigate whether Mars ever offered an environment favorable for microbial life, past or present and is now nearly a quarter of the way through her two year prime mission. Curiosity might reach the base of Mount Sharp by the end of 2013, which is about 6 miles (10 km) away as the Martian crow flies. *Source: Universe Today*

http://ars.to/UtQuTT

Polynesians reached South America, picked up sweet potatoes, went home

Tubers were spread from New Zealand to Hawaii before European contact.

by John Timmer - Jan 22 2013, 5:00am TST

The sweet potato was one of a number of crops domesticated in the Andes and, like many of the rest, it became a global crop in the colonial era. But there were some hints that the sweet potato may have already started its global sweep before the Europeans ever took a bite out of one.

Some of the early European explorers, including Captain Cook, reported finding it in places like Hawaii. All of which implies that the Polynesians, who managed to spread widely across the Pacific, had made it all the way to South America.

But it was difficult to be sure, given that European travelers later enhanced its spread within the Pacific and elsewhere. This has also created a complex genetic legacy that obscures its origins. Now, researchers have gone back and obtained DNA from museum samples, including some collected by Cook's crew, and find that the DNA indicates that Polynesians made it as far as South America.

Archeological remains appear to place sweet potato cultivation in the core of Polynesia by the year 1200, and it spread with further migrations to places like New Zealand and Hawaii. It's possible that the plant had naturally spread as seeds across the ocean and the Polynesians learned to cultivate it independently.

One of the arguments against this is the fact that the Polynesian terms for the crop appear to be closely related to its name in Quechua, the language of the Peruvian Andes. ("Kuumala" and derivatives vs. "kumara" and relatives.)

That, and the fact that the Polynesians made it most of the way across the Pacific, clearly getting as far as Easter Island. Still, reaching South America and then returning with crops is quite a significant step beyond that.

Trying to piece together a model of the sweet potato's spread based on things like historical reports, known human travels, and genetic information, however, has been quite a mess.

Even the simplest ideas that are consistent with the data involve the sweet potato entering the Pacific through three different routes, and then potentially hybridizing with the strains already in residence.

It may be complicated, but the new genetic study provides support for this three-pronged (tripartite) assault on the Pacific.

The researchers start with a detailed study of the cultivars found in South America, Central America, and the Caribbean. The researcher team, based in France, found that there are two distinct populations: a northern strain, found in Mexico and the Caribbean, and a southern one, in the Andes, where the crop was first domesticated. (There's also a region of overlap and intermingling in between the two.)

Genetic relatives of the northern strain entered the Pacific via two routes. In the first, trade with the Philippines during the Spanish colonial era brought it there; from that site, it diffused into mainland Asia and to some island strains.

But the Caribbean strain made its way across the Atlantic, through Madagascar, and into Indonesia. Its arrival, likely in the 1700s, transformed the agriculture of the New Guinea highlands, which had previously been focused on taro. Cultural changes followed in its wake.

Most modern cultivars are descended from some combination of these two invasions. But samples from museums, including some collected by the earliest European voyagers, show that this wasn't likely to be the case prior to the late 1800s. Before then, most strains were spread directly from initial sources, with very little interbreeding.

The other thing that museum samples indicate is that, prior to extensive European travels in the Pacific, there was another, genetically distinct form of the sweet potato present in Eastern Polynesia. And that appears to have originated from the southern population, focused in the Andes. It was already present in Polynesia before colonists left this region to settle in Hawaii and New Zealand.

Given that we already know Polynesians had the technology to engage in long-distance voyages across the Pacific, the simplest explanation for this is that they did make it to South America, probably somewhere around the year 1000. And, most strikingly, some of them apparently turned around and traveled back halfway across the Pacific.

This, combined with last week's results that showed travelers from India made it to Australia over 4,000 years ago, provides impressive evidence of just how mobile some of our ancestors have been. And they managed to travel all that distance with technologies we'd generally consider primitive.

But it's important to consider that, just because you wouldn't hop into an open canoe and head out into the Pacific, it wouldn't have meant certain death for anyone with the right skills. *PNAS, 2013. DOI: 10.1073/pnas.1211049110 (About DOIs).*

http://www.sciencedaily.com/releases/2013/01/130121161749.htm

Longer CPR Improves Survival in Both Chidren and Adults

Studies showing that extending CPR longer than previously thought useful saves lives

Experts from The Children's Hospital of Philadelphia were among the leaders of two large national U.S. studies showing that extending CPR longer than previously thought useful saves lives in both children and adults. The research teams analyzed impact of duration of cardiopulmonary resuscitation in patients who suffered cardiac arrest while hospitalized.

"These findings about the duration of CPR are game-changing, and we hope these results will rapidly affect hospital practice," said Robert A. Berg, M.D., chief of Critical Care Medicine at The Children's Hospital of Philadelphia. Berg is the chair of the Scientific Advisory Board of the American Heart Association's Get With Guidelines-Resuscitation program (GWTG-R). That quality improvement program is the only national registry that tracks and analyzes resuscitation of patients after in-hospital cardiac arrests.

The investigators reported data from the GWTG-Resuscitation registry of CPR outcomes in thousands of North American hospital patients in two landmark studies -- one in children, published January 2013, the other in adults, published in October 2012.

Berg was a co-author of the pediatric study, appearing online January 21 in Circulation, which analyzed hospital records of 3,419 children in the U.S. and Canada from 2000 through 2009. This study, whose first author was Renee I. Matos, M.D., M.P.H., a mentored young investigator, found that among children who suffered in-hospital cardiac arrest, more children than expected survived after prolonged CPR -- defined as CPR lasting longer than 35 minutes. Of those children who survived prolonged CPR, over 60 percent had good neurologic outcomes. The conventional thinking has been that CPR is futile after 20 minutes, but Berg said these results challenge that assumption.

In addition to Berg, two other co-authors are critical care and resuscitation science specialists at The Children's Hospital of Philadelphia: Vinay M. Nadkarni, M.D., and Peter A. Meaney, M.D., M.P.H.

Nadkarni noted that illness categories affected outcomes, with children hospitalized for cardiac surgery having better survival and neurological outcomes than children in all other patient groups.

The overall pediatric results paralleled those found in the adult study of 64,000 patients with in-hospital cardiac arrests between 2000 and 2008. Berg also was a co-author of that GWTG-R study, published in The Lancet on Oct. 27, and led by Brahmajee K. Nallamothu, M.P.H., M.D., of the University of Michigan. Patients at hospitals in the top quartile of median CPR duration (25 minutes), had a 12 percent higher chance of surviving cardiac arrest, compared to patients at hospitals in the bottom quartile of median CPR duration (16 minutes). Survivors of prolonged CPR had similar neurological outcomes to those who survived after shorter CPR efforts.

Matos et al. Duration of CPR and Illness Category Impact Survival and Neurologic Outcomes for In-Hospital Pediatric Cardiac Arrests. Circulation, Jan. 21, 2013

Zachary D Goldberger, Paul S Chan, Robert A Berg, Steven L Kronick, Colin R Cooke, Mingrui Lu, Mousumi Banerjee, Rodney A Hayward, Harlan M Krumholz, Brahmajee K Nallamothu. Duration of resuscitation efforts and survival after in-hospital cardiac arrest: an observational study. The Lancet, 2012; 380 (9852): 1473 DOI: 10.1016/S0140-6736(12)60862-9

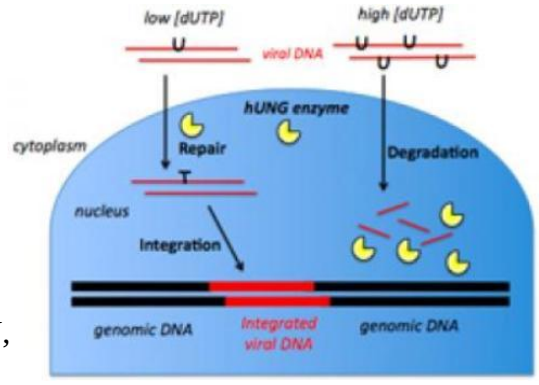
http://www.sciencedaily.com/releases/2013/01/130121161751.htm

How Cells' DNA Repair Machinery Can Destroy Viruses

A team of researchers based at Johns Hopkins has decoded a system that makes certain types of immune cells impervious to HIV infection.

The system's two vital components are high levels of a molecule that becomes embedded in viral DNA like a code written in invisible ink, and an enzyme that, when it reads the code, switches from repairing the DNA to chopping it up into unusable pieces. The researchers, who report the find in the Jan. 21 early edition of the Proceedings of the National Academy of Sciences, say the discovery points toward a new approach to eradicating HIV from the body.

"For decades, we've seen conflicting reports on whether each of these components helped protect cells from viruses," says James Stivers, Ph.D., a professor of pharmacology and molecular sciences at the Johns Hopkins University School of Medicine's Institute for Basic Biomedical Sciences. "By plotting how much of each are found in different types of cells, as well as the cells' response to HIV, we learned that both are needed to get the protective effect."



This is an illustration of what happens when viral DNA enters the nucleus of a cell with low dUTP levels (left) versus high dUTP levels (right). **Amy Weil**

Researchers have long known that DNA's code is made up of four building blocks called nucleotides, commonly abbreviated A, T, G, and C. Before a cell divides, DNA-copying enzymes string these nucleotides together based on existing templates, so that each of the new cells gets its own copy of the genome. But because the T nucleotide, dTTP, is very similar to dUTP, a fifth nucleotide that doesn't belong in DNA, the copying enzyme sometimes mistakenly puts in a U where there should be a T.

To prevent this, says Stivers, most human cell types have an enzyme whose job is to break down dUTP, keeping its levels very low. Another quality control measure is the enzyme hUNG2, which snips stray Us out of newly copied DNA strands, leaving the resulting holes to be filled by a different repair enzyme. Certain immune cells called resting cells lack the first quality-control mechanism because, Stivers explains, "They're not replicating their DNA and dividing, so they couldn't care less if they have a lot of dUTP."

This is a critical piece of information, Stivers says, because when a retrovirus like HIV invades a cell, its first order of business is to make a DNA copy of its own genome, then insert that copy into the host cell's genome. If there are many dUTPs floating around in the cell, they will likely make their way into the new viral DNA, and, potentially, later be snipped out by hUNG2. The question, Stivers says, left open by the conflicting results of previous studies, was what effect, if any, this process has on HIV and other viruses.

To address this question, Amy Weil, a graduate student in Stivers' laboratory, measured dUTP levels and hUNG2 activity in a variety of human cells grown in the laboratory, then exposed them to HIV. Cells with high dUTP but little hUNG2 activity succumbed easily to the virus, which appeared to function just fine with a U-ridden genome. Similarly, cells with low dUTP levels but high hUNG2 activity were susceptible to HIV. For these cells, it seemed, hUNG2 would snip out the few stray Us, but the resulting holes would be repaired, leaving the viral DNA as good as new.

But in cells with both high dUTP and vigilant hUNG2, the repair process turned into a hack job, Stivers says, leaving the viral DNA so riddled with holes that it was beyond repair. "It's like dropping a nuclear bomb on the viral genome," he says.

By showing how dUTP and hUNG2 work together to protect resting cells from infection, Stivers says, the study identifies a new pathway that could restrict HIV infection in non-dividing cells. Current anti-retroviral drugs effectively suppress the virus, but, Stivers explains, they miss copies of the virus that hide out in non-dividing cells, and "the minute you stop taking anti-retrovirals, it starts replicating again." He suggests that drug strategies could be devised to target this pathway in affected cells, possibly lessening the pool of viruses hiding out in non-dividing cells. The principle could also be applied to other retroviruses, he says, since they, like HIV, all make DNA copies of their genomes as part of the infection process.

Other authors on the paper were Devlina Ghosh, Yan Zhou, Lauren Seiple and Robert F. Siliciano of the Johns Hopkins University School of Medicine; Moira A. McMahon of the University of California, San Diego; and Adam M. Spivak of the University of Utah School of Medicine.

The study was funded by the National Institute of General Medical Sciences (grant number GM056834) and the National Institute of Allergy and Infectious Diseases Extramural Activities (grant number AI081600).

http://www.sciencedaily.com/releases/2013/01/130121161915.htm

New Way to Kill Lymphoma Without Chemotherapy

Golden Nanoparticle Starves Cancer Cell to Death

How do you annihilate lymphoma without using any drugs? Starve it to death by depriving it of what appears to be a favorite food: HDL cholesterol.

Northwestern Medicine® researchers discovered this with a new nanoparticle that acts like a secret double agent. It appears to the cancerous lymphoma cell like a preferred meal -- natural HDL. But when the particle engages the cell, it actually plugs it up and blocks cholesterol from entering. Deprived of an essential nutrient, the cell eventually dies.

A new study by C. Shad Thaxton, M.D., and Leo I. Gordon, M.D. shows that synthetic HDL nanoparticles killed B-cell lymphoma, the most common form of the disease, in cultured human cells, and inhibited human B-cell lymphoma tumor growth in mice. The paper will be published Jan. 21 in the journal Proceedings of the National Academy of Sciences.

"This has the potential to eventually become a nontoxic treatment for B-cell lymphoma which does not involve chemotherapy," said Gordon, a co-corresponding author with Thaxton on the paper. "It's an exciting preliminary finding." Gordon is a professor of medicine in hematology/oncology and Thaxton is an assistant professor of urology, both at Northwestern University Feinberg School of Medicine.

Gordon also is co-director of the hematologic malignancy program at the Robert H. Lurie Comprehensive Cancer Center of Northwestern University and a physician at Northwestern Memorial Hospital. Thaxton is also a member of the Lurie Cancer Center.

Lymphoma Gobbles HDL Cholesterol

Recent studies have shown that B-cell lymphoma is dependent on the uptake of natural HDL -- short for high-density lipoprotein -- from which it derives fat content, such as cholesterol.

The nanoparticle -- originally developed by Thaxton as a possible therapy for heart disease -- closely mimics the size, shape and surface chemistry of natural HDL particles. But it has one key difference: a five nanometer gold particle at its core. Thus, when the nanoparticle is incubated with human B-cell lymphoma cells or used to treat a mouse with the human tumor, it socks lymphoma with a double whammy. After it attaches to the lymphoma cell, the gold particle's spongy surface sucks out its cholesterol while the gold core prevents the cell from absorbing more cholesterol typically carried in the core of natural HDL particles.

The lymphoma research showed Thaxton that the HDL nanoparticle had more than one trick up its golden sleeve.

"At first I was heavily focused on developing nanoparticles that could remove cholesterol from cells, especially those involved in heart disease," Thaxton said. "The lymphoma work has broadened this focus to how the HDL nanoparticles impact both the removal and uptake of cholesterol by cells. We discovered the particles are multi-taskers." The Northwestern study also showed that natural HDL did not kill the cells or inhibit tumor growth. The nanoparticle was essential to starve the lymphoma cell.

Detour From Heart Disease to Cancer Killer

After developing the HDL nanoparticle, Thaxton gave a lecture in 2010 to Feinberg faculty. Gordon was in the audience. He knew that patients with advanced forms of B-cell lymphoma sometimes have dropping levels of cholesterol. A long-time lymphoma researcher and oncologist, Gordon was looking for new methods to deliver drugs to patients. He contacted Thaxton and they began to collaborate.

They tested the HDL nanoparticle alone and the HDL nanoparticle transporting cancer drugs. Surprisingly, the nanoparticle without drugs was just as effective at killing the B-cell lymphoma cells.

"We thought, 'That's odd. Why don't we need the drug?'" Gordon recalled.

That's when the scientists began delving into the mechanism by which the HDL nanoparticles were sticking to the HDL receptors on the lymphoma cell and manipulating cholesterol transport. In addition, patient samples analyzed by collaborators at Duke University for the study showed that lymphoma cells in patients had an overproduction of these HDL receptors compared to normal lymphocytes.

B-cell Lymphoma Most Common Lymphoma

The National Cancer Institutes reports that in 2012 there were about 70,000 new cases of non-Hodgkin lymphoma in the U.S. with nearly 19,000 deaths. About 90 percent of those new cases were B-cell lymphoma. Non-Hodgkin lymphoma is a cancer that starts in cells called lymphocytes, which are part of the body's immune system.

Why a Heart of Gold?

"Gold has a good track record of being compatible with biologic systems," Thaxton said.

Thaxton and Gordon are encouraged by their early data showing that the HDL nanoparticles do not appear toxic to other human cells normally targeted by HDLs, normal human lymphocytes or to mice. Also, because gold nanoparticles can be made in a discreet size and shape, they are excellent scaffolds for creating synthetic HDLs that closely mimic those found in nature.

"Like every new drug candidate, the HDL nanoparticle will need to undergo further testing," Thaxton noted.

S. Yang, M. G. Damiano, H. Zhang, S. Tripathy, A. J. Luthi, J. S. Rink, A. V. Ugolkov, A. T. K. Singh, S. S. Dave, L. I. Gordon, C. S. Thaxton. Biomimetic, synthetic HDL nanostructures for lymphoma. Proceedings of the National Academy of Sciences, 2013; DOI: 10.1073/pnas.1213657110

http://www.bbc.co.uk/news/world-africa-21080224

Using prawns to battle a killer disease in Senegal

Prawn farming in Senegal may hold the key to eradicating a common and deadly parasitic disease.

By Maud Jullien BBC Africa, Lampsar, Senegal

Researchers believe if the shell fish are reintroduced into the West African nation's rivers, they will eat the snails that host the parasite that causes schistosomiasis. Spread through contaminated water, the disease, also known as bilharzia, kills more than 200,000 people a year, according to UN figures.

More than two million more are infected each year by the parasitic worms which impair child growth and damage internal organs. "I've been infected with schistosomiasis for two years," says Gadiaga Diop from the village of Lampsar, about 20km (12 miles) from the city of Saint Louis.

Nearby children play and bathe in the sun as mothers wash household dishes and clothes in the Senegal River. It is a beguiling scene - as the water is dangerous with a 60% prevalence rate of schistosomiasis.

"It started with painful and bloody urination," says Ms Diop. "A doctor gave me pills, but they had side effects, so I also vomited, and had diarrhoea. "I was very tired, I lost weight, and I was afraid for my life."
Schistosomiasis is the second most common parasitic disease in the world after malaria - with 90% of cases in Africa. Complications include profuse bleeding in the digestive system that can lead to death. The infection can be treated fairly effectively with a drug called praziquantel.

No running water

The latest government campaign to distribute the pill has lowered bilharzia cases around Lampsar village from about 30 a month to less than 10, says Fatou Sarr Diouf, head of the regional health centre. But there is nothing to prevent re-infection.
The government has put up posters and organised talks to explain to the villagers that urinating in the water can make them sick, and that they should avoid bathing in the river at noon - the snails come out when the temperature is highest. But for as long as people are exposed to the river, they will be exposed to the disease.
"I feel better, but the disease won't go away completely," says Ms Diop. "I know it's because I keep going back to the river, but there is no running water here and I have to go there at least twice a day, to wash the dishes, do my laundry, wash my children. I'm afraid every time I go in, but I have no choice."
Scientists have been looking for ways to definitively eliminate the disease for years, especially since the 1980s, when there was an unprecedented bilharzia outbreak shortly after a dam was built on the Senegal River.
An organisation called Espoir Pour La Sante has been working on a vaccine for 20 years - and the results of the latest set of tests are due this month.
Those behind a new non-profit scheme called Project Crevette (Prawn) hope that by reintroducing prawns into the Senegal River, not only will the causes of the disease be wiped out, but the region will also benefit economically.
The idea was born after scientist Armand Kuris, from the University of California, proved that prawns eat the mollusc hosts. He shared his findings with Elizabeth Huttinger, who worked on public health development projects and went on to found Project Crevette. "I realised immediately that the idea of raising prawns and selling them through micro-commerce meant that the health effect could be sustainable," she says.

Fewer snails

Project Crevette is still at an experimental phase. Researchers first set up an enclosure around an area at one end of Lampsar village popular with bathers and filled it with more than 100 prawns. Another bathing site on the other side of the village was left untouched. Then 300 people were treated for schistosomiasis from the two sections of the village. Six months later, they were tested and it was found that there was a lower infection rate amongst those who bathed near the prawns - 80% lower than the area where there were no prawns. The researchers also reported that there were fewer snails in the areas of the river where the prawns were introduced.

Schistosomiasis
Also known as bilharzia
Affects more than 230 million people worldwide a year
The schistosomiasis-causing parasite is released by freshwater snails
The parasites are released into the water, and use fork tails to burrow into the skin
They travel to blood vessels that supply urinary and intestinal organs, including the liver, where they mature
Female worms, which live inside the thicker males, release many thousands of eggs each day
Eggs shed in urine and faeces may make their way into snail-inhabited water, where they hatch to release parasites that seek out snails to begin the cycle again

Before the dam was built, prawns were an important source of revenue for the locals.
"My father used to fish hundreds of prawns every day," recalls Batch Boye, a fisherman who works near the dam. "They sold well. Now it's very difficult for us, the younger generation, to make a living out of fishing."
But if the Project Crevette experiment continues to be conclusive, the biggest challenge will be to find a way to sustainably restore prawns to the river.
The river used to be their natural habitat, but the dam prevented the prawns from accessing salty water where they reproduce. The prawns being used in the experiments were imported from Cameroon, but Project Crevette wants to breed its prawns locally in the future and to involve local communities as much as possible.
A few months ago it set up a hatchery at the National Aquaculture Agency and is training four water farming students from Saint Louis University to breed prawns. They are hoping profit may prove a motivator.
Ahmadou Tidjane Camara, head of the National Aquaculture Agency, who backs the reintroduction, says the project is an opportunity for local technicians to learn to breed prawns. "The prawns could be a great source of profit for poor populations in the area," he says.

http://www.eurekalert.org/pub_releases/2013-01/pu-fdh012213.php

From dark hearts comes the kindness of mankind

Communal disavowal of greed originated when competing selfish individuals sought to control and cancel out one another

The kindness of mankind most likely developed from our more sinister and self-serving tendencies, according to Princeton University and University of Arizona research that suggests society's rules against selfishness are rooted in the very exploitation they condemn.

The report in the journal Evolution proposes that altruism — society's protection of resources and the collective good by punishing "cheaters" — did not develop as a reaction to avarice. Instead, communal disavowal of greed originated when competing selfish individuals sought to control and cancel out one another. Over time, the direct efforts of the dominant fat cats to contain a few competitors evolved into a community-wide desire to guard its own well-being.

The study authors propose that a system of greed dominating greed was simply easier for our human ancestors to manage. In this way, the work challenges dominant theories that selfish and altruistic social arrangements formed independently — instead the two structures stand as evolutionary phases of group interaction, the researchers write.

Second author Andrew Gallup, a former Princeton postdoctoral researcher in ecology and evolutionary biology now a visiting assistant professor of psychology at Bard College, worked with first author Omar Eldakar, a former Arizona postdoctoral fellow now a visiting assistant professor of biology at Oberlin College, and William Driscoll, an ecology and evolutionary biology doctoral student at Arizona.

To test their hypothesis, the researchers constructed a simulation model that gauged how a community withstands a system built on altruistic punishment, or selfish-on-selfish punishment. The authors found that altruism demands a lot of initial expenditure for the group — in terms of communal time, resources and risk of reprisal from the punished — as well as advanced levels of cognition and cooperation.

On the other hand, a construct in which a few profligate players keep like-minded individuals in check involves only those members of the community — everyone else can passively enjoy the benefits of fewer people taking more than their share. At the same time, the reigning individuals enjoy uncontested spoils and, in some cases, reverence.

Social orders maintained by those who bend the rules play out in nature and human history, the authors note: Tree wasps that police hives to make sure that no member other than the queen lays eggs will often lay illicit eggs themselves. Cancer cells will prevent other tumors from forming. Medieval knights would pillage the same civilians they readily defended from invaders, while neighborhoods ruled by the Italian Mafia traditionally had the lowest levels of crime.

What comes from these arrangements, the researchers conclude, is a sense of order and equality that the group eventually takes upon itself to enforce, thus giving rise to altruism.

The paper, "When Hawks Give Rise To Doves: The Evolution and Transition of Enforcement Strategies," was published online Jan. 11 by the journal Evolution. The work was supported by a grant from the National Institutes of Health.

www.sciencedaily.com/releases/2013/01/130122142841.htm

Simple Policy Change Could Solve U. S. Physician Shortages in 25 States

Equalizing licensure requirements for foreign-educated physicians and U.S.-educated physicians could end primary care physician shortages

According to a new University of Virginia study, half of the 50 states could end their primary care physician shortages, and save billions annually in health care costs, by a simple policy change: equalizing the licensure requirements for foreign-educated physicians and U.S.-educated physicians.

More than a quarter of physicians practicing today received their medical education outside of the U.S., and this dependence on foreign-trained physicians is poised to grow with the implementation of the Affordable Care Act and an aging population, notes the new study, "Doctors With Borders: Occupational Licensing as an Implicit Barrier to High Skill Migration," by U.Va. politics professors David Leblang and Sonal Pandya, and doctoral student Brenton Peterson.

All but a few states require graduates of non-U.S. medical schools to complete longer post-graduate residency training -- generally one to two years longer -- than graduates of U.S. medical schools before being eligible for a state license to practice medicine. Having a state license allows a new doctor to practice without supervision, opening the door to much higher earning potential. Prior research has found that maximizing expected earnings is the No. 1 determinant of location for international migration.

The additional requirements purportedly ensure that international medical graduates meet the same standards as American-trained doctors. But the study authors are skeptical of this rationale for a number of reasons.

First, in order to even be eligible to apply for residency training in the U.S., international medical graduates must demonstrate that their qualifications are equivalent to U.S. medical graduates by passing three sections of the U.S. Medical Licensing Exam.
The test is not easy; in 2008, only 42.6 percent of international medical graduates passed all three components of the test on their first try, and only 73 percent of those who passed all necessary exams eventually found a residency -- and getting a residency match is effectively an additional level of quality screening. This screening is effective, the authors note: post-licensure, according to other studies, there are few differences between U.S. and international medical graduates in patient health outcomes, or in the frequency of disciplinary actions by state medical boards.
The history of additional residency requirements suggests they were created as a barrier to entry, Pandya said. Historically, states frequently prohibited non-citizens from obtaining medical licenses, regardless of where they were educated, until the U.S. Supreme Court ruled this practice unconstitutional in the 1970s. Additional residency requirements for international medical graduates blossomed in the immediate wake of that ruling, suggesting the policies were created as a replacement for the outlawed citizenship restrictions.
Consistent with the hypothesis that state medical boards may be captured by physicians acting to pad their own bottom line, the study finds that states with self-financing medical boards (indicative of less public accountability than state-financed medical boards, the authors assert) are more likely to impose lengthier residency requirements for international medical graduates.
States that impose lengthier training requirements for international medical graduates reduce the expected returns to medical training, and not surprisingly, these states receive fewer migrant physicians. As further evidence of barriers to entry, jurisdictions with more onerous requirements have higher physician salaries and poorer quality medical service.
As of 2009, Pandya said, the five states with the worst physician shortages per million residents are New Mexico, Louisiana, Mississippi, Missouri and North Dakota, four of which require international medical graduates to complete three years of residency training versus one year for U.S. medical school graduates. The exception is New Mexico, which requires two years for both domestic and international graduates.
Lowering barriers to international medical graduates, Pandya said, is a particularly apt solution to address U.S. physician shortages -- a problem in much of the U.S., especially in primary care -- because those graduates are more likely than U.S.-trained medical graduates to become general practitioners, and more likely to work in localities suffering from physician shortages.
Using Department of Homeland Security records of the number of international medical graduates (those self-identifying as doctors) entering each state annually, the study authors modeled the expected physician migration if state residency requirements were equalized for U.S.- and foreign-educated physicians over the six-year period from 2004 to 2009.
The modeling found that 25 states would gain enough physicians to end their shortages. Physician gains vary widely from state to state, the study estimates. Large states would be the biggest gainers, with California, New York and Illinois gaining an estimated 3,321, 2,816 and 1,030 foreign-trained physicians, respectively, over six years. In contrast, Idaho, Wyoming and Montana would each gain fewer than two physicians. The expected increase in foreign physicians into a state correlates highly with the degree of physician shortage it faces.
This policy change would also generate sizable savings in health care costs, the authors estimate.
They calculated expected state health care cost savings based on existing estimates of the savings associated with reducing primary care physician shortages -- which reduce the number of preventable hospitalizations. The average state, they found, would see an approximately $139 million decline in annual health care costs through fewer hospital visits alone.
State-by-state estimates of annual cost reductions range from $615,669 for Wyoming to $1.28 billion for California. Nationwide, reduced hospital visits would have saved $6.23 billion annually, or $37.4 billion over six years, if states had eliminated their additional residency requirements from 2005-10.
The cost savings estimate is conservative, the authors note, because hospitalization is only one of several ways in which greater access to primary care physicians should lower health care costs. The estimate omits the effect of additional specialist physicians altogether, omits the wage-lowering effects of physician migration and ignores the value of better health in terms of economic growth and life-years gained.
"Each of these omissions suggest that we vastly underestimate the economic impact of eliminating international medical graduates' residency requirements in this counterfactual policy simulation," the study notes.
"While equalizing residency requirements would not completely satisfy physician needs in half the states, it is a straightforward, practical policy change that can result in measurable improvements in social welfare," Pandya said.

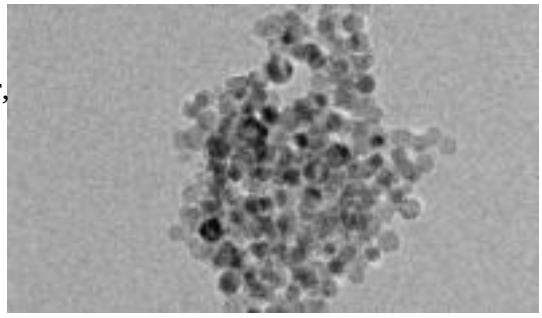
The study is published in the new working paper series of U.Va.'s Frank Batten School of Leadership and Public Policy, where Leblang is a professor of politics and public policy in addition to his posts as the J. Wilson Newman Professor of Governance at U.Va.'s Miller Center and chair of the Woodrow Wilson Department of Politics. The study is also currently under review at a peer-reviewed journal.

Link to working paper; http://www.batten.virginia.edu/content/2013-003-doctors-borders-occupational-licensing-implicit-barrier-high-skill-migration-david

http://www.sciencedaily.com/releases/2013/01/130122143224.htm

Just Add Water: How Scientists Are Using Silicon to Produce Hydrogen On Demand

Super-small particles of silicon react with water to produce hydrogen almost instantaneously, according to University at Buffalo researchers.



In a series of experiments, the scientists created spherical silicon particles about 10 nanometers in diameter. When combined with water, these particles reacted to form silicic acid (a nontoxic byproduct) and hydrogen -- a potential source of energy for fuel cells.

The reaction didn't require any light, heat or electricity, and also created hydrogen about 150 times faster than similar reactions using silicon particles 100 nanometers wide, and 1,000 times faster than bulk silicon, according to the study.

Transmission electron microscopy image showing spherical silicon nanoparticles about 10 nanometers in diameter. These particles, created in a UB lab, react with water to quickly produce hydrogen, according to new UB research. **(Credit: Swihart Research Group, University at Buffalo.)**

The findings appeared online in Nano Letters on Jan. 14. The scientists were able to verify that the hydrogen they made was relatively pure by testing it successfully in a small fuel cell that powered a fan.

"When it comes to splitting water to produce hydrogen, nanosized silicon may be better than more obvious choices that people have studied for a while, such as aluminum," said researcher Mark T. Swihart, UB professor of chemical and biological engineering and director of the university's Strategic Strength in Integrated Nanostructured Systems.

"With further development, this technology could form the basis of a 'just add water' approach to generating hydrogen on demand," said researcher Paras Prasad, executive director of UB's Institute for Lasers, Photonics and Biophotonics (ILPB) and a SUNY Distinguished Professor in UB's Departments of Chemistry, Physics, Electrical Engineering and Medicine. "The most practical application would be for portable energy sources."

Swihart and Prasad led the study, which was completed by UB scientists, some of whom have affiliations with Nanjing University in China or Korea University in South Korea. Folarin Erogbogbo, a research assistant professor in UB's ILPB and a UB PhD graduate, was first author.

The speed at which the 10-nanometer particles reacted with water surprised the researchers. In under a minute, these particles yielded more hydrogen than the 100-nanometer particles yielded in about 45 minutes. The maximum reaction rate for the 10-nanometer particles was about 150 times as fast.

Swihart said the discrepancy is due to geometry. As they react, the larger particles form nonspherical structures whose surfaces react with water less readily and less uniformly than the surfaces of the smaller, spherical particles, he said. Though it takes significant energy and resources to produce the super-small silicon balls, the particles could help power portable devices in situations where water is available and portability is more important than low cost. Military operations and camping trips are two examples of such scenarios.

"It was previously unknown that we could generate hydrogen this rapidly from silicon, one of Earth's most abundant elements," Erogbogbo said. "Safe storage of hydrogen has been a difficult problem even though hydrogen is an excellent candidate for alternative energy, and one of the practical applications of our work would be supplying hydrogen for fuel cell power. It could be military vehicles or other portable applications that are near water."

"Perhaps instead of taking a gasoline or diesel generator and fuel tanks or large battery packs with me to the campsite (civilian or military) where water is available, I take a hydrogen fuel cell (much smaller and lighter than the generator) and some plastic cartridges of silicon nanopowder mixed with an activator," Swihart said, envisioning future applications. "Then I can power my satellite radio and telephone, GPS, laptop, lighting, etc. If I time things right, I might even be able to use excess heat generated from the reaction to warm up some water and make tea."

Folarin Erogbogbo, Tao Lin, Phillip M. Tucciarone, Krystal M. LaJoie, Larry Lai, Gauri D. Patki, Paras N. Prasad, Mark T. Swihart. On-Demand Hydrogen Generation using Nanosilicon: Splitting Water without Light, Heat, or Electricity. Nano Letters, 2013; : 130117162526001 DOI: 10.1021/nl304680w

http://www.sciencedaily.com/releases/2013/01/130122163854.htm

NASA's Veteran Mars Rover Ready to Start 10th Year

Mars Exploration Rover Opportunity bounced to airbag-cushioned safe landings on Mars nine years ago this week

NASA's Mars Exploration Rover Opportunity, one of the twin rovers that bounced to airbag-cushioned safe landings on Mars nine years ago this week, is currently examining veined rocks on the rim of an ancient crater. Opportunity has driven 22.03 miles (35.46 kilometers) since it landed in the Meridiani Planum region of Mars on Jan. 24, 2004, PST (Jan. 25, Universal Time). Its original assignment was to keep working for three months, drive about 2,000 feet (600 meters) and provide the tools for researchers to investigate whether the area's environment had ever been wet. It landed in a backyard-size bowl, Eagle Crater. During those first three months, it transmitted back to Earth evidence that water long ago soaked the ground and flowed across the surface. Since then, the mission's team at NASA's Jet Propulsion Laboratory, Pasadena, Calif., has driven Opportunity across the plains of Meridiani to successively larger craters for access to material naturally exposed from deeper, older layers of Martian history.

Opportunity has operated on Mars 36 times longer than the three months planned as its prime mission. "What's most important is not how long it has lasted or even how far it has driven, but how much exploration and scientific discovery Opportunity has accomplished," said JPL's John Callas, manager of NASA's Mars Exploration Rover Project. The project has included both Opportunity and its twin, Spirit, which ceased operations in 2010.

This month, Opportunity is using cameras on its mast and tools on its robotic arm to investigate outcrops on the rim of Endeavour Crater, 14 miles (22 kilometers) in diameter. Results from this area of the rim, called "Matijevic Hill," are providing information about a different, possibly older wet environment, less acidic than the conditions that left clues the rover found earlier in the mission.

Timed with the anniversary of the landing, the rover team has prepared a color panorama of the Matijevic Hill area. The image is online at: http://photojournal.jpl.nasa.gov/catalog/pia16703 .

JPL, a division of the California Institute of Technology in Pasadena, manages the Mars Exploration Rover Project for NASA's Science Mission Directorate, Washington. JPL also manages the Mars Science Laboratory Project and its rover, Curiosity. For more information about Opportunity, visit http://www.nasa.gov/rovers and http://marsrovers.jpl.nasa.gov . You can follow the project on Twitter and on Facebook at: http://twitter.com/MarsRovers and http://www.facebook.com/mars.rovers .

http://www.bbc.co.uk/news/health-21143602

First UK live liver donation to a stranger takes place

A 21-year-old man has donated a quarter of his liver to a complete stranger in the first UK operation of its kind.

By Smitha Mundasad BBC News

Daniel Broadhead, who underwent the four-hour operation in December, says he made the decision on purely altruistic grounds. But this selfless act carries risks - there is a chance of one death in 200 procedures and the long-term effects on donors' health are not fully understood, experts say.

With more than 400 people currently waiting for a life-saving liver transplant in the UK, this type of donation needs serious consideration, doctors say. A shortage of organs in the UK means one in five people who need a liver transplant will die before a suitable one is found. Most people on the waiting list have to rely on organs that become available when someone on the organ donor register dies.

But a few now opt for living liver donation, a procedure more commonly carried out in countries where donations from people who have died are considered unacceptable on religious grounds.

So far every living liver donor in the UK has been a relative or friend of the recipient, undertaking this complex surgery in an attempt to save the lives of children and adults close to them.

'Physical risks'

And despite having more than 500 different functions in the body, the liver has the ability to regenerate, making successful live donation possible.

But all living liver donors - whether they are related to the recipient or not - must carefully consider the two types of risks they face, says Dr Varuna Aluvihare, a transplant specialist at King's College Hospital, London.

There are the physical risks - first and foremost the risk of death - which is one in 200 cases.

This is considerably higher than the risk of death from more commonly carried out live kidney transplants - which is one death in every 1,700 cases. And donors face a one in five chance of complications from surgery. Most of these can be relatively minor - for example treatable infections and pain after the operation.

But in rare cases donors' livers fail and they can end up needing transplants themselves, says Dr Aluvihare.

Raj Prasad, clinical director for surgery and transplantation at St James's University Hospital, Leeds, who undertook Mr Broadhead's operation, said in terms of the long-term risk to donors' health there is data spanning the first 12 years after donation which looks encouraging.
But possible future complications are less well known, he says.

Psychological assessment

There are also psychological risks - all living donors undergo rigorous psychological assessments too. There have been some reports of donors suffering from psychiatric conditions including depression after donation, Dr Aluvihare says.
But altruistic donations, in which the donor has no connection to the recipient, need special consideration, says Mr Prasad. He says that the donor needs to be checked that they have the capacity to make rational decisions and that the motivation for donation is clear.
Mr Broadhead under went two psychological assessments and the many medical tests all potential donors face.
"It was very clearly Daniel's wish to go ahead. He was in the right frame of mind and his state of health was right," said Mr Prasad.
His family were offered support too, but they found it hard to come to terms with his choice. "They found it difficult to understand why I would put myself in harm's way for someone I didn't know," Mr Broadhead says.
"I tried to explain my reasons - that someone out there was going to die if not given a liver and while I am fit and healthy, I can do it. So why wouldn't I?" Hearing about the risks involved did not deter him.

'Do it again'

"I tried to think of the risks from the point of view of the child who needed a liver so I kept the risks to myself to the back of my mind," he said.
The operation took place six weeks ago and has left Mr Broadhead with a 6in (15cm) scar. Apart from a little pain when he goes for long walks, he is now recovering well and is even considering going back to work soon.
In fact, he says he would do it all over again if he could and would encourage other people to do the same.
But whether more altruistic donations should take place is open for debate.
Both Mr Prasad and Dr Aluvihare agree there is a place for encouraging more living donations from relatives.
And both doctors admire Mr Broadhead for taking on such risks to save a young person.
"But I personally have some reservations about altruistic donations. I believe if we did everything we can to improve the supply of donations after death we wouldn't have a need for this type of donation," Dr Aluvihare says. He suspects the psychological risk may be greater for altruistic donors than for people who donate to their relatives and friends.
And the physical risks cannot be forgotten. "If we do 400 of these then statistically at least one altruistic donor will die and that immediately changes our perspective on this."

http://www.eurekalert.org/pub_releases/2013-01/plos-hrl011813.php

Hailstones reveal life in a storm cloud

Scientists make first inventory of microbes, soil chemicals in storm clouds

It isn't life on Mars, but researchers have found a rich diversity of microbial life and chemicals in the ephemeral habitat of a storm cloud, according to a study published January 23 in the open access journal PLOS ONE by Tina Šantl Temkiv and colleagues from Aarhus University, Denmark.
The researchers analyzed hailstones recovered after a storm in May 2009 and found that they carried several species of bacteria typically found on plants and almost 3000 different compounds usually found in soil.
However, the hailstones had very few soil-associated bacteria or chemicals that would usually occur in plants.
Three of the bacterial species discovered were found in most of the hailstones studied, and may represent 'typical' cloud inhabitants, the study reports.
According to the authors, this selective enrichment of certain plant bacteria and soil chemicals in the hailstones reveals how specific processes during the lifetime of a cloud may impact certain bacteria more than others.
They suggest that these processes could affect the long-distance transport and geographical distribution of microbes on Earth.
"When we started these analyses, we were hoping to arrive at a merely descriptive characterization of the bacterial community in an unexplored habitat. But what we found was indirect evidence for life processes in the atmosphere, such as bacterial selection and growth," says Ulrich Gosewinkel Karlson, leader of the aeromicrobiology research group at Aarhus University.

Citation: Santl-Temkiv T, Finster K, Dittmar T, Hansen BM, Thyrhaug R, et al. (2013) Hailstones: A Window into the Microbial and Chemical Inventory of a Storm Cloud. PLOS ONE 8(1): e53550. doi:10.1371/journal.pone.0053550
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http://www.sciencedaily.com/releases/2013/01/130123091658.htm?

Emerging Antibiotic Resistance in Listeria Discovered in Frozen Burger Patties

Malaysian researchers have revealed the presence of multidrug-resistant strains of Listeria monocytogenes in frozen burger patties taken from supermarkets and other retail shops in Malaysia.

A recent publication by W.C. Wong and colleagues in the Pertanika Journal of Tropical Agricultural Science revealed the presence of multidrug-resistant strains of Listeria monocytogenes in frozen burger patties taken from supermarkets and other retail shops in Malaysia. The research was published in Pertanika Journal of Tropical Agricultural Science. The results also suggested that the overall incidence of antibiotic resistance in L. monocytogenes is relatively low, and that most of the bacterial strains isolated from food are susceptible to antibiotics commonly used in veterinary and human therapy.

Often found in raw foods, L. monocytogenes can cause listeriosis when ingested. Symptoms may range from gastrointestinal upset to headaches, fever and, in severe cases, brain infection and/or blood poisoning. Those at highest risk include pregnant women, newborns and the elderly, as well as people with weakened immune systems. Early diagnosis of listeriosis increases the likelihood of applying appropriate antibiotic treatment before serious consequences occur. The most commonly used antibiotics for treating Listeria infections are ampicillin, penicillin, trimethoprim, tetracycline, erythromycin and gentamicin.

In this study, researchers examined the susceptibility of L. monocytogenes isolated from raw beef, chicken and vegetarian patties to 11 different antibiotics. Thirteen out of 41 bacteria samples or isolates were not resistant to any of the antibiotics, while 28 were resistant to at least one. Moreover, 19 out of 41 isolates showed resistance to at least two antibiotics. The most common form of antibiotic resistance was tetracycline resistance, followed by erythromycin resistance. However, none of the 41 isolates were resistant to imipenem or gentamicin.

Antibiotic-resistant L. monocytogenes strains were first reported in 1988. The spread of antibiotic-resistant bacteria is accelerating worldwide, partly due to the over-prescription of drugs in clinical settings and the heavy use of antibiotics as growth promoters in livestock husbandry. The authors recommend the continuous monitoring of antimicrobial resistance in L. monoctyogenes to assure the ongoing effectiveness of listeriosis treatment.

Wong, W. C., Pui, C. F., Tunung, R., Ubong, A., Noor Hidayah, M. S., Farinazleen, M. G., Noorlis, A., Cheah, Y. K. and Son, R. Antibiogram Pattern among Cultures of Listeria monocytogenes Isolated from Frozen Burger Patties in Malaysia. Pertanika J. Trop. Agric. Sci., 35 (4): 793 - 804 (2012)

http://bit.ly/WuGqI2

Diapers Hinder Walking for Babies

A new study finds that diapers, both disposable and cloth, impede walking for babies. Christie Nicholson reports

It's a given that most babies wear diapers, in western cultures anyway. But diapers may trap more than waste—they may also confine a baby's ability to walk.

Scientists compared the walking gaits of 60 babies who were either naked, wore a thin disposable diaper or a thick cloth diaper.

Half the babies were 13-month-old novice walkers and the other half 19-month-old experienced walkers.

When the 30 13-month-olds walked naked only 10 fell, but while wearing the cloth diaper 21 of them fell, and while wearing the disposable 17 of them fell.

Among the 19-month-olds only four fell while naked or wearing disposables, while eight fell when wearing cloth diapers. But both age groups took wider and shorter steps while wearing diapers as opposed to walking naked.

The research is in the journal Developmental Science. *[Whitney G. Cole, Jesse M. Lingeman and Karen E. Adolph, Go naked: diapers affect infant walking]*

Because the effects were immediate, this study cannot predict if wearing diapers has a long-term impact. Nonetheless, the researchers believe walking naked would speed up walking development.

But then we are left with the issue of covering the entire house in plastic and relying heavily on the child's ability to communicate his or her elimination intentions.

http://phys.org/news/2013-01-starchy-genes-dog-friend.html

Starchy genes made dog into Man's best friend, study reports

Why some wolves became dogs

Key genetic changes allowed certain canines to eat starchy scraps left by humans, study shows.

The question of how some wolves evolved into the trusty dogs that work on farms, lead the blind and curl up on pillows in bedrooms has remained largely unanswered. Until now.

An international team of researchers used complex genetic analysis and an understanding of archeology, ecology, biochemistry and agricultural science to discover that adaptations that allowed dogs to thrive on starch-rich diets was central to the domestication of canines.

"I think the domestication of dogs is especially interesting because we have such a special relationship with dogs; they stand out in terms of being domesticated animals, as they become part of our families," explained study author Erik Axelsson, an assistant professor at Uppsala University, in Sweden.

The transition from wolf to dog was relatively simple. In early agricultural settlements, "humans began to gather their trash into small waste dumps, which might have attracted wolves because the waste dumps provided a relatively constant supply of food," Axelsson explained. "That sort of nutrition must have been the leftover remains—of what they ate, which included starch."

To be an efficient scavenger, a wolf had to have an effective method of digesting starch, he said. "Some wolves were slightly better than others at digesting starch and had an advantage. A natural selection process created animals that we later called dogs."

Axelsson said it's actually easy to envision how it might have happened. To be able to effectively grab food out of the waste dump, dogs had to be comfortable around people. "Imagine a shy wolf running away every time it saw a human," he noted.

As for when the evolution of wolves into dogs may have occurred, Axelsson said it's hard to give a well-defined time. He said both archeological and genetic data suggests it could have happened anywhere from 6,000 to 30,000 years ago.

While the evidence isn't conclusive, Axelsson noted that the genetic data combined with the researchers' collective understanding of archeology and other fields fits their conclusion: dogs' increased ability to thrive on starchy food, as opposed to the meat-rich diets of wolves, represents an important step in domestication. The research was published in the Jan. 23 issue of the journal Nature.

To understand the genetic changes associated with the transition from wolves to dogs, the researchers compared whole-genome sequences of domesticated dogs with those of wolves. Genomes are a full set of chromosomes representing all the inheritable traits of a single organism.

From 3.8 million genetic variants, the researchers identified 36 targeted genetic regions that likely played a role in the domestication of dogs. Eight of these regions had genes related to nervous system pathways and 10 had genes involved in starch digestion.

Axelsson explained how the researchers know when they've identified something critical through the genetic analysis: "When a mutation occurs, it will arise in one individual and if the mutation confers a good trait—in this case being able to digest starch—then in a relatively short time period, everyone will carry that mutation. Usually there are lots of other mutations, too, but nearby that mutation for the good trait, there won't be any other mutations or genetic variations in that region."

So, "When all dogs look similar on the genetic level, then you have a signal, or a sign, that selection is happening," Axelsson said.

The researchers said that the study results show how coping with an increasingly starch-rich diet when humans began to grow their own food caused similar adaptive responses in dog and human.

While this may all sound quite academic, Dr. Amber Andersen, a veterinarian at Point Vicente Animal Hospital in Palos Verdes, Calif., said the research provides practical guidance about what your beloved dog should be eating.

"There has always been this argument that dogs are meant to eat meat, but now I can feel even more confident telling my clients that dogs have adapted to eat starches and can eat them in kibble, for example, unless there's a specific allergy or a chronic medical condition where we're concerned about starch digestion," Andersen said.

Andersen added that the study also points to the importance of understanding that people and their dogs and other pets inhabit a common environment, including the home, the backyard and the community. "Since the very beginning, there's been this shared environment," Anderson noted.

More information: To learn more about the history of dogs, go to the Archaeological Institute of America.

Paper: dx.doi.org/10.1038/nature11837

http://www.eurekalert.org/pub_releases/2013-01/ps-fcr012313.php

Free clinics reduce emergency department visits

People who receive primary care from free clinics are less likely to use the emergency department for minor issues, according to a team of medical researchers.

HERSHEY, Pa. -- Nationally, the number of emergency departments (EDs) has decreased yet the number of ED visits has gone up, the team reported. Therefore, it is important to figure out how to reduce unnecessary ED visits. According to the National Association of Free and Charitable Clinics, there are more than 1,200 free clinics nationwide. Many of these clinics work in cooperation with one of their local hospitals.

Wenke Hwang, associate professor of public health sciences at Penn State College of Medicine, and his colleagues analyzed records of uninsured patients from five hospitals and four free clinics across neighboring Virginia communities.

Over three years, 52,010 individual uninsured patients visited at least one of the hospitals' five emergency departments a total of 99,576 times. The researchers found that approximately 10 percent of those ED visits were by patients who had been treated at free clinics associated with the hospitals in the first two years studied. Their results are reported in a recent article in the Journal of Health Care for the Poor and Underserved.

Hwang compared the diagnoses at the time of admittance to the emergency department between the free clinic patients and the non-free clinic patients. The five most common diagnoses were identical for both groups -- sprains and strains, disorders of teeth and jaw, superficial injury or contusion, abdominal pain and back problems.

The secondary diagnoses were not as similar for the two groups, but the researchers found mental health and substance abuse to be the most common underlying condition for both groups of uninsured patients.

"Emergency department visits by free clinic patients were less likely to require the lowest levels of care, suggesting uninsured free clinic users were less likely to use the emergency department as their primary care provider," the researchers wrote.

The researchers determined that half of the ED visits in this study were avoidable, using the measurements the hospitals themselves use. By providing primary care for the uninsured, free clinics are able to help reduce non-emergency visits to the ED. "The emergency department is an extremely expensive and inefficient way to handle many problems that show up there," said Hwang. "If hospitals support local free clinics, the ED will be less crowded and therefore have less need for expensive expansions. Free clinics are the cheaper solution."

Kimberly Liao, research associate, public health sciences, Penn State College of Medicine; Leah Griffin, statistician, biostatistical sciences, Wake Forest University School of Medicine; and Kristie Long Foley, associate professor, medical humanities, Davidson College, Davidson, North Carolina, also contributed to this research.

All hospitals in this study are members of the Hospital Corporation of America, which also supported this research.

http://www.eurekalert.org/pub_releases/2013-01/osu-sup012313.php

Scientists underestimated potential for Tohoku quake. Now what?

Earthquake scientists are going back to the drawing board and admitting that existing predictive models of maximum earthquake size are not valid

CORVALLIS, Ore. –The massive Tohoku, Japan, earthquake in 2011 and Sumatra-Andaman superquake in 2004 stunned scientists because neither region was thought to be capable of producing a megathrust earthquake with a magnitude exceeding 8.4. Now earthquake scientists are going back to the proverbial drawing board and admitting that existing predictive models looking at maximum earthquake size are no longer valid.

In a new analysis published in the journal Seismological Research Letters, a team of scientists led by Oregon State University's Chris Goldfinger describes how past global estimates of earthquake potential were constrained by short historical records and even shorter instrumental records. To gain a better appreciation for earthquake potential, he says, scientists need to investigate longer paleoseismic records.

"Once you start examining the paleoseismic and geodetic records, it becomes apparent that there had been the kind of long-term plate deformation required by a giant earthquake such as the one that struck Japan in 2011," Goldfinger said. "Paleoseismic work has confirmed several likely predecessors to Tohoku, at about 1,000-year intervals."

The researchers also identified long-term "supercycles" of energy within plate boundary faults, which appear to store this energy like a battery for many thousands of years before yielding a giant earthquake and releasing the pressure. At the same time, smaller earthquakes occur that do not dissipate to any great extent the energy stored within the plates. The newly published analysis acknowledges that scientists historically may have underestimated the number of regions capable of producing major earthquakes on a scale of Tohoku.

"Since the 1970s, scientists have divided the world into plate boundaries that can generate 9.0 earthquakes versus those that cannot," said Goldfinger, a professor in OSU's College of Earth, Ocean, and Atmospheric

Sciences. "Those models were already being called into question when Sumatra drove one stake through their heart, and Tohoku drove the second one.
"Now we have no models that work," he added, "and we may not have for decades. We have to assume, however, that the potential for 9.0 subduction zone earthquakes is much more widespread than originally thought."
Both Tohoku and Sumatra were written off in the textbooks as not having the potential for a major earthquake, Goldfinger pointed out. "Their plate age was too old, and they didn't have a really large earthquake in their recent history," Goldfinger said. "In fact, if you look at a northern Japan seismic risk map from several years ago, it looks quite benign – but this was an artifact of recent statistics."
Paleoseismic evidence of subduction zone earthquakes is not yet plentiful in most cases, so little is known about the long-term earthquake potential of most major faults. Scientists can determine whether a fault has ruptured in the past – when and to what extent – but they cannot easily estimate how big a specific earthquake might have been. Most, Goldfinger says, fall into ranges – say, 8.4 to 8.7.
Nevertheless, that type of evidence can be more telling than historical records because it may take many thousands of years to capture the full range of earthquake behavior.
In their analysis, the researchers point to several subduction zone areas that previously had been discounted as potential 9.0 earthquake producers – but may be due for reconsideration. These include central Chile, Peru, New Zealand, the Kuriles fault between Japan and Russia, the western Aleutian Islands, the Philippines, Java, the Antilles Islands and Makran, Pakistan/Iran.
Onshore faults such as the Himalayan Front may also be hiding outsized earthquakes, the researchers add. Their work was supported by the National Science Foundation.
Goldfinger, who directs the Active Tectonics and Seafloor Mapping Laboratory at Oregon State, is a leading expert on the Cascadia Subduction Zone off the Pacific Northwest coast of North America. His comparative studies have taken him to the Indian Ocean, Japan and Chile, and in 2007, he led the first American research ship into Sumatra waters in nearly 30 years to study similarities between the Indian Ocean subduction zone and Cascadia.
Paleoseismic evidence abounds in the Cascadia Subduction Zone, Goldfinger pointed out. When a major offshore earthquake occurs, the disturbance causes mud and sand to begin streaming down the continental margins and into the undersea canyons. Coarse sediments called turbidites run out onto the abyssal plain; these sediments stand out distinctly from the fine particulate matter that accumulates on a regular basis between major tectonic events.
By dating the fine particles through carbon-14 analysis and other methods, Goldfinger and colleagues can estimate with a great deal of accuracy when major earthquakes have occurred. Over the past 10,000 years, there have been 19 earthquakes that extended along most of the Cascadia Subduction Zone margin, stretching from southern Vancouver Island to the Oregon-California border.
"These would typically be of a magnitude from about 8.7 to 9.2 – really huge earthquakes," Goldfinger said. "We've also determined that there have been 22 additional earthquakes that involved just the southern end of the fault. We are assuming that these are slightly smaller – more like 8.0 – but not necessarily. They were still very large earthquakes that if they happened today could have a devastating impact."
Other researchers on the analysis include Yasutaka Ikeda of University of Tokyo, Robert S. Yeats of Oregon State University, and Junjie Ren, of the Chinese Seismological Bureau.

http://www.eurekalert.org/pub_releases/2013-01/afot-occ012313.php

Oxygen chamber can boost brain repair

Hyperbaric treatment has significantly resuscitated activity in damaged brains, Tel Aviv University researchers find

Stroke, traumatic injury, and metabolic disorder are major causes of brain damage and permanent disabilities, including motor dysfunction, psychological disorders, memory loss, and more. Current therapy and rehab programs aim to help patients heal, but they often have limited success.
Now Dr. Shai Efrati of Tel Aviv University's Sackler Faculty of Medicine has found a way to restore a significant amount of neurological function in brain tissue thought to be chronically damaged — even years after initial injury. Theorizing that high levels of oxygen could reinvigorate dormant neurons, Dr. Efrati and his fellow researchers, including Prof. Eshel Ben-Jacob of TAU's School of Physics and Astronomy and the Segol School of Neuroscience, recruited post-stroke patients for hyperbaric oxygen therapy (HBOT) — sessions in high pressure chambers that contain oxygen-rich air — which increases oxygen levels in the body tenfold.
Analysis of brain imaging showed significantly increased neuronal activity after a two-month period of HBOT treatment compared to control periods of non-treatment, reported Dr. Efrati in PLoS ONE. Patients experienced

improvements such as a reversal of paralysis, increased sensation, and renewed use of language. These changes can make a world of difference in daily life, helping patients recover their independence and complete tasks such as bathing, cooking, climbing stairs, or reading a book.

Oxygen breathes new life into neurons

According to Dr. Efrati, there are several degrees of brain injury. Neurons impacted by metabolic dysfunction have the energy to stay alive, but not enough to fire electric signals, he explains. HBOT aims to increase the supply of energy to these cells.

The brain consumes 20 percent of the body's oxygen, but that is only enough oxygen to operate five to ten percent of neurons at any one time. The regeneration process requires much more energy. The tenfold increase in oxygen levels during HBOT treatment supplies the necessary energy for rebuilding neuronal connections and stimulating inactive neurons to facilitate the healing process, explains Dr. Efrati.

For their study, the researchers sought post stroke patients whose condition was no longer improving. To assess the potential impact of HBOT treatment, the anatomical features and functionality of the brain were evaluated using a combination of CT scans to identify necrotic tissue, and SPECT scans to determine the metabolic activity level of the neurons surrounding damaged areas.

Seventy-four participants spanning 6 to 36 months post-stroke were divided into two groups. The first treatment group received HBOT from the beginning of the study, and the second received no treatment for two months, then received a two-month period of HBOT treatment. Treatment consisted of 40 two-hour sessions five times weekly in high pressure chambers containing oxygen-rich air. The results indicate that HBOT treatment can lead to significant improvement in brain function in post stroke patients even at chronically late stages, helping neurons strengthen and build new connections in damaged regions.

A potential avenue for prevention

Although the study focuses on patients only through three years post-stroke, Dr. Efrati has seen similar improvement in patients whose brain injuries occurred up to 20 years before, belying the concept that the brain has a limited window for growth and change. "The findings challenge the leading paradigm since they demonstrate beyond any doubt that neuroplasticity can still be activated for months and years after acute brain injury, thus revealing that many aspects of the brain remain plastic into adulthood," says Prof. Ben-Jacob.

This study also "opens the gate into a new territory of treatment," adds Dr. Efrati. The researchers are currently conducting a study on the benefits of HBOT for those with traumatic brain injury. This treatment also has potential as an anti-aging therapy, applicable in other disorders such as Alzheimer's disease and vascular dementia at their early stages.

"It is now understood that many brain disorders are related to inefficient energy supply to the brain," explains Dr. Efrati. "HBOT treatment could right such metabolic abnormalities before the onset of full dementia, where there is still potential for recovery."

http://www.sciencedaily.com/releases/2013/01/130123133930.htm

Retrovirus in the Human Genome Is Active in Pluripotent Stem Cells

A retrovirus which inserted itself into the human genome millions of years ago, may play an important role in pluripotent stem cells

A retrovirus called HERV-H, which inserted itself into the human genome millions of years ago, may play an important role in pluripotent stem cells, according to a new study published in the journal Retrovirology by scientists at UMass Medical School. Pluripotent stem cells are capable of generating all tissue types, including blood cells, brain cells and heart cells. The discovery, which may help explain how these cells maintain a state of pluripotency and are able to differentiate into many types of cells, could have profound implications for therapies that would use pluripotent stem cells to treat a range of human diseases.

"What we've observed is that a group of endogenous retroviruses called HERV-H is extremely busy in human embryonic stem cells," said Jeremy Luban, MD, the David L. Freelander Memorial Professor in HIV/AIDS Research, professor of molecular medicine and lead author of the study. "In fact, HERV-H is one of the most abundantly expressed genes in pluripotent stem cells and it isn't found in any other cell types."

In the study, Dr. Luban and colleagues describe how RNA from the HERV-H sequence makes up as much as 2 percent of the total RNA found in pluripotent stem cells. The HERV-H sequence is controlled by the same factors that are used to reprogram skin cells into induced pluripotent stem (iPS) cells, a discovery that garnered the 2012 Nobel Prize in Physiology or Medicine. "In other words, HERV-H is a new marker for pluripotency in humans that has the potential to aid in the development of iPS cells and transform current stem cell technology," said Luban.

When a retrovirus infects a cell, it inserts its own genes into the chromosomal DNA of the host cell. As a result, the host cell treats the viral genome as part of its own DNA sequence and begins making the proteins required to assemble new copies of the virus. And because the retrovirus is now part of the host cell's genome, when the cell divides, the virus is inherited by all daughter cells.

In rare cases, it's believed that retroviruses can infect human sperm or egg cells. If this happens, and if the resulting embryo survives, the retrovirus can become a permanent part of the human genome, and be passed down from generation to generation. Scientists estimate that as much as 8 percent of the human genome may be composed of extinct retroviruses left over from infections that occurred millions of years ago. Yet these sequences of fossilized retrovirus were thought to have no discernible functional value. "The human genome is filled with retrovirus DNA thought to be no more than fossilized junk," said Luban. "Increasingly, there are indications that these sequences might not be junk. They might play a role in gene expression after all."

An expert in HIV and other retroviruses, Luban and his colleagues were seeking to understand if there was a rationale behind where, in the expansive human genome, retroviruses inserted themselves. Knowing where along the chromosomal DNA retroviruses might attack could potentially lead to the development of drugs that protect against infection; better gene therapy treatments; or novel biomarkers that would predict where a retrovirus would insert itself in the genome, said Luban.

Turning these same techniques on the retrovirus sequences already in the human genome, they discovered a sequence, HERV-H, that appeared to be active. "The sequences weren't making proteins because they had been so disrupted over millions of years, but they were making these long, noncoding RNAs," said Luban.

Specifically, the HERV-H sequence was making abundant amounts of RNA in human embryonic stem cells -- and only stem cells. In total, there are more than 1,000 HERV-H retrovirus genomes scattered throughout the human genome. The Luban lab also found high levels of HERV-H RNA in some iPS cells. Other iPS cells, perhaps those lines that were not sufficiently reprogrammed to pluripotency, had lower levels of the HERV-H RNA, another indication that HERV-H may be an important marker for pluripotency. Interestingly, the HERV-H genes that were expressed in human pluripotent stem cells are only found in the human and chimpanzee genomes, indicating that HERV-H infected a relatively recent ancestor to humans, said Luban.

"Once upon a time HERV-H was an invader to our genome and perhaps caused diseases like AIDS or cancer," said Luban. "Now it seems that a kind of détente has been reached. Not only that, but this ancient invader may one day be exploited by clinicians to cure people of a wide range of diseases using stem cell therapies."

Luban and colleagues will next try to determine the specific mechanisms by which HERV-H contributes to pluripotency.

Federico A Santoni, Jessica Guerra, Jeremy Luban. HERV-H RNA is abundant in human embryonic stem cells and a precise marker for pluripotency. Retrovirology, 2012; 9 (1): 111 DOI: 10.1186/1742-4690-9-111

http://www.eurekalert.org/pub_releases/2013-01/plos-hvi012213.php

HIV-like viruses in non-human primates have existed much longer than previously thought

Viruses similar to those causing AIDS present in non-human primates in Africa up to 12 million years ago

Viruses similar to those that cause AIDS in humans were present in non-human primates in Africa at least 5 million years ago and perhaps up to 12 million years ago, according to study published January 24 in the Open Access journal PLOS Pathogens by scientists at Fred Hutchinson Cancer Research Center. Until now, researchers have hypothesized that such viruses originated much more recently.

HIV-1, the virus responsible for AIDS, infiltrated the human population in the early 20th century following multiple transmissions of a similar chimpanzee virus known as SIVcpz. Previous work to determine the age of HIV-like viruses, called lentiviruses, by comparing their genetic blueprints has calculated their origin to be tens of thousands of years ago.

However, other researchers have suspected this time frame to be much too recent. Michael Emerman, Ph.D., a virologist and member of the Human Biology Division at Fred Hutchinson Cancer Research Center, and Alex Compton, a graduate student in the Emerman Lab, describe the use of a technique to estimate the extent to which primates and lentiviruses have coexisted by tracking the changes in a host immunity gene called APOBEC3G that were induced by ancient viral challenges.

They report that this host immunity factor is evolving in tandem with a viral gene that defends the virus against APOBEC3G, which allowed them to determine the minimum age for the association between primates and lentiviruses to be around 5 or 6 million years ago, and possibly up to 12 million years ago.

These findings suggest that HIV-like infections in primates are much older than previously thought, and they have driven selective changes in antiviral genes that have incited an evolutionary arms race that continues to

this day. The study also confirms that viruses similar to HIV that are present in various monkey species today are the descendants of ancient pathogens in primates that have shaped how the immune system fights infections. "More than 40 non-human primate species in sub-Saharan Africa are infected with strains of HIV-related viruses," Emerman said. "Since some of these viruses may have the potential to infect humans as well, it is important to know their origins."

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PLEASE ADD THIS LINK TO THE PUBLISHED ARTICLE IN ONLINE VERSIONS OF YOUR REPORT: http://dx.plos.org/10.1371/journal.ppat.1003135 (link will go live upon embargo lift)
CITATION: Compton AA, Emerman M (2013) Convergence and Divergence in the Evolution of the APOBEC3G-Vif Interaction Reveal Ancient Origins of Simian Immunodeficiency Viruses. PLoS Pathog 9(1): e1003135. doi:10.1371/journal.ppat.1003135

http://www.eurekalert.org/pub_releases/2013-01/afot-mcp012413.php

Medical cannabis provides dramatic relief for sufferers of chronic ailments

Treatment can improve appetite, ease chronic pain, and more, say Tel Aviv University researchers

Though controversial, medical cannabis has been gaining ground as a valid therapy, offering relief to suffers of diseases such as cancer, Post-Traumatic Stress Disorder, ALS and more. The substance is known to soothe severe pain, increase the appetite, and ease insomnia where other common medications fail.

In 2009, Zach Klein, a graduate of Tel Aviv University's Department of Film and Television Studies, directed the documentary Prescribed Grass. Through the process, he developed an interest in the scientific research behind medical marijuana, and now, as a specialist in policy-making surrounding medical cannabis and an MA student at TAU's Porter School of Environmental Studies, he is conducting his own research into the benefits of medical cannabis.

Using marijuana from a farm called Tikkun Olam — a reference to the Jewish concept of healing the world — Klein and his fellow researchers tested the impact of the treatment on 19 residents of the Hadarim nursing home in Israel. The results, Klein says, have been outstanding. Not only did participants experience dramatic physical results, including healthy weight gain and the reduction of pain and tremors, but Hadarim staff saw an immediate improvement in the participants' moods and communication skills. The use of chronic medications was also significantly reduced, he reports.

Klein's research team includes Dr. Dror Avisar of TAU's Hydrochemistry Laboratory at the Department of Geography and Human Environment; Prof. Naama Friedmann and Rakefet Keider of TAU's Jaime and Joan Constantiner School of Education; Dr. Yehuda Baruch of TAU's Sackler Faculty of Medicine and director of the Abarbanel Mental Health Center; and Dr. Moshe Geitzen and Inbal Sikorin of Hadarim.

Cutting down on chronic medications

Israel is a world leader in medical cannabis research, Klein says. The active ingredient in marijuana, THC, was first discovered there by Profs. Raphael Mechoulam and Yechiel Gaoni. Prof. Mechoulam is also credited for having defined the endocannabinoid system, which mimics the effects of cannabis and plays a role in appetite, pain sensation, mood and memory.

In the Hadarim nursing home, 19 patients between the ages of 69 and 101 were treated with medical cannabis in the form of powder, oil, vapour or smoke three times daily over the course of a year for conditions such as pain, lack of appetite, and muscle spasms and tremors. Researchers and nursing home staff monitored participants for signs of improvement, as well as improvement in overall life quality, such as mood and ease in completing daily living activities.

During the study, 17 patients achieved a healthy weight, gaining or losing pounds as needed. Muscle spasms, stiffness, tremors and pain reduced significantly. Almost all patients reported an increase in sleeping hours and a decrease in nightmares and PTSD-related flashbacks.

There was a notable decline in the amount of prescribed medications taken by patients, such as antipsychotics, Parkinson's treatment, mood stabilizers, and pain relievers, Klein found, noting that these drugs have severe side effects. By the end of the study, 72 percent of participants were able to reduce their drug intake by an average of 1.7 medications a day.

Connecting cannabis and swallowing

This year, Klein is beginning a new study at Israel's Reuth Medical Center with Drs. Jean-Jacques Vatine and Aviah Gvion, in which he hopes to establish a connection between medical cannabis and improved swallowing. One of the biggest concerns with chronically ill patients is food intake, says Klein. Dysphagia, or difficulty in

swallowing, can lead to a decline in nutrition and even death. He believes that cannabis, which has been found to stimulate regions of the brain associated with swallowing reflexes, will have a positive impact.
Overall, Klein believes that the healing powers of cannabis are close to miraculous, and has long supported an overhaul in governmental policy surrounding the drug. Since his film was released in 2009, the number of permits for medical cannabis in Israel has increased from 400 to 11,000. His research is about improving the quality of life, he concludes, especially for those who have no other hope.

http://www.sciencedaily.com/releases/2013/01/130123164906.htm

First Brain Pacemaker Implanted to Treat Alzheimer's

During a five-hour surgery an Alzheimer's patient became America's first to have a pacemaker implanted in her brain.

During a five-hour surgery last October at The Ohio State University Wexner Medical Center, Kathy Sanford became the first Alzheimer's patient in the United States to have a pacemaker implanted in her brain.
She is the first of up to 10 patients who will be enrolled in an FDA-approved study at Ohio State's Wexner Medical Center to determine if using a brain pacemaker can improve cognitive and behavioral functioning in patients with Alzheimer's disease.
The study employs the use of deep brain stimulation (DBS), the same technology used to successfully treat about 100,000 patients worldwide with movement disorders such as Parkinson's disease. In the study, researchers hope to determine whether DBS surgery can improve function governed by the frontal lobe and neural networks involved in cognition and behavior by stimulating certain areas of the brain with a pacemaker.
Dr. Douglas Scharre, neurologist and director of the division of cognitive neurology, and Dr. Ali Rezai, neurosurgeon and director of the neuroscience program, both at Wexner Medical Center, are conducting the study.
"If the early findings that we're seeing continue to be robust and progressive, then I think that will be very promising and encouraging for us," says Rezai, who also directs the Center for Neuromodulation at Ohio State. "But so far we are cautiously optimistic."
The deep brain stimulation implant is similar to a cardiac pacemaker device with the exception that the pacemaker wires are implanted in the brain rather than the heart. "Basically, the pacemakers send tiny signals into the brain that regulate the abnormal activity of the brain and normalize it more," says Rezai. "Right now, from what we're seeing in our first patient, I think the results are encouraging, but this is research. We need to do more research and understand what's going on."
The study, which will enroll people with mild or early-stage Alzheimer's disease, will help determine if DBS has the potential to improve cognitive, behavioral and functional deficits.
Sanford continues to be evaluated to determine the effectiveness of the technology, says Rezai. She says she volunteered for the study to help others avoid the angst she has suffered as Alzheimer's slowly disrupted her life. "I'm just trying to make the world a better place," says Sanford. "That's all I'm doing." Her father, Joe Jester, says he is proud that his daughter is participating in the study, and is pleased to see her showing improvements. "This study seemed to just give us hope," said Jester. "I guess we were at the place where you just don't do anything and watch the condition deteriorate over the years, or try to do something that would give us hope and might stop the progression of this disease."
Alzheimer's disease is the most common form of degenerative dementia, afflicting about 5.5 million Americans and costing more than $100 billion per year, ranking it the third costliest disease in terms of health care expenditures in the United States.
Alzheimer's disease -- which has no cure and is not easily managed -- becomes progressively disabling with loss of memory, cognition, worsening behavioral function, in addition to a gradual loss of independent functioning, says Scharre. The Alzheimer's study is scheduled to be completed in 2015.

http://www.eurekalert.org/pub_releases/2013-01/tuhs-tsf012413.php

Temple scientists find cancer-causing virus in the brain, potential connection to epilepsy

The virus becomes a potential new target for treating a common form of childhood epilepsy

(Philadelphia, PA) - Researchers at Shriner's Hospital Pediatric Research Center at the Temple University School of Medicine, and the University of Pennsylvania have evidence linking the human papillomavirus 16 (HPV16) – the most common cause of cervical cancer – to a common form of childhood epilepsy. They have shown for the first time that HPV16 may be present in the human brain, and found that when they added a viral protein to the brains of fetal mice, the mice all demonstrated the same developmental problems in the cerebral cortex associated with this type of epilepsy, called focal cortical dysplasia type IIB (FCDIIB). The findings suggest that the virus could play a role in the development of epilepsy.

The results also mean that doctors may have to re-think their approach to treating this type of epilepsy, and perhaps consider other therapeutic options related to HPV, an infectious disease.
"This is a novel mechanism, and it fills a gap in our understanding about the development of congenital brain malformations," said Peter Crino, MD, PhD, Professor of Neurology at Temple University School of Medicine, and a member of Shriner's Hospital Pediatric Research Center, and the senior author of a recent report in the Annals of Neurology.
"If our data are correct, future treatment of cortical dysplasia could include targeted therapy against HPV16 infection, with the goal of halting seizures. Identifying an infectious agent as part of the pathogenesis of brain malformations could open up an array of new therapeutic approaches against various forms of epilepsy."
FCDIIB is a developmental malformation in the cerebral cortex, the area of the brain that plays key roles in thought, perception and memory. It is a common cause of both pediatric and adult epilepsy – especially difficult-to-treat forms of epilepsy – and it is thought to occur in the womb during early brain development. The condition is characterized by a disorganized cellular structure and enlarged, "balloon cells." Current treatments include surgery and medication.
Balloon cells contain a signaling cascade called the mammalian target of rapamycin complex 1 (mTOR1), which is important for cellular growth, proliferation and division, particularly in brain development. Other scientists have recently found the mTOR pathway is activated by the HPV16 E6 oncoprotein.
While there had never been any studies indicating that HPV16 could infect the brain, Dr. Crino saw a potential connection. "This is a sporadic, congenital brain malformation associated with mTOR signaling with no genetic predisposition," he said. "Based on various cellular and cell signaling similarities between cervical dysplasia and focal cortical dysplasia, this led me to a hypothesis that the HPV protein could be detected in FCDIIB."
To find out, the investigators first examined FCDIIB tissue samples from 50 patients for evidence of the HPV16 E6 protein. They found that all of the samples were positive for the protein in the balloon cells, but not in regions without balloon cells or in 36 control samples from healthy individuals.
They next examined the samples' genetic material by several sophisticated molecular techniques to look for evidence of HPV16 E6, and compared the findings to tissue from healthy controls and tissue from patients with different types of brain malformations and epilepsy. Again, every sample of FCDIIB was found to contain HPV16 E6 protein, whereas the control specimens and tissue from other types of dysplasia and conditions did not.
Finally, in a series of experiments, the scientists painstakingly delivered the E6 protein into the brains of fetal mice. "If E6 is the causative element for HPV cervical dysplasia and focal cortical dysplasia, putting the protein into a fetal mouse brain should disrupt the cortical development," Dr. Crino explained. When the scientists did this, they found that the fetal mouse brains did indeed develop brain malformations.
Dr. Crino plans to investigate other forms of cortical dysplasia to see if HPV or related viral proteins can be found. He and his team aren't sure how the virus gets into the brain, but their results suggest that an HPV infection in the placenta could be one possible path. The exact mechanism by which HPV16 might cause a malformation and epilepsy remains to be determined. He acknowledged several potential implications from the findings.
"We are going to have to think about this epidemiologically as an infectious disease, not a genetic disorder. In terms of prevention, with current HPV vaccination, we have a potentially modifiable disease," he said. "In addition, if in fact this type of epilepsy represents a disorder of mTOR signaling, then one strategy could be, rather than treating the patients with anti-epileptic drugs, is to perhaps use mTOR inhibitors.
"The million dollar result would be to show it is possible to induce a brain malformation with an E6 infection, and the animal develops epilepsy," Dr. Crino said. "It would be even better if we showed that it is preventable."
Other investigators contributing to this research include Julie Chen, Victoria Tsai, Whitney E. Parker, and Marianna Baybis, University of Pennsylvania; and Eleonora Aronica, University of Amsterdam, The Netherlands.
This research was supported by Citizens United for Research in Epilepsy and the National Epilepsy Fund.

http://www.eurekalert.org/pub_releases/2013-01/icl-alo012513.php

At least 1 in 5 were infected in flu pandemic, international study suggests

The highest rates of infection were in children, with 47 per cent of those aged five to 19 showing signs of having caught the virus.

Older people were affected less, with only 11 per cent of people aged 65 or older becoming infected.
The findings come from an international collaboration led by the World Health Organization and Imperial College London, which analysed data from 19 countries, including the UK, US, China and India, to assess the global impact of the 2009 influenza pandemic. The results, published in the journal Influenza and Other Respiratory Viruses, showed that 20-27 per cent of people studied were infected in the pandemic during the

first year of circulation. The researchers believe the incidence of influenza is likely to have been similar in countries where data were not available, meaning that as many as a quarter of the world's population may have been infected.
The study collated results from more than two dozen research studies involving more than 90,000 blood samples collected before, during and after the pandemic. The samples were tested for antibodies produced by the body in response to the specific flu strain that caused the pandemic.
While this study did not set out to look at mortality, the authors also used previously published estimates of pandemic influenza mortality together with mortality estimates that are still in progress, to estimate the proportion of people infected who died from the pandemic virus. Based on an estimate of approximately 200,000 deaths, they suggest that the case fatality ratio was less than 0.02 per cent.
Multiple exposures to previously circulating influenza viruses may have given older people some protection against the strain that emerged in 2009. Blood samples from before the pandemic showed that 14 per cent of people aged 65 or over already had antibodies that reacted to the 2009 strain.
Dr Maria Van Kerkhove, from the Medical Research Council Centre for Outbreak Analysis and Modelling at Imperial College London, one of the lead authors of the study, said: "This study is the result of a combined effort by more than 27 research groups worldwide, who all shared their data and experience with us to help improve our understanding of the impact the pandemic had globally."
Dr Anthony Mounts of the World Health Organization, the senior author, said: "Knowing the proportion of the population infected in different age groups and the proportion of those infected who died will help public health decision-makers plan for and respond to pandemics. This information will be used to quantify severity and develop mathematical models to predict how flu outbreaks spread and what effect different interventions may have."
The study was funded by the Medical Research Council.
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http://www.sciencedaily.com/releases/2013/01/130124150808.htm

Scientists Discover How Epigenetic Information Could Be Inherited

Mechanism of Epigenetic Reprogramming Revealed

New research reveals a potential way for how parents' experiences could be passed to their offspring's genes. The research was published January, 25 in the journal Science.
Epigenetics is a system that turns our genes on and off. The process works by chemical tags, known as epigenetic marks, attaching to DNA and telling a cell to either use or ignore a particular gene.
The most common epigenetic mark is a methyl group. When these groups fasten to DNA through a process called methylation they block the attachment of proteins which normally turn the genes on. As a result, the gene is turned off.
Scientists have witnessed epigenetic inheritance, the observation that offspring may inherit altered traits due to their parents' past experiences. For example, historical incidents of famine have resulted in health effects on the children and grandchildren of individuals who had restricted diets, possibly because of inheritance of altered epigenetic marks caused by a restricted diet.
However, it is thought that between each generation the epigenetic marks are erased in cells called primordial gene cells (PGC), the precursors to sperm and eggs. This 'reprogramming' allows all genes to be read afresh for each new person -- leaving scientists to question how epigenetic inheritance could occur.
The new Cambridge study initially discovered how the DNA methylation marks are erased in PGCs, a question that has been under intense investigation over the past 10 years. The methylation marks are converted to hydroxymethylation which is then progressively diluted out as the cells divide. This process turns out to be

remarkably efficient and seems to reset the genes for each new generation. Understanding the mechanism of epigenetic resetting could be exploited to deal with adult diseases linked with an accumulation of aberrant epigenetic marks, such as cancers, or in 'rejuvenating' aged cells.
However, the researchers, who were funded by the Wellcome Trust, also found that some rare methylation can 'escape' the reprogramming process and can thus be passed on to offspring -- revealing how epigenetic inheritance could occur. This is important because aberrant methylation could accumulate at genes during a lifetime in response to environmental factors, such as chemical exposure or nutrition, and can cause abnormal use of genes, leading to disease. If these marks are then inherited by offspring, their genes could also be affected.
Dr Jamie Hackett from the University of Cambridge, who led the research, said: "Our research demonstrates how genes could retain some memory of their past experiences, revealing that one of the big barriers to the theory of epigenetic inheritance -- that epigenetic information is erased between generations -- should be reassessed."
"It seems that while the precursors to sperm and eggs are very effective in erasing most methylation marks, they are fallible and at a low frequency may allow some epigenetic information to be transmitted to subsequent generations. The inheritance of differential epigenetic information could potentially contribute to altered traits or disease susceptibility in offspring and future descendants."
"However, it is not yet clear what consequences, if any, epigenetic inheritance might have in humans. Further studies should give us a clearer understanding of the extent to which heritable traits can be derived from epigenetic inheritance, and not just from genes. That could have profound consequences for future generations."
Professor Azim Surani from the University of Cambridge, principal investigator of the research, said: "The new study has the potential to be exploited in two distinct ways. First, the work could provide information on how to erase aberrant epigenetic marks that may underlie some diseases in adults. Second, the study provides opportunities to address whether germ cells can acquire new epigenetic marks through environmental or dietary influences on parents that may evade erasure and be transmitted to subsequent generations, with potentially undesirable consequences."
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http://bit.ly/TGLfm7

Greek economic crisis has cleared the air

EVEN the darkest cloud may have a silver lining. The sharp drop in air pollution that accompanied Greece's economic crisis could be a boon to the nation's health.

25 January 2013 by Michael Marshall

Mihalis Vrekoussis of the Cyprus Institute in Nicosia and colleagues used three satellites and a network of ground-based instruments to measure air pollution over Greece between 2007 and 2011. Levels of nitrogen dioxide fell over the whole country, with a particularly steep drop of 30 to 40 per cent over Athens. Nitrogen monoxide, carbon monoxide and sulphur dioxide also fell (Geophysical Research Letters, DOI: 10.1002/grl.50118).
Pollution levels have been falling since 2002, but the rate accelerated after 2008 by a factor of 3.5, says Vrekoussis. He found that the drop in pollution correlated with a decline in oil consumption, industrial activity and the size of the economy. "This suggests that the additional reported reduction in gas pollutant levels is due to the economic recession," he says.
In Athens, a combination of heavy car use and lots of sunshine have created serious health problems, so city dwellers should see real benefits. Sunlight triggers chemical reactions that make the car exhaust pollution more harmful, for instance by forming small particulates that cause respiratory diseases. "Hospital admissions for asthma should decline," says Dwayne Heard of the University of Leeds in the UK.
It's not all good news: despite the drop in pollutants, levels of ground-level ozone - another cause of respiratory disease - have risen. Ozone would normally be suppressed by nitrogen oxides, but those have declined. That will take the edge off the benefit, says Heard.
Greece isn't the only country where air pollution has dropped. Nitrogen oxide levels fell across Europe after the 2008 financial crisis (Scientific Reports, doi.org/j74). In the US, nitrogen dioxide levels fell between 2005 and 2011, with the sharpest fall at the height of the recession (Atmospheric Chemistry and Physics, doi.org/j75).
Such declines can be one-offs, or governments can help make them permanent, says Ronald Cohen of the University of California, Berkeley, who led the US study. "A time of crisis is a real opportunity to initiate change." After the 2008 financial downturn, for instance, the US and Europe committed to pollution cuts. "In

10 years, there will be an end to air pollution in the US and Europe," says Cohen. "It's an incredible success story."
Greece, however, is not seizing the current opportunity, says Vrekoussis. "Investments in clean technologies and low-carbon green strategies have been abandoned," he says. "I'm afraid that in the long run the negative effects will override the positives."
Global greenhouse gas emissions initially fell in the wake of the financial crisis, but not by much. Emerging economies like China and India continued their economic growth, so a small emissions drop in 2009 was followed by a huge rise in 2010 which continued in 2011.

http://www.eurekalert.org/pub_releases/2013-01/vu-ntf012513.php

New tool for mining bacterial genome for novel drugs

Vanderbilt biochemists have discovered that the process bacteria undergo when they become drug resistant can act as a powerful tool for drug discovery.

Their findings – reported this week in the Online Early Edition of the Proceedings of the National Academy of Sciences – should give a major boost to natural products drug discovery – the process of finding new drugs from compounds isolated from living organisms – by substantially increasing the number of novel compounds that scientists can extract from individual microorganisms.
Bacteria have traditionally been the source of important drugs such as antibiotics and anticancer agents. Researchers looking for new bacterially synthesized drugs have long known that bacterial genomes contain a large number of "silent genes" that contain the instructions for making drug-like compounds. But, until now, scientists have found it is very difficult to find ways to turn on the production of these compounds, known as secondary metabolites.
While investigating how bacteria develop drug resistance, Vanderbilt biochemists Brian Bachmann and John McLean discovered that strains of antibiotic-resistant bacteria express hundreds of compounds not produced by their progenitors, many of which are potential secondary metabolites.
"It's as if the bacteria respond to the assault by the antibiotic with a 'save-all-ships' strategy of turning on hundreds of silent genes," said Bachmann, associate professor chemistry at Vanderbilt.
"This technique is something like fracking in the natural gas industry. We've known for a long time that there were large amounts of underground natural gas that we couldn't extract using conventional methods but now we can, using hydraulic fracturing technology. In a similar fashion we think we can use bacteria's antibiotic resistance to intensively mine the bacterial genome for new drug leads," he said.
The original purpose of the study was to take the most detailed look yet at what happens when microbes develop drug resistance.
Bachmann is an expert in natural products drug discovery and McLean, an assistant professor of chemistry, is a pioneer in the development of analytical instrumentation and chemical techniques that can identify thousands of different biological compounds simultaneously, such as ion mobility-mass spectrometry.
"One of the daunting challenges is to rapidly inventory the tens to hundreds of thousands of molecules the bacteria construct to live, and then to read this inventory to understand how the bacteria compensate for their changing circumstances. To complicate matters further, we are looking for new drug-like molecules, so by definition we are looking for something that has not been seen before," said McLean.
Working with Research Assistant Dagmara Derewacz and graduate students Cody Goodwin and Ruth McNees, Bachmann and McLean started with the well-characterized soil bacterium Nocardiopsis. They exposed the bacterium to two different antibiotics – streptomycin and rifampicin – and observed the results.
"The first thing that happens is almost all of the bacteria die. Less than one cell in a million survives," said Bachmann. The chemists then cultured the survivors (six streptomycin-resistant strains and five rifampicin-resistant strains) without the antibiotic and used McLean's instrumental methods to profile the drug-like compounds that they produced.
They discovered that the differences were much greater than they expected. The survivors had undergone extensive mutations, not only in the genes that produce secondary metabolites but also in the housekeeping genes that alter the way they make RNA and proteins.
As a result, they determined that the resistant strains produced more than 300 compounds that were not expressed by the original organism.
"The cells appear to be 'de-repressing' as many of their silent genes as possible. This seems like a very drastic way to become drug resistant," Bachmann said.

McLean's team has developed strategies that allow them to automatically identify and compare the relative uniqueness and the relative abundance of tens of thousands of molecules from which the hundreds of novel compounds were found. "What we are looking for are new species of molecules in the mutants that are the most unique and the most abundant," said Bachmann.

In the antibiotic-resistant Nocardiopsis strains the researchers found a total of five compounds that were both unique enough and abundant enough to isolate, determine their molecular structures and test for biological activity.

"Normally, we only find one compound per organism, so this is a significant improvement in yield, allowing us to get many new compounds from previously mined microorganisms," Bachmann said.

The research was supported by National Institutes of Health grants 1R01GM09221B and RC2DA028981 and theDefense Threat Reduction Agency grant HDTRA-09-1-0013.

http://phys.org/news/2013-01-evolution-efficient-solar-cell-geometric.html

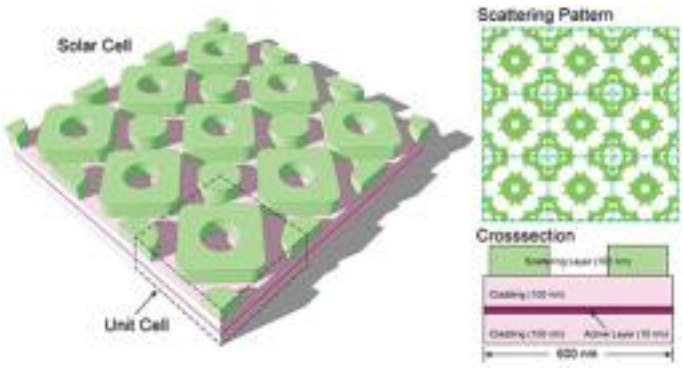
Evolution inspires more efficient solar cell design

Geometric pattern maximizes time light is trapped in solar cell

The sun's energy is virtually limitless, but harnessing its electricity with today's single-crystal silicon solar cells is extremely expensive—10 times pricier than coal, according to some estimates. Organic solar cells—polymer solar cells that use organic materials to absorb light and convert it into electricity—could be a solution, but current designs suffer because polymers have less-than-optimal electrical properties.

Researchers at Northwestern University have now developed a new design for organic solar cells that could lead to more efficient, less expensive solar power.

Instead of attempting to increase efficiency by altering the thickness of the solar cell's polymer layer—a tactic that has preciously garnered mixed results—the researchers sought to design the geometric pattern of the scattering layer to maximize the amount of time light remained trapped within the cell.



McCormick researchers have designed a geometrically-patterned light scattering layer that could make solar cells more efficient and less expensive.

Using a mathematical search algorithm based on natural evolution, the researchers pinpointed a specific geometrical pattern that is optimal for capturing and holding light in thin-cell organic solar cells.

The resulting design exhibited a three-fold increase over the Yablonovitch Limit, a thermodynamic limit developed in the 1980s that statistically describes how long a photon can be trapped in a semiconductor.

A paper about the results, "Highly Efficient Light-Trapping Structure Design Inspired by Natural Evolution," was published January 3 in Scientific Reports, a publication of Nature.

In the newly designed organic solar cell, light first enters a 100-nanometer-thick "scattering layer," a geometrically-patterned dielectric layer designed to maximize the amount of light transmitted into the cell. The light is then transmitted to the active layer, where it is converted into electricity.

"We wanted to determine the geometry for the scattering layer that would give us optimal performance," said Cheng Sun, assistant professor of mechanical engineering in Northwestern's McCormick School of Engineering and Applied Science and co-author of the paper. "But with so many possibilities, it's difficult to know where to start, so we looked to laws of natural selection to guide us."

The researchers employed a genetic algorithm, a search process that mimics the process of natural evolution, explained Wei Chen, Wilson-Cook Professor in Engineering Design and professor of mechanical engineering at McCormick and co-investigator of the research.

"Due to the highly nonlinear and irregular behavior of the system, you must use an intelligent approach to find the optimal solution," Chen said. "Our approach is based on the biologically evolutionary process of survival of the fittest."

The researchers began with dozens of random design elements, then "mated" and analyzed their offspring to determine their particular light-trapping performance. This process was carried out over more than 20 generations and also accounted for evolutionary principles of crossover and genetic mutation.

The resulting pattern will be fabricated with partners at Argonne National Laboratory.

More information: www.nature.com/srep/2013/130103/srep01025/full/srep01025.html

http://bit.ly/Y947aO

Dung beetles navigate using the Milky Way

Ever look up at the stars and wonder if some bug-eyed creature is doing the same? It turns out at least one does: the dung beetle uses the glow of the Milky Way to navigate.

15:31 25 January 2013 by Jacob Aron

Once a beetle (Scarabaeus satyrus) has constructed its dung ball, it moves off in a straight line in order to escape from rival beetles as quickly as possible, lest they try and steal its carefully crafted ball. This behaviour doesn't sound complicated, but several years ago, Marie Dacke of Lund University in Sweden and colleagues showed that polarised light from the moon is important for dung beetles to keep to a straight line.

Then the researchers were surprised to find the insects were able to stay on course even on a moonless night. "We thought there was something wrong in our set-up," Dacke says.

The team allowed the beetles to crawl around the floor of a plain-walled cylindrical drum with an open top, meaning they could only use the night sky to orientate themselves. The researchers timed how long it took the beetles to reach the edge of the drum from the centre, and found that under a full moon, the insects took around 20 seconds on average; on a starry but moonless night, they took around 40 seconds.

But when beetles had a cardboard cap placed on them to prevent them from seeing the sky, they needed over two minutes, suggesting the stars were playing a role.

Planetarium clincher

To test this, the team moved the experiment to a planetarium. By switching stars on and off, Dacke discovered that the glowing strip of the whole Milky Way was what guided the beetles' movement. "Before it was assumed insects could not use the stars because their eyes don't have the resolution to see them," she says. Navigating using the whole of the Milky Way does away with the need to see individual stars.

Dacke says the results suggest moths, locusts and other insects might navigate by the Milky Way, too. Her team is now looking at whether the beetles prefer to navigate by the moon or the Milky Way when both are on view.

Journal reference: Current Biology, doi.org/kbm

http://www.bbc.co.uk/news/science-environment-21150046

'Quantum smell' idea gains ground

A controversial theory that the way we smell involves a quantum physics effect has received a boost, following experiments with human subjects.

By Jason Palmer Science and technology reporter, BBC News

It challenges the notion that our sense of smell depends only on the shapes of molecules we sniff in the air. Instead, it suggests that the molecules' vibrations are responsible. A way to test it is with two molecules of the same shape, but with different vibrations. A report in PLOS ONE shows that humans can distinguish the two.

Tantalisingly, the idea hints at quantum effects occurring in biological systems - an idea that is itself driving a new field of science, as the BBC feature article Are birds hijacking quantum physics? points out.

But the theory - first put forward by Luca Turin, now of the Fleming Biomedical Research Sciences Centre in Greece - remains contested and divisive.

The idea that molecules' shapes are the only link to their smell is well entrenched, but Dr Turin said there were holes in the idea. He gave the example of molecules that include sulphur and hydrogen atoms bonded together - they may take a wide range of shapes, but all of them smell of rotten eggs.

"If you look from the [traditional] standpoint... it's really hard to explain," Dr Turin told BBC News. "If you look from the standpoint of an alternative theory - that what determines the smell of a molecule is the vibrations - the sulphur-hydrogen mystery becomes absolutely clear."

Molecules can be viewed as a collection of atoms on springs, so the atoms can move relative to one another. Energy of just the right frequency - a quantum - can cause the "springs" to vibrate, and in a 1996 paper in Chemical Senses Dr Turin said it was these vibrations that explained smell.

The mechanism, he added, was "inelastic electron tunnelling": in the presence of a specific "smelly" molecule, an electron within a smell receptor in your nose can "jump" - or tunnel - across it and dump a quantum of energy into one of the molecule's bonds - setting the "spring" vibrating.

But the established smell science community has from the start argued that there is little proof of this.

Of horses and unicorns

One way to test the idea was to prepare two molecules of identical shape but with different vibrations - done by replacing a molecule's hydrogen atoms with their heavier cousins called deuterium.

Leslie Vosshall of The Rockefeller University set out in 2004 to disprove Dr Turin's idea with a molecule called acetophenone and its "deuterated" twin. The work in Nature Neuroscience suggested that human participants could not distinguish between the two, and thus that vibrations played no role in what we smell.

But in 2011, Dr Turin and colleagues published a paper in Proceedings of the National Academy of Sciences showing that fruit flies can distinguish between the heavier and lighter versions of the same molecule.
A repeat of the test with humans in the new paper finds that, as in Prof Vosshall's work, the subjects could not tell the two apart. But the team then developed a brand new, far larger pair of molecules - cyclopentadecanone - with more hydrogen or deuterium bonds to amplify the purported effect. In double-blind tests, in which neither the experimenter nor the participant knew which sample was which, subjects were able to distinguish between the two versions.
Still, Prof Vosshall believes the vibrational theory to be no more than fanciful. "I like to think of the vibration theory of olfaction and its proponents as unicorns. The rest of us studying olfaction are horses," she told BBC News. "The problem is that proving that a unicorn exists or does not exist is impossible. This debate on the vibration theory or the existence of unicorns will never end, but the very important underlying question of why things smell the way they do will continue to be answered by the horses among us."
Tim Jacob, a smell researcher at the University of Cardiff, said the work was "supportive but not conclusive". "But the fact is that nobody has been able to unequivocally contradict [Dr Turin]," he told BBC News. "There are many, many problems with the shape theory of smell - many things it doesn't explain that the vibrational theory does."
And although many more scientists are taking the vibrational theory seriously than back in 1996, it remains an extraordinarily polarised debate. "He's had some peripheral support, but... people don't want to line up behind Luca," Prof Jacob said. "It's scientific suicide."
Columbia University's Richard Axel, whose work on mapping the genes and receptors of our sense of smell garnered the 2004 Nobel prize for physiology, said the kinds of experiments revealed this week would not resolve the debate - only a microscopic look at the receptors in the nose would finally show what is at work. "Until somebody really sits down and seriously addresses the mechanism and not inferences from the mechanism... it doesn't seem a useful endeavour to use behavioural responses as an argument," he told BBC News. "Don't get me wrong, I'm not writing off this theory, but I need data and it hasn't been presented."

http://phys.org/news/2013-01-free-ticket-estonia-capital.html

Free ticket to ride in Estonia capital

Tallinn is the first EU capital to offer its residents free public transport

Tallinn is the first EU capital to offer its residents free public transport, and though the move aimed at driving down car pollution is proving popular, visitors feel let down and others are accusing City Hall of a campaign gimmick.
Since the start of the year, hopping on a bus, tram or trolleybus has become a fare-free proposition for Tallinn's 420,000 residents. All they must do is validate a special pass proving they are eligible.
Pavel Ilmjarv, a 19-year-old student, says it's taken a while to get used to the new routine of swiping his pass against a special reader at the start of each journey.
"It's such a new thing, I often forget to do it," Ilmjarv said, adding he previously didn't need to swipe his monthly bus, which cost 23 euros.
"I'm not complaining, I love it," he said, a sentiment echoed by the vast majority of resident commuters.
With Estonia's average monthly salary at about 900 euros and around half the city's population relying on public transport, a family of four could save hundreds of euros in transport costs each year.
But it's a different story for non-residents.
As a Tallinn University student from Estonia's coastal resort town of Parnu, Eve—who did not want to provide her last name—doesn't qualify for a free ride. Even though she lives in the capital, her registered hometown is outside the city.
She gets an 8.50-euro student discount on the standard 23 euro pass. Meanwhile, visitors must shell out 1.60 euro per ticket.
"People from rural areas generally earn less than those in capital. I believe that in such a small state, transport in the capital where many people have to come not only for shopping, but also to visit state offices, should be free for everyone," she told AFP at a tram stop in front of the university.
For non-Tallinners, the fine for being caught riding without a ticket could be as much as 60 euros—almost equal to Estonia's monthly unemployed benefit.
Joblessness in this Baltic state of 1.3 million which broke from the Soviet Union in 1991, joined NATO and the EU in 2004 and the eurozone in 2011, is hovering around 10 percent.
Toomas Pirn, a spokesman for Tallinn City Hall, says the free pass is already encouraging residents to leave their cars at home, easing both pollution and congestion in the picturesque, historic city centre.

"We hope to limit the number of cars on streets, and via that, the pollution of city air. Studies have shown that in Tallinn cars pollute the air most," Pirn says.
About half of all Tallinners have already taken advantage of the free public transport, he says, noting the project will cost the city around 12.4 million euros per year—about a quarter of its annual public transport budget.
Data collected from usage of the special resident passes has caused some to raise privacy concerns.
The Estonian Data Protection Inspectorate has warned people's personal information and journey habits could be compromised, because the city intends to keep records of their movements for up to seven years.
Others believe City Hall, governed by the left-leaning Centre Party, is more interested in currying voter support ahead of a municipal election this October than in fighting pollution.
Nothing of the sort, insists Deputy Mayor Taavi Aas.
He hopes the European Commission will soon name Tallinn as Europe's Green Capital, a title held this year by Nantes in France before going to the Danish capital Copenhagen in 2014.
"We're seeking the title for 2018 and hope that being the first EU capital offering a free ride to all city residents is among steps that helps us to get it," he told AFP.