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Nanoparticle Leads to World Record for Battery Storage

A new world record is in the books for battery technology. Thanks to a tiny particle resembling an egg yolk and shell, scientists have been able to dramatically increase lithium-ion battery storage capacity.

By Melissa C. Lott | January 28, 2013

According to their paper in Nature Communications (published January 8*), researchers from Stanford University and the SLAC National Accelerator Laboratory a new material described as a "sulfur-TiO2 yolk-shell nanoarchitecture with internal void space for long-cycle lithium-sulphur batteries." This material can be used in the cathode of lithium-ion batteries to overcome a key obstacle that has stumped scientists for the past two decades.

This result – a fivefold increase in the amount of energy that can be stored in the battery (per unit of sulfur) plus a long life material that could revolutionize the rechargeable battery market.

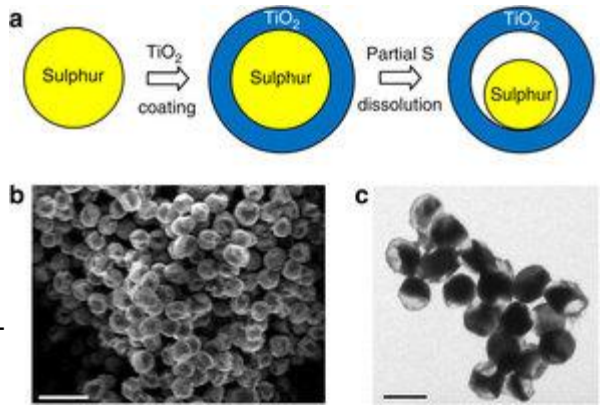
According to Stanford's Yi Cui, a researcher on the project that developed this material:

"After 1,000 charge/discharge cycles, our yolk-shell sulfur cathode had retained about 70 percent of its energy-storage capacity. This is the highest performing sulfur cathode in the world, as far as we know…Even without optimizing the design, this cathode cycle life is already on par with commercial performance. This is a very important achievement for the future of rechargeable batteries."

Battery researchers have long known that sulfur could help to increase the storage capabilities of lithium-ion batteries. But, the combination of sulfur and lithium ions was problematic. In particular, how to allow the cathode to operate without the material simply dissolving with each charge.

This new nanoparticle's structure prevents this problem by providing space between the sulfur (the egg-yolk) and its hard shell (a porous titanium oxide). This allows the combined sulfur-lithium compound to expand without cracking or dissolving.

This structure is shown in the pictures below:



References: *Shi Wei She, Weiyang Li, Judy J. Cha, Guangyuan Zheng, Yuan Yang, Matthew T. McDowell, Po Chun, and Yi Cui. Nature Communications, Article number:1331 | doi:10.1038/ncomms2327 | Received 02 July 2012 | Accepted 23 November 2012 | Published 08 January 2013 (link)*

http://www.eurekalert.org/pub_releases/2013-01/uocp-wat012813.php

Why are there redheads? Birds might hold the clues

Red coloration—historically seen as costly in vertebrates—might represent some physiological benefit after all, according to research published in the journal Physiological and Biochemical Zoology.

Pheomelanin, which is responsible for red hair and freckles in humans and orange and chestnut coloration in other animals, is known to increase the damage to skin cells and melanoma risk when present in large amounts. Furthermore, its creation involves the consumption of glutathione, a beneficial antioxidant.

In an attempt to unearth the factors favoring the evolution of pheomelanin in spite of its costs, Ismael Galván and Anders P. Møller of the University of Paris-Sud examined the survival from one breeding season to the next of a wild European population of barn swallows, as well as the annual survival rates of 58 species of American birds.

A recent hypothesis claims that the consumption of cysteine (a component of glutathione) that occurs when pheomelanin is produced can be beneficial under conditions of low stress. Cysteine, which is mainly acquired through diet, can be toxic at high levels, so the production of pheomelanin may help to sequester excess quantities of this amino acid.

Galván and Møller measured birds' blood levels of uric acid and analyzed the coloration of their chestnut throat feathers (an indication of pheomelanin content). When they compared birds that had similar uric acid levels (and therefore similar capacities to excrete excess amino acids), they found that both the European barn swallows and the American birds with larger amounts of pheomelanin in their feathers survived better.

This study is the first to propose that the costs/benefits of pheomelanin may depend on prevailing environmental conditions, and its results suggest that the production of this pigment may even be beneficial in some circumstances. Given that all higher vertebrates, including humans, present pheomelanin in skin, pelage, and plumage, Galván and Møller's findings increase the scant current knowledge on the physiological consequences of pheomelanin and open new avenues for research that will help us understand the evolution of pigmentation.

Ismael Galván and Anders P. Møller, "Pheomelanin-Based Plumage Coloration Predicts Survival Rates in Birds." Physiological and Biochemical Zoology 86:2 (March/April 2013). Available ahead of print at http://www.jstor.org/stable/10.1086/668871.

http://www.sciencedaily.com/releases/2013/01/130128104739.htm

Neuroscientists Pinpoint Location of Fear Memory in Amygdala

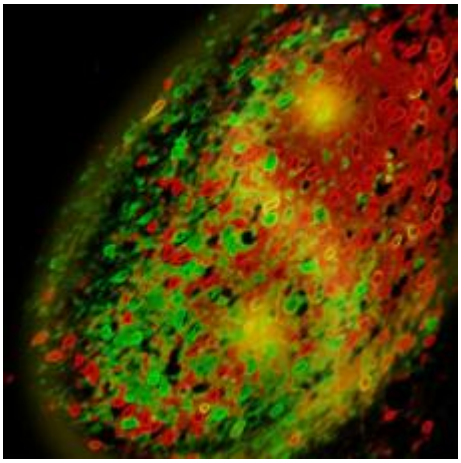
A particular class of neurons in a subdivision of the amygdala plays an active role in fear responses

A rustle of undergrowth in the outback: it's a sound that might make an animal or person stop sharply and be still, in the anticipation of a predator. That "freezing" is part of the fear response, a reaction to a stimulus in the environment and part of the brain's determination of whether to be afraid of it.

A neuroscience group at Cold Spring Harbor Laboratory (CSHL) led by Assistant Professor Bo Li Ph.D., together with collaborator Professor Z. Josh Huang Ph.D., have just released the results of a new study that examines how fear responses are learned, controlled, and memorized. They show that a particular class of neurons in a subdivision of the amygdala plays an active role in these processes.

Locating fear memory in the amygdala

Previous research had indicated that structures inside the amygdalae, a pair of almond-shaped formations that sit deep within the brain and are known to be involved in emotion and reward-based behavior, may be part of the circuit that controls fear learning and memory. In particular, a region called the central amygdala, or CeA, was thought to be a passive relay for the signals relayed within this circuit.



Li's lab became interested when they observed that neurons in a region of the central amygdala called the lateral subdivision, or CeL, "lit up" in a particular strain of mice while studying this circuit.

"Neuroscientists believed that changes in the strength of the connections onto neurons in the central amygdala must occur for fear memory to be encoded," Li says, "but nobody had been able to actually show this."

An image showing neurons in the lateral subdivision of the central amygdala (CeL). In red are somatostain-positive (SOM+) neurons, which control fear; in green are another set of neurons known as PKC-delta cells. **Image courtesy of Bo Li**

This led the team to further probe into the role of these neurons in fear responses and furthermore to ask the question: If the central amygdala stores fear memory, how is that memory trace read out and translated into fear responses?

To examine the behavior of mice undergoing a fear test the team first trained them to respond in a Pavlovian manner to an auditory cue. The mice began to "freeze," a very common fear response, whenever they heard one of the sounds they had been trained to fear.

To study the particular neurons involved, and to understand them in relation to the fear-inducing auditory cue, the CSHL team used a variety of methods. One of these involved delivering a gene that encodes for a light-sensitive protein into the particular neurons Li's group wanted to look at.

By implanting a very thin fiber-optic cable directly into the area containing the photosensitive neurons, the team was able to shine colored laser light with pinpoint accuracy onto the cells, and in this manner activate them. This is a technique known as optogenetics. Any changes in the behavior of the mice in response to the laser were then monitored.

A subset of neurons in the central amygdala controls fear expression

The ability to probe genetically defined groups of neurons was vital because there are two sets of neurons important in fear-learning and memory processes. The difference between them, the team learned, was in their release of message-carrying neurotransmitters into the spaces called synapses between neurons. In one subset of neurons, neurotransmitter release was enhanced; in another it was diminished. If measurements had been taken across the total cell population in the central amygdala, neurotransmitter levels from these two distinct sets of neurons would have been averaged out, and thus would not have been detected.

Li's group found that fear conditioning induced experience-dependent changes in the release of neurotransmitters in excitatory synapses that connect with inhibitory neurons -- neurons that suppress the activity of other neurons -- in the central amygdala. These changes in the strength of neuronal connections are known as synaptic plasticity.

Particularly important in this process, the team discovered, were somatostatin-positive (SOM+) neurons. Somatostatin is a hormone that affects neurotransmitter release. Li and colleagues found that fear-memory formation was impaired when they prevent the activation of SOM+ neurons.

SOM+ neurons are necessary for recall of fear memories, the team also found. Indeed, the activity of these neurons alone proved sufficient to drive fear responses. Thus, instead of being a passive relay for the signals driving fear learning and responses in mice, the team's work demonstrates that the central amygdala is an active component, and is driven by input from the lateral amygdala, to which it is connected.

"We find that the fear memory in the central amygdala can modify the circuit in a way that translates into action -- or what we call the fear response," explains Li.

In the future Li's group will try to obtain a better understanding of how these processes may be altered in post-traumatic stress disorder (PTSD) and other disorders involving abnormal fear learning. One important goal is to develop pharmacological interventions for such disorders.

Li says more research is needed, but is hopeful that with the discovery of specific cellular markers and techniques such as optogenetics, a breakthrough can be made.

Haohong Li, Mario A Penzo, Hiroki Taniguchi, Charles D Kopec, Z Josh Huang, Bo Li. Experience-dependent modification of a central amygdala fear circuit. Nature Neuroscience, 2013; DOI: 10.1038/nn.3322

http://phys.org/news/2013-01-rice-grown-paddies-drought-stricken-expert.html

Rice grown without paddies can feed drought-stricken communities, expert says

Research has led to a simple but profound solution that requires less water – growing rice in fields

Phys.org - Consumed by 3 billion people, rice is arguably the world's most important food staple, and one reason for its popularity is that rice can be grown under flooded conditions that suppress weeds, making cultivation easier.

In some parts of the world, water is in short supply, but farmers often devote what they can to rice farming because the crop is so important. However, research has led to a simple but profound solution that requires less water – growing rice in fields, a practice called aerobic rice production.

The practice relies on rainfall plus limited irrigation to meet the plants' moisture needs. It requires about 40 percent less water than paddy-grown rice, according to a University of Florida study in the current issue of Agronomy Journal.

Aerobic rice production is gaining popularity in India and Southeast Asia, particularly in drought-stricken or upland areas, said Rao Mylavarapu, a professor with UF's Institute of Food and Agricultural Sciences and one of the study's authors.

Mylavarapu is working to address a major challenge in aerobic rice production: yield. In the two-year study, conducted in Hyderabad, India, researchers grew rice in irrigated fields and paddies. The first year's aerobic rice harvest weighed 39 percent less than the paddy harvest; the second year the difference narrowed to 15 percent.

"Right now, there's no way you can get the same yield under optimal conditions," he said.

He explained that grain production is influenced by a rice plant's ability to use nitrogen, which in turn is influenced by moisture availability. In other words, paddied plants grown in standing water have an advantage over aerobic plants receiving modest irrigation. And, the rice varieties used for paddied production are different from the ones in aerobic production.

But in a drought there may not be enough water to keep rice paddies flooded. Under those circumstances, aerobic production can ensure that a community has rice to eat, while the paddied plants wither away.

"The real impact of aerobic rice will be shown in a rainfall shortage year," Mylavarapu said. "However, in a rainfall shortage year, we have to be able to provide supplemental irrigation to aerobic rice and keep the root zone moist. So if there's a very bad drought, even aerobic rice will fail."

He adds that few rice varieties have been developed specifically for aerobic production. In time, breeders may develop improved varieties and close the "yield gap" with paddied rice.

Currently, Mylavarapu's focus is on another aspect of the cropping system – overall grain production in systems where rice is rotated with corn. This approach is used on about 8.65 million acres in Asia because little soil preparation is needed to plant corn in a field following aerobic rice. In contrast, rice paddies must be drained and converted from a flooded anaerobic system to an aerobic system before the land can be used for corn.

In the study, researchers found that corn yields were about 5 percent higher when the corn followed aerobic rice, compared with paddied rice.

So far, aerobic rice production hasn't caught on with U.S. farmers, but that could be just a matter of time, he said.

"In the U.S., water quality is usually a bigger issue than water quantity," Mylavarapu said. "Certainly, it (aerobic rice) will become a very important factor for the U.S. to consider in the future, with climate change."

The United States is the world's 10th largest producer of paddied rice, with annual production of about 12 million tons, according to the United Nations' Food and Agriculture Organization. Arkansas is the leading U.S. rice *Provided by University of Florida*

http://www.eurekalert.org/pub_releases/2013-01/osu-sft012813.php

Study finds taking the stairs, raking leaves may have same health benefits as a trip to the gym

New research suggests the health benefits of small amounts of activity can be just as beneficial as longer bouts of physical exercise

CORVALLIS, Ore. – New research at Oregon State University suggests the health benefits of small amounts of activity – even as small as one- and two-minute increments that add up to 30 minutes per day – can be just as beneficial as longer bouts of physical exercise achieved by a trip to the gym.

The nationally representative study of more than 6,000 American adults shows that an active lifestyle approach, as opposed to structured exercise, may be just as beneficial in improving health outcomes, including preventing metabolic syndrome, high blood pressure, and high cholesterol.

"Our results suggest that engaging in an active lifestyle approach, compared to a structured exercise approach, may be just as beneficial in improving various health outcomes," said Paul Loprinzi, lead author of the study. "We encourage people to seek out opportunities to be active when the choice is available. For example, rather than sitting while talking on the phone, use this opportunity to get in some activity by pacing around while talking."

Perhaps just as importantly, the researchers found that 43 percent of those who participated in the "short bouts" of exercise met physical activity guidelines of 30 minutes day. In comparison, less than 10 percent of those in the longer exercise bouts met those federal guidelines for exercise.

This graphic shows daily activities, and how simply making movement part of every day can lead to a healthier lifestyle. Information provided by Brad Cardinal, professor of exercise science at Oregon State University, in conjunction with his new study. Values are kcal, or calories, and are for a 178 lb. person, which is the "average" weight of the participants in Cardinal's study. **Graphic: Oliver Day/OSU Web Communications**

Loprinzi, who is an assistant professor at Bellarmine University, conducted the research as a doctoral student working in the lab of Brad Cardinal at Oregon State University. Cardinal, a professor of exercise and sport science, is co-author of the study, which is in the current issue of the American Journal of Health Promotion.

"You hear that less than 10 percent of Americans exercise and it gives the perception that people are lazy," Cardinal said. "Our research shows that more than 40 percent of adults achieved the exercise guidelines, by making movement a way of life."

Cardinal, who has studied the "lifestyle exercise" model for more than 20 years, said one of the most common barriers people cite to getting enough exercise is lack of time. He said the results of this study are promising, and show that simply building movement into everyday activities can have meaningful health benefits.

"This is a more natural way to exercise, just to walk more and move around a bit more," Cardinal said. "We are designed by nature as beings who are supposed to move. People get it in their minds, if I don't get that 30 minutes, I might as well not exercise at all. Our results really challenge that perception and give people meaningful, realistic options for meeting the physical activity guidelines."

For example, Cardinal said instead of driving half a mile, try biking or walking the same distance; instead of using a riding lawn mower, use a push lawn mower. Instead of sitting through TV commercials, try doing some sit-ups, push-ups, or jumping jacks during the commercial breaks; and instead of sitting and being a spectator at a child's sporting event, try walking around during the halftime break.

The researchers said the participants in this study wore accelerometers, which is an objective tool to measure physical activity. Those who participated in the short bouts of activity could be moving as few as one or two minutes at a time. The people in the "short bouts" group had positive results in areas such as blood pressure, cholesterol, metabolic syndrome, and waist circumference.

For instance, the study showed those in the shorter exercise group who met physical activity guidelines had an 89 percent chance of not having metabolic syndrome, compared to 87 percent for those meeting guidelines using the structured exercise approach.
Loprinzi said the one area where small bursts of activity did not seem to equal the benefits of longer, sustained exercise was in Body Mass Index, or BMI. However, the researchers cautioned that these findings do not necessarily mean that short bouts of activity do not help with weight loss, especially since they did find a benefit on weight circumference. "There are inherent limitations in BMI as a surrogate measure of fat and health in general," Cardinal said. "People can still be 'fit' and 'fat.'"
The researchers emphasized that for health benefits, people should, seek out opportunities to be physically active. "In our society, you will always be presented with things that entice you to sit or be less active because of technology, like using a leaf blower instead of a rake," Cardinal said. "Making physical activity a way of life is more cost-effective than an expensive gym membership. You may be more likely to stick with it, and over the long term, you'll be healthier, more mobile and just feel better all around."

http://www.eurekalert.org/pub_releases/2013-01/plos-eme012313.php

Increasing severity of erectile dysfunction is a marker for increasing risk of cardiovascular disease and death

Risk of future cardiovascular disease and death increased with severity of erectile dysfunction in men

A large study published in PLOS Medicine on January 29, 2013, shows that the risk of future cardiovascular disease and death increased with severity of erectile dysfunction in men both with and without a history of cardiovascular disease. While previous studies have shown an association between ED and CVD risk, this study finds that the severity of ED corresponds to the increased risk of CVD hospitalization and all-cause mortality.
The study authors, Emily Banks (from the Australian National University) and colleagues, analyzed data from the Australian prospective cohort 45 and Up Study. The authors examined the association between severity of self-reported ED and CVD hospitalization and mortality in 95,038 men aged 45 years and older, after adjusting for a number of potential confounding factors. The study included more than 65,000 men without known CVD at baseline and more than 29,000 men with known CVD. There were 7855 incident admissions for CVD during an average 2.2 years of follow-up ending in June 2010, and 2304 deaths during an average of 2.8 years of follow-up, ending in December 2010.
The authors found that, among men without known CVD, those with severe versus no ED had a relative 35% increase in risk of hospitalization for all CVDs, and a relative 93% increased risk of all-cause mortality. Among men with known CVD at baseline and severe ED, their increased risk of hospitalization for all CVDs combined was a relative 64% and for all-cause mortality, 137%.
The researchers say: "The findings of this study highlight the need to consider ED in relation to the risk of a wide range of CVDs". They also stress that it is unlikely that ED causes CVD; rather both are caused by similar underlying causes such as atherosclerosis. As a result, ED could serve as a useful marker to identify men who should undergo further testing to assess their risk for CVD.
Funding: This specific project was supported by a development grant from the National Heart Foundation, NSW Cardiovascular Research Network, made available through the 45 and Up Study Cardiovascular Research Collaboration. EB is supported by the Australian National Health and Medical Research Council. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
Competing interests: JC has received research grants from Servier, administered through the University of Sydney and The George Institute, as principal investigator for the ADVANCE trial and ADVANCE-ON post trial follow-up study, and have received honoraria from Servier for speaking about ADVANCE at Scientific meetings. PM has received payment from Pfizer for giving a lecture on the treatment of pulmonary hypertension. All other authors have declared that no competing interests exist.
Citation: Banks E, Joshy G, Abhayaratna WP, Kritharides L, Macdonald PS, et al. (2013) Erectile Dysfunction Severity as a Risk Marker for Cardiovascular Disease Hospitalisation and All-Cause Mortality: A Prospective Cohort Study. PLoS Med 10(1): e1001372. doi:10.1371/journal.pmed.1001372

http://www.eurekalert.org/pub_releases/2013-01/asfm-hst012913.php

Hydrogen sulfide: The next anti-aging agent?

Hydrogen sulfide (H2S) may play a wide-ranging role in staving off aging

Hydrogen sulfide (H2S) may play a wide-ranging role in staving off aging, according to a paper published online ahead of print in the journal Molecular and Cellular Biology. In this review article, a team from China explores the compound's plethora of potential anti-aging pathways.
"H2S has been gaining increasing attention as an important endogenous signaling molecule because of its significant effects on the cardiovascular and nervous systems," the team writes. The evidence is mounting, they note, that hydrogen sulfide slows aging by inhibiting free-radical reactions, by activating SIRT1, an enzyme

believed to be a regulator of lifespan, and probably through its interactions with a gene, klotho, which appears to have its own market basket of anti-aging activity.
Hydrogen sulfide is produced within the human body, and has a variety of important physiological effects. For example, it relaxes the vascular endothelium and smooth muscle cells, which is important to maintaining clean arteries as one ages, says first author Zhi-Sheng Jiang, of the University of South China, Hunan. It functions as an antioxidant. And it inhibits expression of pro-inflammatory factors, all of which "imply an important role in aging and age-associated diseases," according to the paper. For example, mice lacking CSE, the gene for an enzyme involved in producing H2S, manifest extensive, premature arteriosclerosis, an inevitable consequence of aging, says Jiang.
The gene, klotho, which appears to be upregulated by hydrogen sulfide, is thought to extend lifespan via a number of different pathways, some of which promote production of endogenous antioxidants, according to the report. Produced in the kidneys, it has direct angiotensin-converting enzyme (ACE) inhibiting activity; that is, it's an ACE inhibitor, just like certain drugs that mitigate high blood pressure. Not surprisingly, plasma H2S declines with age, and is lower in spontaneously hypertensive rats than in those with normal blood pressure. More generally, a lack of H2S is implicated in cardiovascular disease.
A decline in H2S is also thought to undermine neurological health. Endogenous H2S has been found wanting in an animal model of Parkinson's disease, and is found to be depressed in the brains of patients with Alzheimer's disease. There are even suggestions, mostly in animal models, but also in human studies, that H2S may be protective against cancer, according to the report.
"Data available so far strongly suggest that H2S may become the next potent agent for preventing and ameliorating the symptoms of aging and age-associated diseases," concludes Jiang. In the future, he says, people may take H2S via food, or as an anti-aging supplement.
A copy of the manuscript can be found online at http://bit.ly/asmtip0113c. Formal publication is scheduled for the late March 2013 issue of Molecular and Cellular Biology.
(Y. Zhang, Z.-H. Tang, Z.-R., S.L. Qu, M.-H. Liu, L.-S. Liu, Z.-S. Jiang, 2013. Hydrogen sulfide: the next potent preventive and therapeutic agent in aging and age-associated diseases. Mol. Cell. Bio. Online ahead of print, 7 January 2013, doi:10.1128/MCB.01215-12)

http://news.discovery.com/animals/pets/cats-kill-billion-animals-130129.htm#mkcpgn=rssnws1

Cats Kill Billions of Animals a Year

Cats kill billions of birds every year and even more tiny rodents and other mammals in the United States, a new study finds.

Tia Ghose, LiveScience

According to the research, published today (Jan. 29) in the journal Nature Communications, cats kill between 1.4 billion and 3.7 billion birds and between 6.9 billion and 20.7 billion small mammals, such as meadow voles and chipmunks. Though it's hard to know exactly how many birds live in the United States, the staggering number of bird deaths may account for as much as 15 percent of the total bird population, said study co-author Pete Marra, an animal ecologist with the Smithsonian Conservation Biology Institute.

Staggering Toll

Marra and his colleagues are looking at human-related causes for bird and wildlife deaths in the country, from windmills and glass windows to pesticides.
But first, Marra and his team looked at the impact of the feline population, one of the biggest putative causes of bird demise in the country.
While past studies had used critter cams or owner reports to estimate the number of birds killed by cats, those studies were usually small and not applicable to the entire country, Marra told LiveScience.
For this broader analysis, the team first looked at all prior studies on bird deaths and estimated that around 84 million owned-cats live in the country, many of which are allowed outdoors.
"A lot of these cats may go outside and go to 10 different houses, but they go back to their house and cuddle up on Mr. Smith's lap at night," Marra said.
Based on an analysis of past studies, the researchers estimated that each of those felines killed between four and 18 birds a year, and between eight and 21 small mammals per year.
But the major scourges for wildlife were not those free-ranging, owned-cats, but instead feral and un-owned cats that survive on the streets. Each of those kitties — and the team estimates between 30 million and 80 million of them live in the United States — kills between 23 and 46 birds a year, and between 129 and 338 small mammals, Marra said.
And, it seems, the small rodents taken by felines aren't Norway rats or apartment vermin, but native rodent species such as meadow voles and chipmunks, he added.

No Easy Answers

One obvious step to reduce the mass wildlife death is to keep kitties indoors, Marra said.

Perhaps seeing their furry friends bring in a meadow vole or a cardinal will spur cat owners to say, "Listen, Tabby, we're going to have a heart-to-heart talk about how much time you spend outside," he said.

Wild cats pose tougher questions, because capture and sterilization approaches have varying levels of success depending on the community, said Bruce Kornreich, a veterinarian at Cornell University's Feline Health Center, who was not involved in the study.

While keeping owned-cats indoors is the best way to benefit both kitties and wildlife, a complete cat ban, like the one recently proposed in New Zealand, is probably not the answer, he said.

For one, it's not clear how completely removing cats from outdoors would affect the ecosystem.

"It may be in some cases that cats may also be keeping other species that may negatively impact bird and other small mammal populations in check," Kornreich told LiveScience.

http://www.eurekalert.org/pub_releases/2013-01/uow-bbc012913.php

Beer's bitter compounds could help brew new medicines

Researchers employing a century-old observational technique have determined the precise configuration of humulones, substances derived from hops that give beer its distinctive flavor.

That might not sound like a big deal to the average brewmaster, but the findings overturn results reported in scientific literature in the last 40 years and could lead to new pharmaceuticals to treat diabetes, some types of cancer and other maladies.

The configuration of a humulone molecule is superimposed on a hops vine and a glass of beer. **Werner Kaminsky**

"Now that we have the right results, what happens to the bitter hops in the beer-brewing process makes a lot more sense," said Werner Kaminsky, a University of Washington research associate professor of chemistry.

Kaminsky is the lead author of a paper describing the findings, published this month in the journal Angewandte Chemie International Edition.

There is documentation that beer and its bittering acids, in moderation, have beneficial effects on diabetes, some forms of cancer, inflammation and perhaps even weight loss.

Kaminsky used a process called X-ray crystallography to figure out the exact structure of those acids, humulone molecules and some of their derivatives, produced from hops in the brewing process. That structure is important to researchers looking for ways to incorporate those substances, and their health effects, into new pharmaceuticals.

Humulone molecules are rearranged during the brewing process to contain a ring with five carbon atoms instead of six. At the end of the process two side groups are formed that can be configured in four different ways – both groups can be above the ring or below, or they can be on opposite sides.

Which of the forms the molecule takes determines its "handedness," Kaminsky said, and that is important for understanding how a particular humulone will react with another substance. If they are paired correctly, they will fit together like a nut and bolt. If paired incorrectly, they might not fit together at all or it could be like placing a right hand into a left-handed glove. That could produce disastrous results in pharmaceuticals.

Kaminsky cited thalidomide, which has a number of safe uses but was famously used to treat morning sickness in pregnant women in the late 1950s and early 1960s before it was discovered to cause birth defects. Molecule "handedness" in one form of the drug was responsible for the birth defects, while the orientation of molecules in another form did not appear to have the negative effects.

To determine the configuration of humulones formed in the brewing process, coauthors Jan Urban, Clinton Dahlberg and Brian Carroll of KinDex Therapeutics, a Seattle pharmaceutical firm that funded the research, recovered acids from the brewing process and purified them.

They converted the humulones to salt crystals and sent them to Kaminsky, who used X-ray crystallography – a technique developed in the early 20th century – to determine the exact configuration of the molecules.

"Now that we know which hand belongs to which molecule, we can determine which molecule goes to which bitterness taste in beer," Kaminsky said.

The authors point out that while "excessive beer consumption cannot be recommended to propagate good health, isolated humulones and their derivatives can be prescribed with documented health benefits."

Some of the compounds have been shown to affect specific illnesses, Kaminsky said, while some with a slight difference in the arrangement of carbon atoms have been ineffective.

The new research sets the stage for finding which of those humulones might be useful in new compounds to be used as medical treatments.

http://www.sciencedaily.com/releases/2013/01/130129080506.htm

Accessible Tourism and Dementia

Researchers are planning new ways of making tourist attractions dementia-friendly.

Fear of getting lost, fear of not finding the toilets or being misunderstood; there are many reasons why people with dementia and the families who care for them stop going on holiday.

For people with dementia, even simple days out can pose a host of hazards. Often, families say, it's easier to just stay at home. But Bournemouth University's newly launched Dementia Institute hopes to change that.

"We have a vision," says Professor Anthea Innes of the BU Dementia Institute (BUDI), "that perhaps in the future, Bournemouth might become a dementia-friendly tourist resort." An expert in health and social care research, Professor Innes is collaborating with Professor Stephen Page of BU's School of Tourism to launch pioneering research into dementia-friendly tourism -- developing venues where people with dementia will feel safe and at ease to enjoy themselves.

Encouraged by a government pledge to create 20 dementia-friendly cities, towns and villages by 2015, Professor Innes is working closely with those who need these facilities most.

"Our aim is to see how tourism can respond to the needs of people with dementia and their carers and find out if and why they haven't been able to access tourist attractions and leisure facilities," she says. "We hope to increase their use of tourist attractions, accommodation and resorts in the South of England."

While an exploratory pilot scheme will take place locally, Professor Innes hopes to expand the research to international, as well as UK, facilities. "Lots of work is currently going into dementia-friendly communities -- safe cashpoints, trained staff and police for instance -- but we are the only people looking specifically at leisure and tourism," she says.

Her initial focus groups with families of people with dementia will feed into research into voluntary organisations, NHS services and businesses themselves. BUDI plans to develop training to shape professional dementia care in the region. In the course of its research, BUDI's team will also interview the many tourist attractions that make up Bournemouth's seaside resort, such as the Oceanarium and venues such as tearooms, galleries, theatres and museums.

Dorset is home to one of the largest ageing populations in England and is a good place to start. Dorset also has the lowest rate of dementia diagnosis in the country, but not because of a shortage of people with the disease. Professor Innes estimates just one in four people with dementia in Dorset have actually been diagnosed.

"That's a shocking statistic. In other areas of the country about half the people with dementia are diagnosed, and if you don't have a diagnosis, you won't be able to access services and support. You might end up in a crisis situation because you and your family have not been able to plan for the future," she says.

Sometimes GPs are reluctant to give a diagnosis due to a lack of local services. A dementia label can also carry a stigma with families and communities -- meaning people are reluctant to admit a problem, and doctors might be unaware of the level of care available. Sometimes elderly people will already be in care homes, but labelled as 'pleasantly muddled,' rather than receiving a formal diagnosis.

A strong business case also exists for improving tourist facilities. Experts predict numbers of people with dementia will double over the next 30 years -- currently the disease costs the UK economy an estimated £19 billion.

"If somewhere is labelled as dementia-friendly, it's good for the industry and people involved. Staff will be better trained and more aware -- and that's good for levels of service overall," says Professor Innes.

Reference: Innes, A, Kelly, F and McCabe, L (2012) (eds) Dementia in the 21st Century: Theory, policy and practice. London: Jessica Kingsley

http://www.eurekalert.org/pub_releases/2013-01/cu-ces012913.php

Cornell engineers solve a biological mystery and boost artificial intelligence

Researchers have discovered why biological networks tend to be organized as modules

ITHACA, N.Y. – By simulating 25,000 generations of evolution within computers, Cornell University engineering and robotics researchers have discovered why biological networks tend to be organized as modules – a finding that will lead to a deeper understanding of the evolution of complexity. The new insight also will help evolve artificial intelligence, so robot brains can acquire the grace and cunning of animals. (Proceedings of the Royal Society, Jan. 30, 2013.)

From brains to gene regulatory networks, many biological entities are organized into modules – dense clusters of interconnected parts within a complex network. For decades biologists have wanted to know why humans, bacteria and other organisms evolved in a modular fashion. Like engineers, nature builds things modularly by building and combining distinct parts, but that does not explain how such modularity evolved in the first place.

Renowned biologists Richard Dawkins, Günter P. Wagner, and the late Stephen Jay Gould identified the question of modularity as central to the debate over "the evolution of complexity."
For years, the prevailing assumption was simply that modules evolved because entities that were modular could respond to change more quickly, and therefore had an adaptive advantage over their non-modular competitors. But that may not be enough to explain the origin of the phenomena.
The team discovered that evolution produces modules not because they produce more adaptable designs, but because modular designs have fewer and shorter network connections, which are costly to build and maintain. As it turned out, it was enough to include a "cost of wiring" to make evolution favor modular architectures.
This theory is detailed in "The Evolutionary Origins of Modularity," published today in the Proceedings of the Royal Society by Hod Lipson, Cornell associate professor of mechanical and aerospace engineering; Jean-Baptiste Mouret, a robotics and computer science professor at Université Pierre et Marie Curie in Paris; and by Jeff Clune, a former visiting scientist at Cornell and currently an assistant professor of computer science at the University of Wyoming.
To test the theory, the researchers simulated the evolution of networks with and without a cost for network connections. "Once you add a cost for network connections, modules immediately appear. Without a cost, modules never form. The effect is quite dramatic," says Clune.
The results may help explain the near-universal presence of modularity in biological networks as diverse as neural networks – such as animal brains – and vascular networks, gene regulatory networks, protein-protein interaction networks, metabolic networks and even human-constructed networks such as the Internet. "Being able to evolve modularity will let us create more complex, sophisticated computational brains," says Clune.
Says Lipson: "We've had various attempts to try to crack the modularity question in lots of different ways. This one by far is the simplest and most elegant."
The National Science Foundation and the French National Research Agency funded this research.

http://bit.ly/Yr8o9R

The Sieve Hypothesis: Clever Study Suggests an Alternate Explanation for the Function of the Human Stomach

You have a stomach. I have a stomach. It is one of our few universals. Humans, mate, sing, talk, and raise their children in many different ways, but we've all got stomachs. The question is why.

By Rob Dunn | January 29, 2013 | 6

Stomachs help to digest food; they get the process rolling, boiling and grinding by coating our food in slime, enzymes and acid. This is the textbook explanation and no one is saying it is wrong, but in one of my treasured meanders through the library, I recently stumbled upon a paper suggesting this explanation is incomplete, perhaps woefully so. Just as important to our survival may be the stomach's role in separating, sieving one might say, bacteria that are good for our guts from those that are bad. The study I found was led by Dr. Orla-Jensen, a retired professor from the Royal Danish Technical College. Orla-Jensen tested this new idea about the stomach by comparing the gut bacteria of young people, healthy older people and older people suffering from dementia. What Orla-Jensen found is potentially a major piece in the puzzle of the ecology of our bodies.

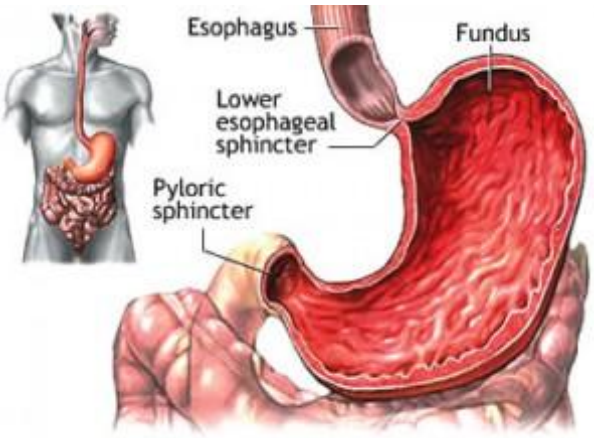


Image 1. A diagram of the human stomach. The stomach may act as a sieve, allowing only some kinds of microbes through to the small intestines.

Orla-Jensen and colleagues began by positing, or perhaps assuming is the better word, that a key function of the stomach is to kill bad bacteria with acid. The acid, they argue, serves as a sieve. It stops bad bacteria, particularly the most opportunistic of pathogens, but it does not stop all bacteria. It lets those beneficial bacteria that have adaptations for dealing with stomach acid–adaptations honed over many thousands of generations–on down the gastrointestinal road. In their model, if the stomach fails to kill bad bacteria, pathogens dominate the intestines. They do so in place of the beneficial microbes that help our bodies to digest food and produce nutrients. And when they do… death or at least the failure to thrive is nearly inevitable.
Orla-Jensen and colleagues knew from earlier work that the pH of the human stomach increases with age; the stomach becomes less acidic. This effect is most acute in individuals over seventy years of age. In these individuals Orla-Jensen predicted that the stomach's effectiveness as a killer of bad microbes might be compromised. In turn, the intestines, recipients of everything that leaves the stomach, living or dead, might

become dominated by pathogenic species such as the weedy and deadly *Clostridium dificile* or by oral species, that while beneficial in the mouth can become a pathogen in the gut. It was a simple enough prediction, but perhaps too simple. The biota of the gut is complex. It can contain thousands of species and is influenced by many, many factors which have proven in many ways intractable. Could the stomach's pH really matter enough to make a measurable difference? As I read Orla-Jensen's paper, I was skeptical, but I was curious enough to read through to the results. I sat down on the floor in the library and prepared to stay a while.

To test their hypothesis, Orla-Jensen and colleagues cultured bacteria they had collected from fecal samples of ninety human participants, one third of whom were between 30 and 40 years old and two thirds of whom were over seventy. They then compared the microbes found in the samples from these different age groups. Again, they would expect that in the older individuals that the bad bacteria and oral bacteria should be more common and, in their abundance, displace the good necessary bacteria, such as *Bifidobacterium*.

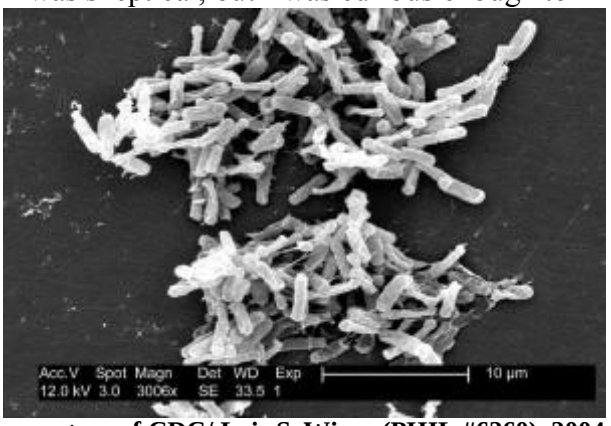


Image 2. Micrograph of Clostridium dificile. **Image courtesy of CDC/ Lois S. Wiggs (PHIL #6260), 2004.**

Remarkably, the authors' predictions from the sieve hypotheses held up. I have reproduced and slightly modified their main table below. Nine percent of the individuals over seventy had more than a million cells of the bad news *Clostridum* bacteria per gram of feces; none of the thirty to forty-year-olds did. What was more, a third of the individuals over seventy had more than a billion cells per gram of feces of the oral bacteria, *Streptococcus salivarius*. Again, none of the thirty to forty-year-olds did. But were these pathogenic and oral bacteria doing well enough to actually compromise the success of good bacteria in the gut? Yes. While all of the thirty to forty year olds had at least a million cells of the good gut bacteria *Bifidobacterium* per gram of sample, less than half of the individuals over seventy did.

Interestingly, the guts of those individuals over seventy years of age who had dementia were in the worst shape, by far. Nearly each and every one of their guts was dominated by *Clostridium* and oral bacteria. Other studies seem to lend support to these general findings, albeit from different angles. A study comparing healthy individuals and individuals with low stomach acidity found that those with low stomach acidity were less likely to have *Bifidobacterium* even though their total density of intestinal bacteria, particularly the pathogens, increased. Another study found that individuals with low stomach acidity tend to be more likely to suffer from diarrhea, as would be expected if their guts were being taken over by pathogens.

The differences seen here as a function of age are much more pronounced than those seen in another study, recently published in the journal *Nature*. The *Nature* article compares the gut microbes of more than five hundred individuals of different ages and ethnicities. In the *Nature* study the authors found little effect of age on gut microbes after the first few years of life (during which there was a large effect as newborns slowly acquired adult microbes). However, the *Nature* study only considered four individuals over seventy years of age (they also did not specifically look for shifts in beneficial versus problematic species, perhaps they will in the future). Orla-Jensen's work suggests that it is precisely the very old individuals in whom the differences begin to be pronounced. Sometimes it takes the perspective of many studies and time to see the full picture. This is probably where I should point out that the Orla-Jensen study I'm discussing was published in 1948. Interesting ideas can get lost in unread scientific articles; many, perhaps most, are. Orla-Jensen's paper has only rarely been cited and never in the context of the discussion of the function of the stomach or even in the context of aging and the microbial wilderness of our bodies.

Table 1. Reproduced (with updates) from Orla-Jensen et al., 1948. Sample size for each group = 30 individuals. The author of this paper, Prof. Orla-Jensen was 77 at the time of the publication of this paper in 1948 and so had a personal interest in these results. One wonders if he sampled himself.

	Percent of individuals with > than 1 billion cells of each bacteria per gram of feces, or, in parentheses, percent of individuals with > 1 million cells per gram.		
Volunteers	Mutualist *Bifidobacterium*	Pathogen *Clostridium*	Oral bacteria, *Streptococcus salivarius*
Aged 30-40 (Healthy)	57 (100)	0	0
> 70 years (Healthy)	25 (44)	9	31
> 70 years (w/ Dementia)	7 (9)	48	35

More than sixty-five years later it is now up to us to figure out what other predictions the sieve hypothesis might make <sup>2/<sup>. Perhaps the most obvious prediction is that as one travels the body, from the skin to

the mouth to the stomach and on into the intestines, that one should encounter, at each step, diminishing subsets of microbial lineages. Is this true? It seems hard to believe. After all, a huge number of studies have proudly announced the great diversity of microbes in the gut, a terrible diversity. Let's look.

The best study I know of included samples from mouth and gut, and considered which taxa of microbes were found in the different habitats. The diversity of major lineages drops by half as you go from the mouth to the stomach AND the lineages present in the gut, particularly the colon, are a subset of those in the stomach which are a subset of those in the mouth (see Figure 2). Comparing the results of this studies with those of others suggests the mouth itself also serves as a kind of filter, winnowing the species that land on the skin and lips or in the mouth to the subset that are most beneficial. From this subset, the stomach further cleaves.

If the sieve hypothesis holds, there must be additional predictions. I have not thought this through terribly well, but I think I would probably expect differences in the stomachs of animals eating different foods. Animals that eat foods that are more likely to include pathogens ought to have filters that are more finely tuned to weeding out bad microbes; they ought, I think, to err on the side of killing too many. This does appear to be the case for some vultures. The stomach of the white-backed vulture has a pH of 1! Conversely it seems plausible to predict that animals that eat diets less likely to lead them to pathogens, fruit eaters for example, should be expected to relax the sieve, open it up a little to make sure that many good microbes make it through. I don't know that it has been tested. There must be more predictions for the differences one expects among species. A broad survey of the evolution of the stomach seems in order.

Image 3. White backed vultures feeding on a wildebeest. These vultures need to very actively fight the pathogens in the dead meat on which they indulge. One way they do so is by having very, very, acidic stomachs. **Photo by Magnus Kjaergaard.**

Modern living also presents us with another testable prediction about the stomach and its effects on microbes. Bariatric surgery is an ever more common medical intervention in which the size of a patient's stomach is reduced so as to reduce the amount of food he or she can eat in one sitting. The surgery also has the consequence, however, of increasing the pH in the stomachs of those who have the surgery, making their stomachs less acidic. If the sieve hypothesis is right these individuals ought to have gut bacteria that look more like those of seventy years old than those of thirty year olds. They do. Recently a study has found that good *Bifidobacterium* species become more rare after bariatric surgery while oral bacteria (in this case *Prevotella*) and *E. coli*, which can be a pathogen, become more common. These results seem to be what the sieve hypothesis would predict.

Image 4. Microbiologist Jonathan Eisen wearing his microbiome. **Image courtesy of Jonathan Eisen.**

I am sure there are more predictions. I'll leave you to them. The good news is that if there are more predictions now is a great time to look, to test them. The study of the microbes of our body is now hip, as sexy as a field of study that often involves the word fecal can be (see Image 4 or check out your own sexy fecal bugs at American Gut). New data are published every day. If we can develop good predictions they can be tested. We might finally figure out what the stomach does, or rather the complex mix of its roles, its churning melange of duties. No one denies that the stomach helps to break down proteins, it just might not be its most important job.

Meanwhile, there is an interesting coda to this story. In addition to considering the difference between old and young individuals, Orla-Jensen, as you might remember, considered the difference between healthy individuals over seventy and individuals over seventy with dementia. The individuals with dementia had even more pathogens and oral microbes in their guts than did the healthy seventy-year-olds. This is interesting, but what is the cause and what is the effect here? Could a poorly functioning stomach lead to a pathogen heavy microbe community in the gut and could that gut community in turn lead to dementia? Could our minds really fail because our stomachs do? A few recent studies have begun to explore the possibility that dementia might result from infection, but it is WAY too soon to say anything conclusive. One is left to imagine the mechanism behind such a decline. I have some ideas, but I'll need to think them over some more. Meanwhile, you can offer your

hypotheses too, and I'll go back to the library and see what other gems I can find, old studies that are as revolutionary as the new ones you read about in the press, studies that whether right or wrong confirm just how little we know and how slow and circular progress can be.

Footnotes (more to be added)

1- They did not sequence the genes of these microbes—now a common technique—and so their results represent just part of what was going on in the sampled guts, a few kinds of common trees in a diverse forest, and yet it was probably a reasonable measure of those trees.

2- Which, I will confess, I've named here. Orla-Jensen and colleagues thought the idea so obvious as to not even deserve a name.

http://phys.org/news/2013-01-theory-african-exit.html

New theory on African exit

Modern humans left Africa twice as early as previously thought, spreading in a number of climate-driven waves, new research suggests.

The paper, published in Quaternary International, pours fresh doubt on the previously-held consensus that humans spread from Africa in a single cohort.

'The consensus view has been that modern humans left Africa around 60,000 years ago by a coastal route, skirting around some very arid places, and spread to Australia very quickly,' explains Professor Michael Petraglia of the University of Oxford, one of the study's authors. 'We think that's wrong. We think people left Africa multiple times, probably a long time before, and we think it was terrestrial rather than coastal.'

Previous attempts to put a date on the exit of modern humans from Africa have relied heavily on evidence from genetics and archaeology.

Petraglia and his team believe that, by adding evidence on climate and environment into the mix, they will be able to unlock new clues as to both how and why humans spread from the continent.

'We know that the climate has shifted a lot of times. We think that has acted like a pump out of Africa, pushing waves of people into South Asia.'

'When the climate was humid, there would have been rivers and lakes across the Asian continent. We think modern humans would have used those as routes, but what we don't know is what happened to those populations when it became arid again.'

The idea goes against a well-established and widely-held consensus. But Petraglia sees signs that academics across the spectrum are beginning to change their minds.

'There are lots of people buying into this idea in many different fields; in genetics, in archaeology, in environmental fields. We're seeing major cracks in the consensus view,' he says.

The team will now zoom in to examine some important sites in more detail, as they attempt to add flesh to their theory.

Petraglia believes that the research has important implications for understanding our present, as well as our past. 'It's in the public imagination. People are fascinated by our own species and how we populated the Earth,' he says.

'But we're also trying to understand this climate pump - how the climate affects the movement of populations and the speed at which that happens - and that could clearly have important implications for today.'

More information: Bolvin, N., Fuller, D., Dennell, R., Allaby, R., and Petraglia, M. Human Dispersal Across Diverse Environments of Asia during the Upper Pleistocene, Quaternary International, 2013, doi: 10.1016/j.quaint.2013.01.008

http://www.scientificamerican.com/article.cfm?id=why-humans-like-to-cry

Why Humans Like to Cry

The anguished tear, a British scientist argues in a new book, is what makes us uniquely human

By Gareth Cook | Tuesday, January 29, 2013 | 6

Michael Trimble, a British professor at the Institute of Neurology in London, begins his new book with Gana the gorilla. In the summer of 2009, 11-year-old Gana gave birth to a boy at a Muenster zoo. But one day in August, the baby suddenly and mysteriously died. Gana held up her son in front of her, staring at his limp body. She held him close, stroking him. To onlookers it appeared that Gana was trying to reawaken him, and, as the hours passed, that she was mourning his passing. Some at the zoo that day cried. But Gana did not. Humans, Trimble tells us, are the only creatures who cry for emotional reasons. "Why Humans Like to Cry" is an exploration of why this would be so, a neuroanatomical "where do tears come from." It's also a meditation on human psychology. Many distinctions have been offered between humans and the rest of the animal world, and to this list Trimble adds another: the anguished tear, the apprehension that life is tragic. Trimble answered questions from Mind Matters editor Gareth Cook.

Cook: How did you first become interested in crying?

Trimble: Of course, because I cry, and some things bring tears quite easily, notably music, and opera with the power of the human voice.

Crying tears, for emotional reasons, is unique to humans. There has been a game of catch me if you can, which has been played by those interested in finding attributes or behaviours which separate humans from our nearest living relatives – namely the chimpanzees and bonobos. Certainly our propositional language is very special, but primate communities have very sophisticated ways of communicating. Other contenders, such as play, using tools, or having what is called theory of mind (the sense that I know that others have a mind very like mine, with similar inclinations and intentions) have all been argued as unique to our species, but all these have been demonstrated, in some form, to be found in other primates. Emotional crying makes us human.

Cook: What is known about crying in the animal world?

Trimble: Tears are necessary to keep the eyeball moist, and contain proteins and other substances which maintain the eye healthy and to combat infection. Tearing occurs in many animals in response to irritants which get in the eye, and in some settings tears fall for simple anatomical facts. When an elephant is standing, tears run down the trunk, but when lying down, the flow is impeded and tears may be seen coming from the eyes. It may be that animals that are abused shed tears, from pain, although observations of this are rare.

Cook: How is crying different in humans?

Trimble: Humans cry for many reasons, but crying for emotional reasons and crying in response to aesthetic experiences are unique to us. The former is most associated with loss and bereavement, and the art forms that are most associated with tears are music, literature and poetry. There are very few people who cry looking at paintings, sculptures or lovely buildings. But we also have tears of joy the associated feelings of which last a shorter time than crying in the other circumstances.

Cook: What do you find most interesting about the neuroscience of crying?

Trimble: If it is the case that only humans cry emotionally, then there must have been a time in human evolution when tears took on an additional meaning to their hitherto biological functions , namely as a signal of distress, and a cipher for suffering. In my book I discuss at when in the past our ancestors may come to possess this trait. I suggest that this is connected with the dawning of self-consciousness, with the development of theory of mind, and the realisation that the self and others can disappear. Attachment emotionally to others, with the development of sophisticated facial gestures associated with suffering, and with loss and bereavement ensued. All this before the development of our elegant propositional language. The emotional responses became largely unconscious and innate, and identification of tears as a signal for such distress was an important addition the so called Social brain, the circuitry of which can now be identified in the human brain.

I also discuss the differences between the neuroanatomy of the human brain and that of chimpanzees and other closely related primates, which may explain our ability to respond emotionally with tears to the arts. The brain areas involved are widespread, but link our cerebral cortex especially anteriorly with those areas associated with the representation of emotion – so called limbic structures and our autonomic system. The latter co-ordinates heart rate, breathing, and vocal output, all of which collaborate in the expression of emotion with tears.

Cook: You mention "theory of mind" and crying. Can you tell me more about the connection between the two?

Trimble: Theory of mind refers to an area of social cognition which has developed hugely in humans, although similar abilities in much more limited forms have been shown in chimpanzees. The ability to feel compassion, the embodiment of which relates to our capacity for empathy, is triggered by what the neurologist Antonio Damasio refers to as emotionally competent stimuli. The responses are automatic, unconscious and bound in with our personal memories. Seeing facial expressions of sadness trigger the neuronal circuits related to theory of mind and empathy, which to some extent overlap, and involve, in part, those brain areas that give us our visceral, emotional feelings noted above. The tear, as part of the expression of suffering, became an emblem embroidering the expression. The tear, mythological linked with purity with a pearl shape has provided an image which, over time, has come by itself to symbolise sadness, grief, but also joy in music, poetry and the visual arts.

Cook: What lesson do you think this holds for us?

Trimble: Tears are a natural response to not only suffering, but also to feeling compassion for someone who is shedding tears. There has been much reluctance, especially on behalf of men, to admit to crying, and to crying in public. Yet Greek heroes such as Agamemnon and Achilles cried, and 2012 has seen many public tears, from the winners and losers in the Olympic games, to President Obama who cried after his re-election victory. We should not be afraid of our emotions, especially those related to compassion, since our ability to feel empathy and with that to cry tears, is the foundation of a morality and culture which is exclusively human.

http://www.sciencedaily.com/releases/2013/01/130130082726.htm

Whistle Away the Need for Diapers: Vietnamese Babies Often out of Diapers at Nine Months

Western babies are potty trained later these days and need diapers until an average of three years of age. But even infants can be potty trained.

A study by researchers at Sahlgrenska Academy, University of Gothenburg, Sweden, followed 47 infants and their mothers in Vietnam -- where potty training starts at birth and the need for diapers is usually eliminated by nine months of age. Not only does eliminating the need for diapers save money and remove one practical chore for parents, but the baby's ability to control its bladder improves efficiency and reduces the risk of urinary tract infection, researchers say.

International research shows that Western babies are being potty trained later these days and average 3-4 years of age before they can take care of their own toileting needs. The situation in Vietnam is very different. Researchers at Sahlgrenska Academy, University of Gothenburg, followed 47 Vietnamese mothers for two years to study their potty training procedure, which begins at birth and generally eliminates the need for diapers by nine months of age. The technique is based on learning to be sensitive to when the baby needs to urinate. "The woman then makes a special whistling sound to remind her baby," Anna-Lena Hellström says. "The whistling method starts at birth and serves as an increasingly powerful means of communication as time goes on."

According to the study, women notice signs of progress by time their babies are three months old. Most babies can use the potty on their own by nine months of age if they are reminded, and they can generally take care of all their toileting needs by the age of two. "Our studies also found that Vietnamese babies empty their bladders more effectively," Professor Hellström says. "Thus, the evidence is that potty training in itself and not age is the factor that causes bladder control to develop."

Swedes have grown accustomed to the idea that babies cannot be potty trained, but that parents need to wait until they are mature, usually when they decide that they no longer want diapers. The evidence from Vietnam demonstrates that more sophisticated communication between parents and their babies would permit potty training to start and be completed much earlier.

Thi Hoa Duong, Ulla-Britt Jansson, Anna-Lena Hellström. Vietnamese mothers' experiences with potty training procedure for children from birth to 2 years of age. Journal of Pediatric Urology, 2012; DOI: 10.1016/j.jpurol.2012.10.023

http://www.wired.com/wiredscience/2013/01/human-gait-optimization/

Human Gait Optimized for Efficiency

Why don't we high kick our way to the bus stop or skip to the grocery store

By Lizzie Wade, ScienceNOW

A quick visit to Monty Python's Ministry of Silly Walks shows just how many ways humans (or at least British comedians) can think of to travel from point A to point B. So why don't we high kick our way to the bus stop or skip to the grocery store? New research suggests that there may be a deep biomechanical reason governing the gaits we choose in different situations, and understanding it could help scientists design better prosthetic limbs and even build more humanlike robots.

From previous experiments done on treadmills, scientists know that people consistently transition between walking and running when they are traveling 2 to 3 meters per second. The reason it feels "natural" to change gaits at that speed is because your body and brain automatically try to minimize the amount of energy you have to expend getting from place to place. Below about 2.3 m/s, walking requires less energy. Above it, it takes less energy to run.

Walking on a treadmill that dictates your speed, however, isn't a perfect model for how you move when you're strolling through your neighborhood. Researchers at the Movement Lab at Ohio State University (OSU), Columbus, wondered whether we naturally move in a way that minimizes energy when we're out in the real world. So they took a collection of healthy people into long corridors and out onto sidewalks and gave them set amounts of time to travel about 250 meters.

As the team reports today in the Journal of the Royal Society Interface, its results clearly echoed the treadmill experiments of the past: people consistently chose to walk when they needed to travel slower than 2 m/s to reach their goal in the given time; when they needed to move about 3 m/s or faster, they ran. But in between—in what OSU mechanical engineer and co-author Manoj Srinivasan calls "the twilight zone between walking and running"—people tended to mix the two gaits. Although the exact fraction of the time spent running to the time spent walking varied from person to person, the overall result perfectly lined up with what you would expect to see if people were unconsciously minimizing the energy needed to get from point A to point B on time. "People always want to move in a manner that saves energy," Srinivasan explains.

The paper comes at an "important juncture in the perspective of the field [of biomechanics]," says John Bertram, a comparative biomechanist at the University of Calgary in Canada who was not involved with the study. Previously, he says, scientists studying human gaits simply observed and described them without making an effort to understand the possible mechanisms behind them. Now, researchers like Srinivasan and his student Leroy Long are making precise mathematical predications in order to experimentally test different theories of movement.

At least for now, the theory of energy minimization is coming out on top, suggesting that the gaits that feel the most "natural" to us are the ones that require the least amount of energy at certain speeds. It's possible, therefore, that if engineers programmed bipedal robots to prioritize energy minimization, they'd end up with robots that walk and run a lot like humans do.

In the meantime, Srinivasan would like to see his research be applied to the design of prosthetic limbs. By using his model, "you could tune the device in certain ways to minimize the energy consumption," which could actually make the prosthetic feel more "natural" and improve the user's quality of life.

This story provided by ScienceNOW, the daily online news service of the journal Science.

http://bit.ly/XP6HAf

Published clinical trials shown to be misleading

Comparison of internal and public reports about Pfizer's drug Neurontin reveals many discrepancies

By Rachel Ehrenberg

Editor's note: This story was updated on January 31 with comment from Pfizer.

A rare peek into drug company documents reveals troubling differences between publicly available information and materials the company holds close to its chest. In comparing public and private descriptions of drug trials conducted by pharmaceutical giant Pfizer, researchers discovered discrepancies including changes in the number of study participants and inconsistent definitions of protocols and analyses.

The researchers, led by Kay Dickersin, director of the Center for Clinical Trials at the Johns Hopkins Bloomberg School of Public Health, gained access to internal Pfizer reports after a lawsuit made them available. Dickersin and her colleagues compared the internal documents with 10 publications in peer-reviewed journals about randomized trials of Pfizer's anti-epilepsy drug gabapentin (brand name Neurontin) that tested its effectiveness for treating other disorders. The results, the researchers say, suggest that the published trials were biased and misleading, even though they read as if standard protocols were followed. That lack of transparency could mean that clinicians prescribe drugs based on incomplete or incorrect information.

"We could see all of the biases right in front of us all at once," says Dickersin, who was an expert witness in the suit, which was brought by a health insurer against Pfizer. Pfizer lost the case in 2010, and a judge ruled it should pay $142 million in damages for violating federal racketeering laws in promoting Neurontin for treating migraines and bipolar disorder. Pfizer had in 2004 settled a case and paid $430 million in civil fines and criminal penalties for promoting Neurontin for unapproved use.

The study's results, published January 29 in PLOS Medicine, show that publications about drug trials don't always reflect the research that was conducted, says Lisa Bero of the University of California, San Francisco, an expert in methods to assess bias in scientific publishing "We know that entire studies don't get published and that what does get published is more likely to make a drug look favorable," she says. "This adds another layer."

In three of the 10 trials, the numbers of study participants in the published results didn't match those in the internal documents. In one case, data from 40 percent of the participants were not included in the published trial. Dickersin and her colleagues also tried to directly compare several other aspects of the studies. But they found so many differences in definitions and in the analyses and protocols that the comparisons turned out to be difficult, she says.

"When we tried to draw a flow chart of who dropped out [of a trial], who stayed in — well, we couldn't do it," she says. "You can't even judge if they did the right thing if you can't figure out what they did."

Pfizer did not immediately respond to requests for comment. The company outlined its policies for making clinical trial data public in a statement provided to Science News on January 30, concluding that the company reports on studies "in an objective, accurate, balanced and complete manner."

The Johns Hopkins analysis highlights the need for standard definitions and protocols and greater transparency in reporting clinical trials, says Bero, a longtime advocate of making raw data from clinical trials publicly available. "You're kind of held hostage to the paper that you are reading," she says.

S. S. Vedula, T. Li and K. Dickersin. Differences in reporting of analyses in internal company documents versus published trial reports: comparisons in industry-sponsored trials in off-label uses of Gabapentin. PLOS Medicine. doi:10.1371/journal.pmed.1001378

http://www.eurekalert.org/pub_releases/2013-01/w-srs013013.php

Study reveals significance of second trimester markers for Down's syndrome

A new analysis has found that some second trimester markers for Down's syndrome that are detected by ultrasound are more telling than others.

Published early online in Ultrasound in Obstetrics & Gynecology, the study's results will help adjust pregnant women's risks for having a child with the condition.

Screening for Down's syndrome is offered to all pregnant women, who start out with a background risk based on their age. Certain features detected during a second trimester ultrasound exam are potential markers for Down's syndrome, and they include dilated brain ventricles, absent or small nose bone, increased thickness of the back of the neck, an abnormal artery to the upper extremities, bright spots in the heart, 'bright' bowels, mild kidney swelling, and shortening of an arm bone or thigh bone.

To determine how these markers affect risk, Kypros Nicolaides, MD, of the Harris Birthright Research Centre for Fetal Medicine at King's College London in England, and his colleagues analyzed all published studies that reported results on second trimester markers for Down's syndrome between 1995 and 2012.

The researchers identified 48 studies, and they discovered that most single markers have only a small effect on modifying the odds for Down's syndrome. This finding could have important clinical implications because currently in the United States, when a marker such as a short arm or thigh bone is detected, women are told that they are at high risk of having a child with Down's syndrome. Dr. Nicolaides and his team found that a few markers do carry increased risks, though. Dilated brain ventricles, increased thickness of the back of the neck, and an abnormal artery to the upper extremities increase the risk by three- to four-fold, and an absent or small nose bone increases the risk by six- to seven-fold.

"The detection of any one of the findings during the scan should prompt the sonographer to look for all other markers or abnormalities," said Prof. Nicolaides. He added that the study also revealed that if a detailed second trimester ultrasound exam demonstrates the absence of all major markers, the risk of having a baby affected by Down's syndrome is reduced by more than seven-fold.

The findings indicate that the relative importance of ultrasound markers is very different from what has been previously assumed. Prof. Nicolaides noted that the results from this study will be incorporated in obstetric ultrasound scan software that adjusts women's risks for having a child with Down's syndrome.

URL: http://doi.wiley.com/10.1002/uog.12364

http://phys.org/news/2013-01-expert-psychologist-era-genius-scientists.html

Expert psychologist suggests the era of genius scientists is over

Dean Keith Simonton fears that surprising originality in the natural sciences is a thing of the past, as vast teams finesse knowledge rather than create disciplines.

Phys.org - Dean Keith Simonton, a psychology professor at the University of California, has published a comment piece in the journal Nature, where he argues that it's unlikely mankind will ever produce another Einstein, Newton, Darwin, etc. This is because, he says, we've already discovered all the most basic ideas that describe how the natural world works. Any new work, will involve little more than adding to our knowledge base.

Simonton's comments are likely to draw a strong reaction, both in and out of the science world. It's been the geniuses among us that have driven science forward for thousands of years, after all. If no more geniuses appear to offer an entirely new way of looking at things, how will the human race ever reach new heights?

Simonton has been studying geniuses and their contributions to science for more than 30 years and has even written books on them. He also writes that he hopes he is wrong in his assessment, even as he clearly doesn't think he is. Sadly, the past several decades only offer proof. Since the time of Einstein, he says, no one has really come up with anything that would mark them as a giant in the field, to be looked up to hundreds, if not thousands of years from now. Worse perhaps, he details how the way modern science is conducted is only adding to the problem. Rather than fostering lone wolves pondering the universe in isolation, the new paradigm has researchers working together as teams, efficiently going about their way, marching towards incremental increases in knowledge. That doesn't leave much room for true insight, which is of course, a necessary ingredient for genius level discoveries.

Simonton could be wrong of course – there might yet be some person that looks at all that has been discovered and compares it with his or her own observations, and finds that what we think we know, is completely wrong, and offers evidence of something truly groundbreaking as an alternative. The study of astrophysics, for example, appears ripe for a new approach. Scientists are becoming increasingly frustrated in trying to explain why the universe is not just expanding, but is doing so at an increasing rate. Perhaps most of the theories put forth over

the past half-century or so, are completely off base. Modern science can't even explain gravity, after all. Isn't it possible that there is something at work that will need the intelligence, insight and courage of an Einstein to figure out? It appears we as a species are counting on it, even as we wonder if it's even possible.
More information: After Einstein: Scientific genius is extinct, Nature 493, 602 (31 January 2013) doi:10.1038/493602a

http://www.eurekalert.org/pub_releases/2013-01/uosc-ngs013113.php

New Geology study raises questions about long-held theories of human evolution

What came first: the bipedal human ancestor or the grassland encroaching on the forest?

A new analysis of the past 12 million years' of vegetation change in the cradle of humanity is challenging long-held beliefs about the world in which our ancestors took shape – and, by extension, the impact it had on them.
The research combines sediment core studies of the waxy molecules from plant leaves with pollen analysis, yielding data of unprecedented scope and detail on what types of vegetation dominated the landscape surrounding the African Rift Valley (including present-day Kenya, Somalia and Ethiopia), where early hominin fossils trace the history of human evolution.
"It is the combination of evidence both molecular and pollen evidence that allows us to say just how long we've seen Serengeti-type open grasslands," said Sarah J. Feakins, assistant professor of Earth sciences at the USC Dornsife College of Letters, Arts and Sciences and lead author of the study, which was published online in Geology on Jan. 17. Feakins worked with USC graduate student Hannah M. Liddy, USC undergraduate student Alexa Sieracki, Naomi E. Levin of Johns Hopkins University, Timothy I. Eglinton of the Eidgenössische Technische Hochschule and Raymonde Bonnefille of the Université d'Aix-Marseille.
The role that the environment played in the evolution of hominins—the tribe of human and ape ancestors whose family tree split from the ancestors of chimpanzees and bonobos about 6 million years ago—has been the subject of a century-long debate. Among other things, one theory dating back to 1925 posits that early human ancestors developed bipedalism as a response to savannas encroaching on shrinking forests in northeast Africa. With fewer trees to swing from, human ancestors began walking to get around.
While the shift to bipedalism appears to have occurred somewhere between 6 and 4 million years ago, Feakins' study finds that thick rainforests had already disappeared by that point—replaced by grasslands and seasonally dry forests some time before 12 million years ago.
In addition, the tropical C4-type grasses and shrubs of the modern African savannah began to dominate the landscape earlier than thought, replacing C3-type grasses that were better suited to a wetter environment. (The classification of C4 versus C3 refers to the manner of photosynthesis each type of plant utilizes.)
While earlier studies on vegetation change through this period relied on the analysis of individual sites throughout the Rift Valley—offering narrow snapshots—Feakins took a look at the whole picture by using a sediment core taken in the Gulf of Aden, where winds funnel and deposit sediment from the entire region. She then cross-referenced her findings with Levin who compiled data from ancient soil samples collected throughout eastern Africa. "The combination of marine and terrestrial data enable us to link the environmental record at specific fossil sites to regional ecological and climate change," Levin said.
In addition to informing scientists about the environment that our ancestors took shape in, Feakins' study provides insights into the landscape that herbivores (horses, hippos and antelopes) grazed, as well as how plants across the landscape reacted to periods of global and regional environmental change.
"The types of grasses appear to be sensitive to global carbon dioxide levels," said Liddy, who is currently working to refine the data pertaining to the Pliocene, to provide an even clearer picture of a period that experienced similar atmospheric carbon dioxide levels to present day. "There might be lessons in here for the future viability of our C4-grain crops," says Feakins.
Funding for this research was provided by the U.S. National Science Foundation HOMINID Grant 0218511 and from USC.

http://www.sciencedaily.com/releases/2013/01/130131095040.htm

Potential of Psilocybin to Alleviate Psychological and Spiritual Distress in Cancer Patients Is Revealed

A review of psilocybin's potential in alleviating the psychological and spiritual distress accompanying a life-threatening cancer diagnosis

Improvements in the diagnosis and treatment of cancers in recent years have led to a marked increase in patients' physical survival rates. While doctors can treat the physical disease, what is not well understood is how best to address the psychological needs of patients with cancer. In addition to the physical pain associated with cancer, many patients also experience psychologically harmful symptoms of anxiety, depression, anger, and denial. Social isolation, in addition to hopelessness, helplessness and loss of independence, has also been associated with significant psychological suffering in patients coping with advanced-stage cancer.

A recently published book chapter "Use of the Classic Hallucinogen Psilocybin for Treatment of Existential Distress Associated with Cancer," reviews the potential of a novel psychoactive drug, psilocybin, in alleviating the psychological and spiritual distress that often accompanies a life-threatening cancer diagnosis.
The chapter, published in Psychological Aspects of Cancer: A Guide to Emotional and Psychological Consequences of Cancer, Their Causes, and Their Management, was co-written by Anthony P. Bossis, PhD, Clinical Assistant Professor of Psychiatry and Oral and Maxillofacial Pathology, Radiology, and Medicine at the New York University College of Dentistry (NYUCD) and Langone Medical Center.
The hallucinogen treatment model with psilocybin has been shown to induce a mystical or spiritual experience and is a unique therapeutic approach to reduce the anxiety of terminal cancer patients.
"Mystical or peak consciousness states in cancer patients have been associated with a number of benefits including improved psychological, spiritual, and existential well-being," said Dr. Bossis.
Psilocybin (a serotonergic psychoactive agent) is a naturally occurring active component of many species of mushrooms, and is rapidly metabolized to psilocin, a highly potent activator of serotonin receptors. In addition to receiving the psilocybin compound, patients enrolled in the study also receive psychological preparation prior to the psilocybin dosing followed by a brief series of integrative psychotherapeutic sessions.
The chapter includes a clinical case vignette of a patient in the ongoing Psilocybin Cancer Anxiety Study at the Bluestone Center for Clinical Research. Participants undergo two drug administration sessions in which psilocybin is administered on one occasion and a placebo on the other.
"The primary objective of this phase I, double-blind, controlled pilot study is to assess the efficacy of psilocybin administration on psychosocial distress, with the specific primary outcome variable being anxiety associated with advanced and/or recurrent cancer," said Bossis. "Secondary outcome measures will look at the effect of psilocybin on symptoms of pain perception, depression, existential/psychospiritual distress, attitudes toward illness, quality of life, and spiritual/mystical states of consciousness," said Bossis.
The clinical vignette describes a patient who, over the course of three years, experienced extreme fatigue, pain, overall body aches, discomfort and psychological distress due to cancer and intensive biweekly chemotherapy. The patient became increasingly anxious and depressed and was enrolled in two study sessions; in one he received psilocybin and the other placebo. Despite continuing the arduous chemotherapy schedule, suffering from illness, and undergoing additional surgical procedures, the patient continued to report a marked improvement in attitude, coping, and mood 18 weeks after his session and stated, "my quality of life is dramatically improved," the patient said.
Stephen Ross, MD, Assistant Professor of Psychiatry and Child and Adolescent Psychiatry at the NYU School of Medicine and Clinical Assistant Professor of Psychiatry and Oral and Maxillofacial Pathology, Radiology, and Medicine at the NYUCD is the principal investigator for the study; Dr. Bossis and Jeffrey Guss, MD, Clinical Assistant Professor of Psychiatry are co-principal investigators. The co-authors of the chapter were: Charles S. Grob, MD, Professor of Psychiatry and Biobehavioral Sciences at Harbor-UCLA Medical Center and Roland R. Griffiths, PhD, Professor of Psychiatry and Behavioral Science and Neuroscience at Johns Hopkins University.
The Psilocybin Cancer Anxiety Study was also recently highlighted in a News article, "Opening Doors of Perception: Psychedelic Drugs and End-of-Life Care" in the Journal of the National Cancer Institute.
"The emotional, spiritual and existential distress that can often accompany a diagnosis of cancer often goes unidentified and untreated in cancer patients. Patients who have benefited from psilocybin clinical research have reported less anxiety, improved quality of life, enhanced psychological and spiritual well-being, and a greater acceptance of the life-changes brought on by cancer. It is a welcome development that this promising and novel clinical research model utilizing psilocybin has begun to gain clinical and academic attention," Bossis notes.
The Psilocybin Cancer Anxiety Study is currently recruiting additional subjects. To enroll or learn more, please visit BluestoneCenter.org or http://www.nyucanceranxiety.org/.

http://www.sciencedaily.com/releases/2013/01/130131144454.htm

Working Alone Won't Get You Good Grades

Students who work together and interact online are more likely to be successful in their college classes

Students who work together and interact online are more likely to be successful in their college classes, according to a study published Jan. 30 in the journal Nature Scientific Reports and co-authored by Manuel Cebrian, a computer scientist at the Jacobs School of Engineering at the University of California San Diego.
Cebrian and colleagues analyzed 80,000 interactions between 290 students in a collaborative learning environment for college courses. The major finding was that a higher number of online interactions was usually an indicator of a higher score in the class. High achievers also were more likely to form strong connections with

other students and to exchange information in more complex ways. High achievers tended to form cliques, shutting out low-performing students from their interactions. Students who found themselves shut out were not only more likely to have lower grades; they were also more likely to drop out of the class entirely.
"Elite groups of highly connected individuals formed in the first days of the course," said Cebrian, who also is a Senior Researcher at National ICT Australia Ltd, Australia's Information and Communications Technology Research Centre of Excellence. "For the first time, we showed that there is a very strong correspondence between social interaction and exchange of information -- a 72 percent correlation," he said "but almost equally interesting is the fact that these high-performing students form 'rich-clubs', which shield themselves from low-performing students, despite the significant efforts by these lower-ranking students to join them. The weaker students try hard to engage with the elite group intensively, but can't. This ends up having a marked correlation with their dropout rates."

A graph showing interactions between 82 students during the last week of a course. High performing students are in dark blue and form a core where the highest density of persistent interactions can be observed. Mid-performing students are in red and low-performing student sin green. Persistent interactions are shown in thick blue edges, while dotted thin grey edges indicate transient interactions. **Image courtesy of University of California - San Diego**

This study co-authored by Luis M. Vaquero, based at Hewlett-Packard UK Labs, shows a way that we might better identify patterns in the classroom that can trigger early dropout alarms, allowing more time for educators to help the student and, ideally, reduce those rates through appropriate social network interventions.
Cebrian's work is part of UC San Diego's wider research effort at the intersection of the computer and social sciences, led by Prof. James H. Fowler, to enhance our understanding of the ways in which people share information and how this impacts areas of national significance, such as the spread of health-related or political behavior.
Luis M. Vaquero, Manuel Cebrian. The rich club phenomenon in the classroom. Scientific Reports, 2013; 3 DOI: 10.1038/srep01174

http://bit.ly/WkDqbx

Dinosaur-killing asteroid was a twin terror

The asteroid that slammed into Earth and helped wipe it clean of large dinosaurs may have been a binary

13:02 01 February 2013 by Colin Barras

Asteroids 2, dinosaurs 0. The infamous space rock that slammed into Earth and helped wipe it clean of large dinosaurs may have been a binary – two asteroids orbiting each other.
The dino-killing asteroid is usually thought of as a single rock with a diameter of 7 to 10 kilometres, but it may really have been two widely separated rocks with that combined diameter.
The surprise conclusion comes from a re-evaluation of the proportion of asteroid craters on Earth that were formed from binary impacts. It could also spell bad news for those hoping to protect our world from catastrophic collisions in future.
Earth bears the scars of twin-asteroid impacts: the Clearwater Lakes near Hudson Bay in Canada, for instance, are really twin craters that formed about 290 million years ago. Examples like Clearwater are rare, though. Just 1 in 50 of craters on Earth come in such pairs.

Binary mismatch

That is a puzzle because counts of the rocks zooming around in the vicinity of Earth suggest binaries are far more common. "It's been known for 15 years that about 15 per cent of near-Earth asteroids are binary," says Katarina Miljković at the Institute of Earth Physics in Paris, France. All else being equal, 15 per cent of Earth's impact craters should be the result of twin impacts. Why does the real figure appear so much lower?
Miljković and her colleagues have found an explanation. They ran computer simulations of binary asteroids hitting Earth and found that they often form a single crater.
This makes sense, given that a crater can be 10 times the diameter of the asteroid that made it. The team found that only unusual cases involving two small, widely separated asteroids are guaranteed to form a pair of distinct craters. The researchers' simulations confirmed that such binary asteroids are rare enough to explain why paired craters account for only 2 per cent of all Earth's craters.
An obvious implication is that binary asteroids hit Earth more often than the crater record appears to suggest – with ramifications for efforts to prevent future impacts (see "Do twin asteroids pose twice the risk?", below).

Not quite symmetrical

The simulations also suggest that it is possible to identify which of Earth's single craters had binary origins. These craters should be subtly asymmetrical, and that makes the crater near Chicxulub in Mexico – thought to be the result of an asteroid impact 65.5 million years ago that wiped out the dinosaurs – a strong candidate.

"The Chicxulub crater shows some important asymmetries," says Miljković. "It is worth considering that it was formed by a binary asteroid."

Petr Pravec at the Academy of Sciences of the Czech Republic in Ondrejov agrees with Miljković that the crater's features make it a particularly likely contender.

Studying the gravity anomalies created by an impact is a powerful way to find out more about a crater – particularly one that is now buried, like the Chicxulub crater. Pravec says recent gravity surveys taken at the Chicxulub impact area support Miljković's conjecture. "The signatures also suggested that the Chicxulub crater might have been formed by a binary asteroid impact," he says.

What might the binary Chicxulub asteroid have looked like? Miljković's simulations, coupled with the Chicxulub crater's diameter of about 180 km, and its shape, suggests it may have been two rocks with a combined diameter of 7 to 10 km – the same diameter as the single rock previously imagined to be the culprit. The twin impactors could have been up to 80 km apart, she says, "but these numbers are just guidelines".

It has long been suspected that binary asteroids can generate single craters, says Jean-Luc Margot at the University of California, Los Angeles. "The new study puts this conjecture on solid analytical footing."

Journal reference: Earth and Planetary Science Letters, doi.org/kcx

Do twin asteroids pose twice the risk?

If binary asteroids can form single craters, then Earth is more likely to hit by a binary impact in future than our planet's crater record would suggest. Could these double whammies be harder to spot or deflect than single asteroid hits?

The existential threat posed by asteroids has gained attention in recent years – underlining the risk, one is due to skim Earth in just two weeks. There are several new efforts to scan the skies for asteroids, and a plethora of suggestions for how they might be deflected. "I am not sure if any of the proposed asteroid deflection techniques could deflect both binary components with a single weapon," says Katarina Miljković at the Institute of Earth Physics in Paris, France, who led the new study.

Alan Harris, a retired asteroid researcher formerly at NASA's Jet Propulsion Lab in Pasadena, California, has one idea: "A nuclear explosion might be directed at the smaller body, and by blowing it away, the recoil on the main asteroid might effectively deflect it from a collision course."

Being able to deploy the appropriate defence would depend on our ability to spot whether or not an object heading our way is a binary. Don Yeomans of NASA's Near Earth Object Program thinks that won't be a problem for a future asteroid-deflecting spacecraft. "There is a slim chance that the autonomous navigation camera might be confused with two images in its field of view, but I should think these issues would be easily overcome," he says.

http://www.eurekalert.org/pub_releases/2013-02/uoca-cpb020113.php

Can plants be altruistic? You bet, says new CU-Boulder-led study

A study led by the University of Colorado Boulder suggests some plants are altruistic too

We've all heard examples of animal altruism: Dogs caring for orphaned kittens, chimps sharing food or dolphins nudging injured mates to the surface. Now, a study led by the University of Colorado Boulder suggests some plants are altruistic too.

The researchers looked at corn, in which each fertilized seed contained two "siblings" -- an embryo and a corresponding bit of tissue known as endosperm that feeds the embryo as the seed grows, said CU-Boulder Professor Pamela Diggle. They compared the growth and behavior of the embryos and endosperm in seeds sharing the same mother and father with the growth and behavior of embryos and endosperm that had genetically different parents.

"The results indicated embryos with the same mother and father as the endosperm in their seed weighed significantly more than embryos with the same mother but a different father," said Diggle, a faculty member in CU-Boulder's ecology and evolutionary biology department. "We found that endosperm that does not share the same father as the embryo does not hand over as much food -- it appears to be acting less cooperatively."

A paper on the subject was published during the week of Jan. 21 in the Proceedings of the National Academy of Sciences. Co-authors on the study included Chi-Chih Wu, a CU-Boulder doctoral student in the ecology and evolutionary biology department and Professor William "Ned" Friedman, a professor at Harvard University who helped conduct research on the project while a faculty member at CU-Boulder.

Diggle said it is fairly clear from previous research that plants can preferentially withhold nutrients from inferior offspring when resources are limited. "Our study is the first to specifically test the idea of cooperation among siblings in plants."
"One of the most fundamental laws of nature is that if you are going to be an altruist, give it up to your closest relatives," said Friedman. "Altruism only evolves if the benefactor is a close relative of the beneficiary. When the endosperm gives all of its food to the embryo and then dies, it doesn't get more altruistic than that."
In corn reproduction, male flowers at the top of the plants distribute pollen grains two at a time through individual tubes to tiny cobs on the stalks covered by strands known as silks in a process known as double fertilization. When the two pollen grains come in contact with an individual silk, they produce a seed containing an embryo and endosperm. Each embryo results in just a single kernel of corn, said Diggle.
The team took advantage of an extremely rare phenomenon in plants called "hetero-fertilization," in which two different fathers sire individual corn kernels, said Diggle, currently a visiting professor at Harvard. The manipulation of corn plant genes that has been going on for millennia -- resulting in the production of multicolored "Indian corn" cobs of various colors like red, purple, blue and yellow -- helped the researchers in assessing the parentage of the kernels, she said.
Wu, who cultivated the corn and harvested more than 100 ears over a three-year period, removed, mapped and weighed every individual kernel out of each cob from the harvests. While the majority of kernels had an endosperm and embryo of the same color -- an indication they shared the same mother and father -- some had different colors for each, such as a purple outer kernel with yellow embryo.
Wu was searching for such rare kernels -- far less than one in 100 -- that had two different fathers as a way to assess cooperation between the embryo and endosperm. "It was very challenging and time-consuming research," said Friedman. "It was like looking for a needle in a haystack, or in this case, a kernel in a silo."
Endosperm -- in the form of corn, rice, wheat and other crops -- is critical to humans, providing about 70 percent of calories we consume annually worldwide. "The tissue in the seeds of flowering plants is what feeds the world," said Friedman, who also directs the Arnold Arboretum at Harvard. "If flowering plants weren't here, humans wouldn't be here."

http://www.sciencedaily.com/releases/2013/02/130201090405.htm

Getting Fit Fast: Inactive People Can Achieve Major Health and Fitness Gains in a Fraction of the Time

Results could be achieved in less than a third of the time

With many of us struggling to get enough exercise, sport and exercise scientists at Liverpool John Moores University (LJMU) and the University of Birmingham, under the lead of Professor Anton Wagenmakers, have been working on a time-saving solution.
Instead of long stints in the gym and miles of running in the cold, the same results could be achieved in less than a third of the time, according to new research published February 1 in The Journal of Physiology.
The current recommendation of the World Health Organisation (WHO) and UK Department of Health is that people of all ages should do three to five hours of endurance training per week to increase health and fitness and prevent chronic diseases and premature mortality. However, most people find it difficult to set aside this much time in their busy lives.
This study has taken existing research to a new level to prove that replacing endurance training with two types of interval training, High intensity Interval Training (HIT) and Sprint Interval Training (SIT), can make a massive difference to our health and aerobic fitness. In two articles in the 1 February issue of The Journal of Physiology, the researchers describe their recent discoveries that three sessions of SIT, taking just 90 min per week, are as effective as five sessions of traditional endurance exercise, taking five hours per week, in increasing whole body insulin sensitivity via two independent mechanisms.
LJMU researcher Matthew Cocks explains: 'One mechanism involves improved delivery of insulin and glucose to the skeletal muscle and the other involves improved burning of the fat stored in skeletal muscle fibres. Additionally, we found a reduced stiffness of large arteries which is important in reducing the risk of vascular disease.'
On the basis of these novel and earlier findings from other laboratories, Professor Wagenmakers expects that HIT and SIT will turn out to be unique alternative exercise modes suitable to prevent blood vessel disease, hypertension, diabetes and most of the other ageing and obesity related chronic diseases.
LJMU researcher Sam Shepherd describes: 'SIT involves four to six repeated 30 second 'all out' sprints on special laboratory bikes interspersed with 4.5 minutes of very low intensity cycling. Due to the very high workload of the sprints, this method is more suitable for young and healthy individuals. However, anyone of

any age or level of fitness can follow one of the alternative HIT programmes which involve 15-60 second bursts of high intensity cycling interspersed with 2-4 minute intervals of low intensity cycling. HIT can be delivered on simple spinning bikes that are present in commercial gyms and are affordable for use at home or in the workplace.'

Lack of time is the number one reason that the majority of the adult population do not meet the current physical activity recommendations. SIT and HIT could solve this problem.

Sam Shepherd comments: 'A pilot study currently ongoing in the Sports Centre at the University of Birmingham has also shown that previously sedentary individuals in the age-range of 25-60 also find HIT on spinning bikes much more enjoyable and attractive than endurance training and it has a more positive effect on mood and feelings of well-being. This could imply that HIT is more suitable to achieve sustainable changes in exercise behaviour.'

HIT, therefore, seems to provide the ideal alternative to outdoor running, dangerous cycling trips and long boring endurance cycling sessions in health and fitness gyms. That is why the researchers believe that there will be a great future for HIT for obese and elderly individuals and potentially also for patients with hypertension, diabetes and cardiovascular disease.

M. Cocks, C. S. Shaw, S. O. Shepherd, J. P. Fisher, A. M. Ranasinghe, T. A. Barker, K. D. Tipton, A. J. M. Wagenmakers. Sprint interval and endurance training are equally effective in increasing muscle microvascular density and eNOS content in sedentary males. The Journal of Physiology, 2012; 591 (3): 641 DOI: 10.1113/jphysiol.2012.239566

http://www.sciencenews.org/view/generic/id/348007/title/Life_found_deep_below_Antarctic_ice

Life found deep below Antarctic ice

U.S. team drills through half-mile-thick sheet of ice to turn up cells

By Janet Raloff

Cells containing DNA have emerged as the first evidence of life in a subglacial lake in West Antarctica. On January 28, a U.S. research team retrieved water from Lake Whillans, which sits 800 meters below the ice surface. The water hosted a surprising bounty of living cells.

The scientists collected three 10-liter water samples from the lake. Preliminary tests conducted in mobile labs show that the cells are actively using oxygen. It may take months for biologists to identify the microbes present. The microbes have been sealed off below the ice for at least 100,000 years.

A challenge was ruling out contamination as a source of the cells, says microbiologist Brent Christner of Louisiana State University in Baton Rouge, reached by satellite phone at a tent encampment at the drill site. Even glacial ice harbors low concentrations of microbes, “or their corpses,” so the researchers were concerned that cells in the lake samples could actually have come from the ice, Christner says.

He argues that the cells come from the lake. First, cell concentrations in water retrieved from the lake were on the order of 10,000 per milliliter, which is about 100 times higher than the cell count in meltwater from the drill hole. Second, that meltwater is roughly comparable chemically to distilled water. In contrast, mineral levels in the water from which Christner’s team isolated its cells are 100 times higher — equivalent to what’s present in the lake’s water.

“This is a big deal — and exciting,” says glaciologist Martin Siegert of the University of Bristol in England. The U.S. team’s drilling endeavor marks “the first clean access to a subglacial lake system.” Acquiring clean samples is imperative, he adds, to inspire confidence that any microbial finds truly come from the buried lakes.

Lake Whillans sits in a shallow cavity at the downstream end of a slow-moving sheet of ice. The deep liquid streams that feed this and more than 340 other subglacial lakes across Antarctica also lubricate the ice above. Geothermal energy, along with friction and a heavy blanket of ice, keeps the water liquid in this frigid land.

Excitement at the prospect of exploring the lakes erupted in 1996, recalls Siegert. That’s when an international research team he was part of realized the massive extent of Lake Vostok (SN: 6/29/96, p. 407), a subglacial lake discovered decades earlier. At once, Siegert says, microbiologists began proposing that this buried lake — and possibly others — might host ecosystems that had been cut off from the surface for a very long time.

Precisely how long remains unknown, says Slawek Tulacyk, a glaciologist from the University of California, Santa Cruz, and a team leader on the Antarctic drill program. At Lake Whillans, “a good guess for a minimum is about 100,000 years.” That’s the last time the ice sheet may have shrunk back enough to expose the roughly 10-square-mile lake, he explains.

The new drilling project uncovered a second surprise: The lake is surprisingly shallow. Two years ago, a team conducted seismic experiments by detonating explosives; researchers used the resulting sound waves to map what lies beneath the ice. These seismic data indicated Lake Whillans was about 30 feet deep, Tulacyk says. But instruments his team sent down the borehole now peg the lake’s depth “at only about 5 to 6 feet.”

The most likely explanation, Tulacyk says, rests on a third surprise that emerged from the drilled borehole: The lake sediment contains a substantial amount of water. That unexpected mixing, he says, confused the earlier seismic readings.
Last year, a Russian team pierced Lake Vostok but has to date found no evidence of life. Last month, technical difficulties convinced Siegert and his colleagues on a British team to suspend their efforts for the year to reach the subglacial Lake Ellsworth (SN: 1/26/13, p. 9).
By January 31, the new 30-centimeter borehole down to Lake Whillans was beginning to freeze shut. So Tulacyk's group began lowering instruments down the hole one last time. This package will freeze in place until the researchers can return. ***Whillans Ice Stream Subglacial Access Research Drilling Project homepage***

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http://bit.ly/11Af5e8

Two worms, same brains – but one eats the other

IF TWO animals have identical brain cells, how different can they really be?

Extremely. Two worm species have exactly the same set of neurons, but extensive rewiring allows them to lead completely different lives.
Ralf Sommer of the Max Planck Institute for Developmental Biology in Tübingen, Germany, and colleagues compared Caenorhabditis elegans, which eats bacteria, with Pristionchus pacificus, which hunts other worms. Both have a cluster of 20 neurons to control their foregut.
Sommer found that the clusters were identical. "These species are separated by 200 to 300 million years, but have the same cells," he says. P. pacificus, however, has denser connections than C. elegans, with neural signals passing through many more cells before reaching the muscles (Cell, doi.org/kbh). This suggests that P. pacificus is performing more complex motor functions, says Detlev Arendt of the European Molecular Biology Laboratory in Heidelberg, Germany.
Arendt thinks predators were the first animals to evolve complex brains, to find and catch moving prey. He suggests their brains had flexible wiring, enabling them to swap from plant-eating to hunting.

http://www.sciencenews.org/view/generic/id/348019/title/Gold-digging_microbe

Gold-digging microbe

By spitting out a molecule, a bacterium draws solid gold out of solution

By Rachel Ehrenberg

Forget ancient maps and metal detectors. Those seeking hidden gold might do well to add bacteria to their toolbox. The bacterium Delftia acidovorans secretes a molecule that binds to dissolved gold and turns it into shiny, solid gold, scientists have discovered. The bacterium — and perhaps others like it — might one day process gold at mining sites or create gold nanoparticles with desirable properties, says geomicrobiologist Frank Reith, a research fellow at the University of Adelaide in Australia.
In 2006 Reith and his colleagues reported finding biofilms of bacteria growing on solid gold grains in soil. Some of these microbial species precipitate gold from solution, Reith and others found.
Now another team reports how D. acidovorans performs its version of this trick: It secretes a protein snippet that snatches up dissolved gold, forming metallic gold. Nathan Magarvey of McMaster University in Canada and colleagues report the finding online February 3 in Nature Chemical Biology.
The bacterium's gold-extracting technique is unusual, says geomicrobiologist Jim Fredrickson of Pacific Northwest National Laboratory in Richland, Wash. Dissolved gold is toxic to many bacteria, but passing electrons to the dissolved element converts it to its metallic, innocuous form. Another gold-altering microbe, Cupriavidus metallidurans, does the conversion inside its cells. The molecule that D. acidovorans secretes renders gold solid and inert.
"Somehow it's sensing the gold and protecting itself," says Fredrickson, who was not involved with the study.
Magarvey and his colleagues have named the secreted compound delftibactin. They found that delftibactin is similar to compounds that bacteria, fungi and some plants use to extract iron and other metals from solution. Perhaps as it was evolving, D. acidovorans co-opted the compound, enabling it to live in the company of gold, Magarvey says.

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Pioneering research helps to unravel the brain's vision secrets

A new study led by scientists at the Universities of York and Bradford has identified the two areas of the brain responsible for our perception of orientation and shape.

Using sophisticated imaging equipment at York Neuroimaging Centre (YNiC), the research found that the two neighbouring areas of the cortex -- each about the size of a 5p coin and known as human visual field maps -- process the different types of visual information independently.

The scientists, from the Department of Psychology at York and the Bradford School of Optometry & Vision Science established how the two areas worked by subjecting them to magnetic fields for a short period which disrupted their normal brain activity. The research which is reported in Nature Neuroscience represents an important step forward in understanding how the brain processes visual information.

Attention now switches to a further four areas of the extra-striate cortex which are also responsible for visual function but whose specific individual roles are unknown.

The study was designed by Professor Tony Morland, of York's Department of Psychology and the Hull York Medical School, and Dr Declan McKeefry, of the Bradford School of Optometry and Vision Science at the University of Bradford. It was undertaken as part of a PhD by Edward Silson at York.

Researchers used functional magnetic resonance imaging (fMRI) equipment at YNiC to pinpoint the two brain areas, which they subsequently targeted with magnetic fields that temporarily disrupt neural activity. They found that one area had a specialised and causal role in processing orientation while neural activity in the other underpinned the processing of shape defined by differences in curvature.

Professor Morland said: "Measuring activity across the brain with FMRI can't tell us what causal role different areas play in our perception. It is by disrupting brain function in specific areas that allows the causal role of that area to be assessed.

"Historically, neuropsychologists have found out a lot about the human brain by examining people who have had permanent disruption of certain parts of the brain because of injury to it. Unfortunately, brain damage seldom occurs at the spatial scale that allows the function of small neighbouring areas to be understood. Our approach is to temporarily disrupt brain activity by applying brief magnetic fields. When these fields are applied to one, small area of the brain, we find that orientation tasks are harder, while disrupting activity in this area's nearest neighbour only affected the ability to perceive shapes."

Dr McKeefry added: "The combination of modern brain scanning technology along with magnetic neuro-stimulation techniques provides us with a powerful means by which we can study the workings of the living human brain.

"The results that we report in this paper provide new insights into how the human brain embarks upon the complex task of analysing objects that we see in the world around us.

"Our work demonstrates how processing of different aspects of visual objects, such as orientation and shape, occurs in different brain areas that lie side by side. The ultimate challenge will be to reveal how this information is combined across these and other brain areas and how it ultimately leads to object recognition."

http://www.sciencedaily.com/releases/2013/02/130203145556.htm

Growth Factor Aids Stem Cell Regeneration After Radiation Damage

Epidermal growth factor has been found to speed the recovery of blood-making stem cells after exposure to radiation, according to Duke Medicine researchers.

The finding could open new options for treating cancer patients and victims of dirty bombs or nuclear disasters. Reported in the Feb. 3, 2013, issue of the journal Nature Medicine, the researchers explored what had first appeared to be an anomaly among certain genetically modified mice with an abundance of epidermal growth factor in their bone marrow. The mice were protected from radiation damage, and the researchers questioned how this occurred.

"Epidermal growth factor was not known to stimulate hematopoiesis, which is the formation of blood components derived from hematopoietic stem cells," said senior author John Chute, M.D., a professor of medicine and professor of pharmacology and cancer biology at Duke University. "However, our studies demonstrate that the epidermal growth promotes hematopoietic stem cell growth and regeneration after injury."

Hematopoietic stem cells, which constantly churn out new blood and immune cells, are highly sensitive to radiation damage. Protecting these cells or improving their regeneration after injury could benefit patients who are undergoing bone marrow transplantation, plus others who suffer radiation injury from accidental environmental exposures such as the Japanese nuclear disaster in 2011.

The Duke researchers launched their investigation using mice specially bred with deletions of two genes that regulate the death of endothelial cells, which line the inner surface of blood vessels and are thought to regulate the fate of hematopoietic stem cells. Blood vessels and the hematopoietic system in these mice were less damaged when exposed to high doses of radiation, improving their survival.

An analysis of secretions from bone marrow endothelial cells of the protected mice showed that epidermal growth factor (EGF) was significantly elevated -- up to 18-fold higher than what was found in the serum of control mice. The researchers then tested whether EGF could directly spur the growth of stem cells in irradiated bone marrow cultured in the lab. It did, with significant recovery of stem cells capable of repopulating transplanted mice.

Next, the Duke team tried the approach in mice using three different solutions of cells in animals undergoing bone marrow transplants. One group received regular bone marrow cells; a second group got bone marrow cells from donors that had been irradiated and treated with EGF; a third group got bone marrow cells from irradiated donors treated with saline.

The regular bone marrow cells proliferated well and had the highest rate of engraftment in the recipient mice. But mice that were transplanted with the cells from irradiated/EGF-treated donors had 20-fold higher engraftment rate than the third group.

Additional studies showed that EGF improved survival from a lethal radiation exposure, with 93 percent of mice surviving the radiation dose if they subsequently received treatment with EGF, compared to 53 percent surviving after treatment with a saline solution.

Chute said it appears that EGF works by repressing a protein called PUMA that normally triggers stem cell death following radiation exposure.

"We are just beginning to understand the mechanisms through which EGF promotes stem cell regeneration after radiation injury," Chute said. "This study suggests that EGF might have potential to accelerate the recovery of the blood system in patients treated with chemotherapy or radiation."

In addition to Chute, study authors include Phuong L. Doan, Heather A. Himburg, Katherine Helms, J. Lauren Russell, Emma Fixsen, Mamle Quarmyne, Jeffrey R. Harris, Divino Deoliviera, Julie M. Sullivan, Nelson J. Chao and David G. Kirsch.

Phuong L Doan, Heather A Himburg, Katherine Helms, J Lauren Russell, Emma Fixsen, Mamle Quarmyne, Jeffrey R Harris, Divino Deoliviera, Julie M Sullivan, Nelson J Chao, David G Kirsch & John P Chute. Epidermal growth factor regulates hematopoietic regeneration after radiation injury. Nature Medicine, 03 February 2013 DOI: 10.1038/nm.3070