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Diagnosing diseases with smartphones

Researchers at UH are developing a system to use smartphones to diagnose diseases in real time

By Toby Weber

Smartphones are capable of giving us directions when we're lost, sending photos and videos to our friends in mere seconds, and even helping us find the best burger joint in a three-mile radius. But University of Houston researchers are using smartphones for another very important function: diagnosing diseases in real time.

The researchers are developing a disease diagnostic system that offers results that could be read using only a smartphone and a $20 lens attachment. The system is the brainchild of Jiming Bao, assistant professor of electrical and computer engineering, and Richard Willson, Huffington-Woestemeyer Professor of Chemical and Biomolecular Engineering. It was created through grants from the National Institutes of Health and The Welch Foundation, and was featured in February in ACS Photonics.

This new device, like essentially all diagnostic tools, relies on specific chemical interactions that form between something that causes a disease – a virus or bacteria, for example – and a molecule that bonds with that one thing only, like a disease-fighting antibody. A bond that forms between a strep bacteria and an antibody that interacts only with strep, for instance, can support an ironclad diagnosis. The trick is finding a way to detect these chemical interactions quickly, cheaply and easily. The solution proposed by Bao and Willson involves a simple glass slide and a thin film of gold with thousands of holes poked in it.

Creating this slide is itself an achievement. This task, led by Bao, starts with a standard slide covered in a light-sensitive material known as a photoresist. He next uses a laser to create a series of interference fringes – basically lines – on the slide, and then rotates it 90 degrees and creates another series of interference fringes. The intersections of these two sets of lines creates a fishnet pattern of UV exposure on the photoresist. The photoresist is then developed and washed away. While most of the slide is then cleared, the spots surrounded by intersecting laser lines – the 'holes' in the fishnet – remain covered, basically forming pillars of photoresist. Next, he exposes the slide to evaporated gold, which attaches to photoresist and the surrounding clean glass surface. Bao then performs a procedure called lift-off, which essentially washes away the photoresist pillars and the gold film attached to them. The end result is a glass slide covered by a film of gold with ordered rows and columns of transparent holes where light can pass through.

These holes, measuring about 600 nanometers each, are key to the system. Willson and Bao's device diagnoses an illness by blocking the light with a disease-antibody bond – plus a few additional ingredients. Here is where Willson comes in. An internationally known biomolecular engineer, Willson starts by placing disease antibodies in the holes, where they are coaxed into sticking to the glass surface. Next, he flows a biological sample over the slide. If the sample contains the bacteria or virus being sought out, it will bond with the antibody in the hole. This bond alone, though, doesn't block the light. "The thing that binds to the antibody is probably not big and grey enough to darken this hole, so you have to find a way to darken it up somehow," Willson said.

Willson achieves this by flowing a second round of antibodies that bond with the bacteria over the slide. Attached to these antibodies are enzymes that produce silver particles when exposed to certain chemicals. With this second set of antibodies now attached to any bacteria in the holes, Willson then exposes the entire system to the chemicals that encourage silver production. About 15 minutes later he rinses off the slide. Thanks to chemical properties of the gold, the silver particles in the holes will remain in place, completely blocking light.

Here's where the smart phone comes in. One of the advantages of this system is that the results can be read with simple tools. A basic microscope used in elementary school classrooms, Willson said, provides enough light and magnification to show whether the holes are blocked. With a few small tweaks, a similar reading could almost certainly be made with a phone's camera, flash and an attachable lens.

This system, then, promises readouts that are affordable and easy to interpret. "Some of the more advanced diagnostic systems need $200,000 worth of instrumentation to read the results," said Willson. "With this, you can add $20 to a phone you already have and you're done."

There are still major technical hurdles to clear before the system can be rolled out, Willson noted. One of the biggest challenges is finding a way to drive the bacteria and viruses in the sample down to the surface of the slide to ensure the most accurate results. But if those problems are overcome, the system would be an excellent tool for healthcare providers in the field.

At the site of an industrial accident, for instance, the holes on a single slide could be populated with molecules that bond with 10 potential contaminants, allowing response teams to quickly assess the situation. In economically disadvantaged areas, such a system could be used to screen large groups of people for widespread and serious health problems, like diabetes. "There are a lot of situations where an affordable diagnostic tool that

is simple to use and simple to interpret could be very useful," said Willson. "If both your disposables and your reader are cheap, that makes it a lot easier to extend your system out into the real world."

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Several FDA-approved anti-cancer drugs induce stem cell tumors, perhaps thwarting therapy

Researchers report that several chemotherapy drugs have a serious side effect: Inducing hyper proliferation in stem cells that could lead to tumor recurrence

AMHERST, Mass.– Using a new approach to systematically test chemotherapy drugs in an unusual animal model, a research team led by University of Massachusetts Amherst molecular biologist Michele Markstein, with Norbert Perrimon at Harvard Medical School, report that several have a serious side effect: Inducing hyper proliferation in stem cells that could lead to tumor recurrence.

Markstein says, "We discovered that several chemotherapeutics that stop fast growing tumors have the opposite effect on stem cells in the same animal, causing them to divide too rapidly. This was a surprise, because it showed that the same drug could have opposite actions on cells in the same animal: Suppressing tumor growth on one cell population while initiating growth in another. Not only is the finding of clinical interest, but with this study we used an emerging new non-traditional tool for assessing drugs using stem cells in the fruit fly gut."

She adds, "We did these experiments in the fly because Drosophila stem cells, in the intestine, are very much like the stem cells in our intestine, and it's a lot easier to do experiments in flies than humans or even mice."

Further, Markstein explains, "When it comes to stem cells, it is important to conduct studies in living animals because stem cells are acutely attuned to the other cells in their microenvironment. Indeed the side effect that we observed is caused by damage that the chemotherapy drugs to cells in the stem cell microenvironment. The stem cells respond to this damage by hyper proliferating."

Markstein and Samantha Dettorre at UMass, with Perrimon and colleagues at Harvard Medical School, pioneered large-scale chemical screening in adult fruit flies that they feel will be useful for testing other chemicals. Conventional in vitro cell screens can identify drugs that act directly on stem cells, the authors note, but they cannot test and identify drugs that act on the all-important microenvironment, which provides cues for stem cell division, differentiation, and death.

The flies provide "ready-made stem cell microenvironments" that are "difficult-to-impossible" to create in petri dishes, Markstein notes. Specifically, she and her colleagues inserted a human cancer-causing gene in the fly genome, turned on that gene in its intestinal stem cells, and found that it did form fast-growing tumors.

To take full advantage of Drosophila's ready-made microenvironments, they developed new technology to determine the size of tumors inside each fly gut. The previous standard in the field was to dissect flies to visualize tumors, which are typically labeled green with green fluorescent protein. In the new method, the researchers decided to use a different label, an enzyme from fireflies called luciferase. This allows them to measure tumor size simply by crushing the flies en masse, rather than dissecting them one-by-one.

They asked the National Cancer Institute for chemotherapy drug samples and received a library of 88 currently in clinical use. After demonstrating that flies are sensitive to human chemotherapy drugs, they obtained a library of over 6,000 small molecules from the Harvard Institute of Chemistry and Cellular Biology, to screen for novel drugs. The screen identified new compounds, three of which are from Chinese medicinal extracts that can inhibit tumors without causing the side effect.

Markstein recalls, "We systematically fed the FDA-approved drugs to the flies and found that 14 suppressed tumor growth in the intestine. This was a great result, validating the relevance of flies as a clinical model. It was also very interesting, however, that we found that half these tumor-suppressing drugs had the opposite effect on the non-tumor stem cells, causing them to over-proliferate. This resulted in small growths or 'tumors,' that with the right genetic background could potentially become cancerous."

These results in the fly may seem surprising. But recent work by others reported a similar effect of the drug doxorubicin in mice, Markstein points out. In mice, doxorubicin induced cells to overgrow by triggering the TNF-alpha pathway, but in flies several chemotherapy drugs including doxorubicin triggered a different pathway called JAK-STAT which has been conserved through evolution in both flies and humans. Both pathways trigger the inflammatory response, which is generally associated with cancer.

Overall, the authors conclude that screening in whole animals such as flies pays off, and is necessary to detect effects that involve more than one cell type. Indeed, Markstein argues that the impact of a chemotherapy drug on the stem cell microenvironment is just as important as its impact on the stem cell itself.

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Mongol Empire rode wave of mild climate, says study

But warming now may be tipping region into unparalleled drought

Researchers studying the rings of ancient trees in mountainous central Mongolia think they may have gotten at the mystery of how small bands of nomadic Mongol horsemen united to conquer much of the world within a span of decades, 800 years ago. The rise of the great leader Genghis Khan and the start of the largest contiguous empire in human history was propelled by a temporary run of nice weather.

The rings show that exactly when the empire rose, the normally cold, arid steppes of central Asia saw their mildest, wettest weather in more than 1,000 years. Grass production must have boomed, as did vast numbers of war horses and other livestock that gave the Mongols their power. But the tree rings, spanning 1,112 years from 900 to 2011, also exhibit an ominous modern trend. Since the mid-20th century, the region has warmed rapidly, and the rings show that recent drought years were the most extreme in the record - possibly a side effect of global warming. In a region already pressed for water, the droughts have already helped spark a new migration in a vast region where people until now have lived the same way for centuries, moving herds from place to place and living in tents. Now, those herders are being driven rapidly into cities, and there could be greater future upheavals. The study appears in this week's early online edition of the Proceedings of the National Academy of Sciences.

"Before fossil fuels, grass and ingenuity were the fuels for the Mongols and the cultures around them," said lead author Neil Pederson, a tree-ring scientist at Columbia University's Lamont-Doherty Earth Observatory. "Energy flows from the bottom of an ecosystem, up the ladder to human society. Even today, many people in Mongolia live just like their ancestors did. But in the future, they may face serious conditions."

In the late 1100s, the Mongol tribes were racked by disarray and internal warfare, but this ended with the sudden ascendance of Genghis (also known as Chinggis) Khan in the early 1200s. In just a matter of years, he united the tribes into an efficient horse-borne military state that rapidly invaded its neighbors and expanded outward in all directions. Genghis Khan died in 1227, but his sons and grandsons continued conquering and soon ruled most of what became modern Korea, China, Russia, eastern Europe, southeast Asia, Persia, India and the Mideast. The empire eventually fragmented, but the Mongols' vast geographic reach and their ideas - an international postal system, organized agriculture research and meritocracy-based civil service among other things--shaped national borders, languages, cultures and human gene pools in ways that resound today. Genghis Khan's last ruling descendants ran parts of central Asia into the 1920s.

Some researchers have postulated that the Mongols expanded because they were fleeing harsh weather at home--but Pederson and colleagues found the opposite. In 2010, Pederson and coauthor Amy Hessl, a tree-ring scientist at West Virginia University, were studying wildfires in Mongolia when they came across a stand of gnarled, stunted Siberian pines growing out of cracks in an old solid-rock lava flow in the Khangai Mountains. They knew that on such dry, nearly soil-less surfaces, trees grow very slowly, are exquisitely sensitive to yearly weather shifts, and may live to fantastic ages.

In a series of expeditions, Pederson, Hessl and colleagues sampled the pines' rings, sawing cross-sections from dead specimens, and removing harmless straw-like cores from living ones. They found that some trees had lived for more than 1,100 years, and likely could survive another millennium; even dead trunks stayed largely intact for another 1,000 years before rotting. One piece of wood they found had rings going back to about 650 B.C. These yearly rings change with temperature and rainfall, so they could read past weather by calibrating ring widths of living trees with instrumental data from 1959-2009, then comparing these with the innards of much older trees. The trees had a clear and startling story to tell. The turbulent years preceding Genghis Khan's rule were stoked by intense drought from 1180 to 1190. Then, from 1211 to 1225 - exactly coinciding with the empire's meteoric rise--Mongolia saw sustained rainfall and mild warmth never seen before or since.

"The transition from extreme drought to extreme moisture right then strongly suggests that climate played a role in human events," said Hessl. "It wasn't the only thing, but it must have created the ideal conditions for a charismatic leader to emerge out of the chaos, develop an army and concentrate power. Where it's arid, unusual moisture creates unusual plant productivity, and that translates into horsepower. Genghis was literally able to ride that wave." (Each Mongol warrior had five or more horses, and ever-moving herds of livestock provided nearly all food and other resources. The rest probably depended on the Mongols' brilliant cavalry skills, smart political maneuvering and savvy adaptions of urbanized peoples' technologies.)

The tree rings show that after the empire's initial expansion, Mongolia's weather turned back to its more normal dryness and cold, though with many ups and downs over the hundreds of years since. The 20th and early 21st centuries are the exception. In the last 40 years, temperatures in parts of the country have gone up by as much

4.5 degrees F - well over the global mean rise of 1 degree. And, since the 1990s, the country has suffered a series of devastating summer droughts, often followed by a dzud - an unusually long, cold winter. The tree rings show that the most recent drought, from 2002-2009, compares in length and paucity of rainfall only to those of the pre-empire 1120s and 1180s. Perhaps more important: the drought of the 2000s was the hottest in the entire record. The heat evaporated water stored in soil, lakes and vegetation, and, in combination with repeated dzuds, devastated livestock. The last dzud alone, in 2009-10, killed at least 8 million animals and destroyed the livelihoods of countless herders. Now, displaced Mongol herders have formed a new invasion force - this time all headed to the capital city of Ulaanbaatar, which has swollen to hold nearly half the country's population of 3 million.

Climate models predict that as the world warms, heat in inner Asia will continue to rise substantially faster than the global mean. Pederson says this means that droughts and other extreme weather will probably worsen and become more frequent. This could further reduce livestock and hurt the few crops the region grows (only 1 percent of Mongolia is arable land). New mining ventures and other industrial activities may employ some of the many people fleeing the countryside - but these also consume water, and it is not clear where that will come from.

"This last big drought is an example of what may happen in the future, not just in Mongolia but in a lot of inner Asia," said Pederson. "The heat is a double whammy - even if rainfall doesn't change, the landscape is going to get drier."

Previous studies by others have advanced the idea that climate swings can change history. These include events such as the disappearance of the Maya, the expansion and fall of Roman imperial power, and, in a separate Lamont-led study, the 13th-century collapse of southeast Asia's Angkor civilization. Most focus on droughts, floods or other disasters that arguably have cut off empires; the new study is one of the few to explore the more complex question how climate might have invigorated one.

The researchers "make a compelling argument that climate played a role in facilitating the Mongol migration," said David Stahle, a paleoclimatologist at the University of Arkansas who has studied the mysterious disappearance of the English Roanoke colony off North Carolina, coinciding with what tree rings show was a disastrous drought. "But," said Stahle, "we live in a sea of coincidence - something like that is hard to prove. There could be a lot of other factors. They've provided an incredibly important climate record, and put the idea out there, so it will stimulate a lot of historical and archeological research."

The tree-ring study is the first in a related series by a larger interdisciplinary team working with Pederson and Hessl. Hanqin Tian, an ecologist at Auburn University in Alabama who studies modern grasslands, is working on models to correlate ancient grass production with the tree-ring records of weather. In coming months, team member Avery Cook Shinneman, a biologist at the University of Washington, plans to analyze sediments taken from the bottoms of Mongolian lakes. These can be read somewhat like tree rings to estimate the abundance of livestock over time, via layers of fungal spores that live in the dung of animals; this would confirm whether animal populations did indeed boom. The conquering Mongols left very few written records of their own, but Nicola Di Cosmo, a historian at the Institute for Advanced Study in New Jersey and coauthor of the current paper, will study accounts of the time left in China, Persia and Europe that might provide further clues.

The other coauthors of the new study are Nachin Baatarbileg, a tree-ring scientist at the National University of Mongolia who has been key in setting up field research around the country; and climate modeler Kevin Anchukaitis of Woods Hole Oceanographic Institution. The team's work has been funded by the U.S. National Science Foundation and the National Geographic Society.

Backgrounder, photo essay and video are at http://blogs.ei.columbia.edu/2013/05/13/climate-and-conquest-how-did-genghis-khan-rise/. High-res images available on request.

The paper, "Pluvials, Droughts, the Mongol Empire and Modern Mongolia," is available from the authors, or (for registered reporters) on Eurekalert.

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UV light aids cancer cells that creep along the outside of blood vessels

A new study by UCLA scientists and colleagues adds further proof to earlier findings by Dr. Claire Lugassy and Dr. Raymond Barnhill of UCLA's Jonsson Comprehensive Cancer Center that deadly melanoma cells can spread through the body by creeping like tiny spiders along the outside of blood vessels without ever entering the bloodstream.

In addition, the new research, published March 6 in the journal Nature, demonstrates that this process is accelerated when the skin cancer cells are exposed to ultraviolet light. The husband-and-wife team of Barnhill and Lugassy collaborated on the study with a team from Germany's University of Bonn led by Dr. Thomas Tuting.

It is well known that melanoma cells from an initial tumor can travel through the bloodstream to other parts of the body, where they accumulate and form new tumors. Through such metastasis, a small skin cancer can become life-threatening by spreading to the brain, lungs, liver or other organs.
Fifteen years ago, Lugassy and Barnhill first discovered and described an alternative metastatic process, which they called extravascular migratory metastasis, or EVMM, by which melanoma cells could move along the outside, or abluminal, surface of blood vessels by way of angiotropism - a biological interaction between the cancer cells and the blood vessel cells. Since then, Lugassy and Barnhill have continued to assemble a body of scientific evidence confirming the existence of this metastatic pathway of cancer cells.
With angiotropism and EVMM, the cancer cells may replace tendril-like cells called pericytes, which are normally found on the outsides of blood vessels, through a process called pericytic mimicry. Imitating the pericytes, the melanoma cells creep along the length of blood vessels until they reach an organ or other point where they accumulate to form new tumors, "potentially explaining the delay between the detection of the primary cancer and the appearance of distant metastases," said Barnhill, a professor of pathology at UCLA.
"At first our idea was controversial," said Lugassy, a UCLA associate professor of pathology. "But mounting evidence confirming angiotropism and EVMM has revolutionized the knowledge of how cancer spreads through the body to the point that other scientists have confirmed the process in other solid-tumor cell types, such as pancreatic cancer."
In the new Nature study, EVMM was observed again by Tuting, Lugassy, Barnhill and their colleagues in a genetically engineered mouse model of melanoma. The researchers also found that the immune systems of mice exposed to ultraviolet radiation responded with inflammation that accelerated the angiotropism, increasing the level of EVMM and leading to more lung metastases than among the mice not exposed to UV light.
This study was conducted at the Laboratory for Experimental Dermatology in Bonn, under the direction of Tuting. "We have known for a long time that UV radiation is a factor in the development of melanoma," Barnhill said, "but in this study, the melanoma was already present in the mice." Tuting observed that UV light provoked inflammation at the site of the tumor, which caused the mouse immune system to attract a type of common white blood cells known as neutrophils. The neutrophils, in turn, promoted angiotropism.
With this new knowledge - and the confirmation of Lugassy and Barnhill's research on angiotropism and EVMM - researchers in the scientific community can now begin looking for a drug target that will interfere with this EVMM process. Because the danger of melanoma comes from its metastasis from the skin to the vital organs, being able to slow down or stop this process could turn a disease that is often a death sentence into a manageable chronic illness with relatively little risk of death.
This research was supported by the Melanoma Research Network, Jurgen Manchot Stiftung, the American Institute for Cancer Research and the Deutsche Forschungsgemeinschaft (German Research Foundation).

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A shocking diet

Researchers describe microbe that 'eats' electricity

There have been plenty of fad diets that captured the public's imagination over the years, but Harvard scientists have identified what may be the strangest of them all – sunlight and electricity.
Led by Peter Girguis, the John L. Loeb Associate Professor of the Natural Sciences, and Arpita Bose, a post-doctoral fellow in Organismic and Evolutionary Biology, a team of researchers showed that the commonly found bacterium Rhodopseudomonas palustris can use natural conductivity to pull electrons from minerals located deep in soil and sediment while remaining at the surface, where they absorb the sunlight needed to produce energy. The study is described in a February 26 paper in Nature Communications.
"When you think about electricity and living organisms, most people default to Mary Shelley's Frankenstein, but we've long understood that all organisms actually use electrons – what constitutes electricity – to do work," Girguis said. "At the heart of this paper is a process called extracellular electron transfer (EET), which involves moving electrons in and out of cells. What we were able to show is that these microbes take up electricity, which goes into their central metabolism, and we were able to describe some of the systems that are involved in that process."
In the wild, the microbes rely on iron to provide the electrons they need to fuel energy generation, but tests in the lab suggest the iron itself isn't critical for this process. By attaching an electrode to colonies of the microbes in the lab, researchers observed that they could take up electrons from a non-ferrous source, suggesting they might also use other electron-rich minerals – such as other metals and sulfur compounds – in the wild.
"That's a game-changer," Girguis said. "We have understood for a long time that the aerobic and anaerobic worlds interact mainly through the diffusion of chemicals into and out of those domains. Accordingly, we also believe this process of diffusion governs the rates of many biogeochemical cycles. But this research

indicates…that this ability to do EET is, in a sense, an end-run around diffusion. That could change the way we think about the interactions between the aerobic and anaerobic worlds, and might change the way we calculate the rates of biogeochemical cycling." Using genetic tools, researchers were also able to identify a gene that is critical to the ability to take up electrons. When the gene was turned off, Girguis said, the microbes' ability to take up electrons dropped by about a third.
"We are very interested in understanding exactly what that role that gene plays in electron uptake," Girguis said. "Related genes are found throughout other microbes in nature, and we aren't exactly sure what they're doing in those microbes. This offers some tantalizing evidence that other microbes carry out this process as well".
The foundation for the new study was laid more than two decades ago, when researchers first characterized a bacterium that "eats" rust by handing off electrons to the oxygen atoms that make up iron oxide molecules. Researchers would later use the bacteria to construct a microbial "fuel cell" in which bacteria handed off electrons not to rust, but to an electrode that could harvest this current.
If some microbes could generate the energy they needed by moving electrons outside their cells, Girguis and colleagues wondered, could others do the same by taking electrons in?
"That question brought us back to iron," he said. "The microbes that are the focus of this paper are the mirror image of the ones that eat rust. Instead of using iron oxide to breathe, they actually make iron oxides from free iron." Getting to that free iron, however, is no easy feat.
The microbes rely on sunlight to help generate energy, but the iron they need is found in sediments below the surface. To reach it, and still remain on the surface, Girguis said, the microbes have developed an unusual strategy. The microbes seem to take up electrons through naturally occurring conductive minerals. Also, as the microbes pull electrons away from iron, they create iron oxide crystals which precipitate into the soil around them. Over time, those crystals can become conductive and act as "circuits," allowing the microbes to oxidize minerals they otherwise couldn't reach.
"What that does is solve the paradox for this sunlight-dependent organism," Girguis said. "These single-celled microbes that grow in biofilms have come up with a way to electrically reach out and pull electrons from minerals in the soil so they can stay in the sun."
Though he remains skeptical about the efficacy of using microbes capable of performing EET for energy generation via fuel cells, Girguis said there are other applications – such as the pharmaceutical industry – where the microbes could be put to use. "I think the biggest applied opportunity here is to use microbes that are capable of taking up electrons to produce something that is of interest," he said, "knowing you can give them electrons to do that through an electrode."

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Natural selection has altered the appearance of Europeans over the past 5,000 years

Ancient DNA from archaeological skeletons shows that European's had darker skin, hair, and eye pigmentation 5,000 years ago

There has been much research into the factors that have influenced the human genome since the end of the last Ice Age. Anthropologists at Johannes Gutenberg University Mainz (JGU) and geneticists at University College London (UCL), working in collaboration with archaeologists from Berlin and Kiev, have analyzed ancient DNA from skeletons and found that selection has had a significant effect on the human genome even in the past 5,000 years, resulting in sustained changes to the appearance of people. The results of this current research project have been published this week in an article entitled "Direct evidence for positive selection of skin, hair, and eye pigmentation in Europeans during the last 5,000 years" in the journal Proceedings of the National Academy of Sciences (PNAS).
For a number of years population geneticists have been able to detect echoes of natural selection in the genomes of living humans, but those techniques are typically not very accurate about when that natural selection took place. The researchers in Mainz and London now decided to take a new approach. This involved analyzing DNA from archaeological skeletons and then comparing the prehistoric data with that of contemporary Europeans using computer simulations. Where the genetic changes could not be explained by the randomness of inheritance, the researchers were able to infer that positive selection played a role, i.e., that frequency of a certain mutation increased significantly in a given population.
While investigating numerous genetic markers in archaeological and living individuals, Sandra Wilde of the Palaeogenetics Group at the JGU Institute of Anthropology noticed striking differences in genes associated with hair, skin, and eye pigmentation. "Prehistoric Europeans in the region we studied would have been consistently darker than their descendants today," says Wilde, first author of the PNAS article. "This is particularly interesting as the darker phenotype seems to have been preferred by evolution over hundreds of thousands of

years. All our early ancestors were more darkly pigmented." However, things must have changed in the last 50,000 years as humans began to migrate to northern latitudes.
"In Europe we find a particularly wide range of genetic variation in terms of pigmentation," adds co-author Dr. Karola Kirsanow, who is also a member of the Palaeogenetics Group at Mainz University. "However, we did not expect to find that natural selection had been favoring lighter pigmentation over the past few thousand years." The signals of selection that the Mainz palaeogeneticists and their colleagues at University College London have identified are comparable to those for malaria resistance and lactase persistence, meaning that they are among the most pronounced that have been discovered to date in the human genome. The authors see several possible explanations. "Perhaps the most obvious is that this is the result of adaptation to the reduced level of sunlight in northern latitudes," says Professor Mark Thomas of UCL, corresponding author of the study. "Most people of the world make most of their vitamin D in their skin as a result UV exposure. But at northern latitudes and with dark skin, this would have been less efficient. If people weren't getting much vitamin D in their diet, then having lighter skin may have been the best option."
"But this vitamin D explanation seems less convincing when it comes to hair and eye color," Wilde continues. "Instead, it may be that lighter hair and eye color functioned as a signal indicating group affiliation, which in turn played a role in the selection of a partner." Sexual selection of this kind is common in animals and may also have been one of the driving forces behind human evolution over the past few millennia.
"We were expecting to find that changes in the human genome were the result of population dynamics, such as migration. In general we expect genetic changes due to natural selection to be the exception rather than the rule. At the same time, it cannot be denied that lactase persistence, i.e., the ability to digest the main sugar in milk as an adult, and pigmentation genes have been favored by natural selection to a surprising degree over the last 10,000 years or so," adds Professor Joachim Burger, senior author of the study. "But it should be kept in mind that our findings do not necessarily mean that everything selected for in the past is still beneficial today. The characteristics handed down as a result of sexual selection can be more often explained as the result of preference on the part of individuals or groups rather than adaptation to the environment."

http://bit.ly/1i81Xnt

Will NZ drug reform bring high times or a comedown?

New Zealand's abandonment of prohibition is a pivotal moment in the global debate over how to control recreational drugs

FOR many years, opponents of drug prohibition have called loudly for radical reform, secure in the expectation that their ideas would remain pie in the sky. Now, though, those open to reform – including this magazine – are facing what you might call a "Liberal Democrat moment". Just as the UK's third political party found itself suddenly thrust into government in 2010 after decades on the fringes, reformers are about to find out how their ideas fare in the real world.
Fed up with the endless game of cat and mouse between drug designers and the law, New Zealand has decided to set up a regulated market for new recreational drugs. Within weeks, New Zealanders will be living in a society not dissimilar to the anti-prohibitionist ideal, with all kinds of psychoactive substances legally available, quality-controlled and out of the hands of criminal gangs (see "High as a Kiwi: Inside the nation saying yes to drugs").
The stakes are high. If New Zealand's experiment succeeds, the already crumbling case for prohibition will be further weakened. Governments around the world are watching this and other attempts at legalisation and decriminalisation. They seem increasingly willing to look at alternatives to prohibition – especially if they bring in new tax revenues.
If it fails, however, the case for reform will lie in ruins. And there is plenty of room for failure. One major unknown is whether drug consumption will rise, and if so, what will happen to New Zealand society. Another is the problem of drug combinations. People often take more than one substance at a time: when the market is flooded with numerous novel compounds – plus alcohol – the possibility of toxic combinations is multiplied.
If New Zealand's experiment fails, there will be wiggle room for reformers to argue that it wasn't a genuine test of an alternative system: drugs that are currently illegal will remain illegal. But the take-home political message will be that legalising drugs doesn't work and prohibition is the only way to keep people safe.
Even if that is the outcome, the reform movement won't have been in vain. For too long, drug policy has been guided by prejudice rather than evidence. Thanks to New Zealand – and to a lesser extent Uruguay, Colorado and Washington, which recently legalised cannabis – the evidence base is set to expand. It may be that, in the cold light of day, prohibition is the least worst option. But at least we will have tested the alternatives.

http://phys.org/news/2014-03-framework-emergence-life.html#rssowlmlink

The conceptual framework for measuring the emergence of life

On early Earth, day and night cycles may have jump-started the evolution of prebiotic chemical networks.

The story of life's origin is one of the great unsolved mysteries of science. The puzzle boils down to bridging the gap between two worlds - chemistry and biology. We know how molecules behave, and we know how cells work. But we still don't know how a soup of lifeless molecules could have given rise to the first living cells.

"It's a really tough problem," says Sara Walker, an astrobiologist at Arizona State University. But she thinks it can be cracked. In fact, she believes there may be a way to measure the transition from non-life to life.

Last month, Dr. Walker presented the inaugural lecture for the NASA Astrobiology NPP seminar series. In a talk titled "Information Hierarchies, Chemical Evolution and the Transition from Non-Living to Living Matter," she described some of the models she developed as a NASA postdoctoral fellow.

These models set up the conceptual framework for measuring the emergence of life, a goal she's now pursuing as an assistant professor at the School of Earth and Space Science and the Beyond Center for Fundamental Concepts in Science at ASU. She began her talk with a quote from the Harvard chemist George Whitesides, which captured nicely the gap she is trying to bridge: "How remarkable is life?" he asked. "The answer is: very. Those of us who deal in networks of chemical reactions know nothing like it." If it succeeds, Walker's approach could broaden our view of what life is, and help us figure out whether its emergence on Earth is merely a fluke or the product of some universal laws.

Getting to "Almost Life"

The first step is to jumpstart chemical evolution, and get a pool of lifeless molecules to form a basic chemical network. While at Georgia Tech, Walker and her colleagues developed a new model for chemical evolution based on the environment on early Earth.

"The idea is that the day and night cycles on early Earth may have driven the process," she explains.

The model starts out with monomers - or loose building blocks - and turns them into polymers. Bonds form during the day (during the dry phase) and break at night (during the wet phase). So the system goes over a constant process of building and destroying new chains of molecules.

Living systems are unique in the way they handle information. Genes determine the nature of proteins, but proteins and higher levels of organization also control gene expression. This two-ways flow of information is a hallmark of life. Credit: Jonathan Bailey, NHGRI

Over time, some of the chains may have a useful function. And because they benefit the system, they stay and are replicated by that cycling, serving as template for the formation of other polymers. Eventually, clusters of polymers begin to grow and interact with each other, until they give rise to a very basic chemical network. Eventually, that network evolves to a state Walker calls "almost life."

The Tipping Point

But how do we bridge the gap between lifeless chemical network and living biological system? "One of the things that's most distinctive about living systems is the way they handle information, and the way it's distributed in the system," Walker says. According to her, the mystery of life's origins lies in the way these rudimentary chemical networks begin to process information. With that framework in mind, the transition to life becomes a well-defined event: a reversal in information flow.

Life is built upon a hierarchy of systems. At the bottom we have genes. Genes then code for proteins. Proteins direct the working of cells. Cells form tissues, which add up to organs, until we reach the level of the organism. A hallmark of life is the way information flows between different levels of organization. In non-living systems, information flows from the bottom up - the properties of the individual parts determine the fate of the system. But with living systems, that flow goes both ways. Not only genes dictate the nature of proteins which in turn affect the functioning of cells, tissues and organisms, but the behavior of proteins, cells, and organisms also control gene expression. This is what Walker calls "top-down control" or "top-down causation."

And to Walker, this transition - from information seeping upward only to information flowing both up and down - is the key to understanding life's origins. Put differently, the blueprint for building an organism isn't stored in its DNA only, but it's distributed in the state of the entire system.

And when it comes to basic chemical networks, Walker thinks, that distribution is something we could potentially measure.

Information in Formation

A potential candidate is a measure called "integrated information." Dr. Giulio Tononi, a neuroscientist at the University of Wisconsin, has shown that it's possible to calculate how much integrated information there is in a network, a quantity he has dubbed 'phi'.

Tononi is working on developing a theory of consciousness based on mathematics and information theory. But to Walker, the origin of life and the origin of consciousness are two related problems.
"The measure should apply equally to understanding the emergence of life from chemistry and to understanding the emergence of consciousness from neural networks," she says. "It's about the way the network is structured, and how it can use information to control its own dynamic."
"A thought you're having in your brain can control all the atoms in your body, and make you get up from a chair and move across the room. In the same way, a bacterial cell can respond to an environmental stimuli and organize all its chemistry accordingly to go after a food source."
The goal is to take these insights and apply them to the puzzle of life's origin. In the end, Walker's approach could broaden our understanding of what life is, and of how unique - or common - it might be in the universe.

http://www.bbc.com/news/health-26518070##rssowlmlink

Resurgence of scarlet fever reaches 24-year high

England is seeing a resurgence of scarlet fever with the number of cases reaching a 24-year high, data reveal.

Scarlet fever symptoms
Sore throat
Headache
Swollen neck glands
Peeling skin on fingertips and toes
White coating on the tongue

Public Health England says there have been 868 notified cases in the first eight weeks of 2014, compared to 591 in the same period in 2013. This figure is at its highest for this time of year since 1990.
The bacterial illness causes a distinctive rash, high temperature and sore throat as well as a white coating on the tongue. The number of cases normally increases during the winter because scarlet fever bacteria is found in mucus and saliva - which can be spread through coughing and sneezing. Cases are more common in children although adults can also develop scarlet fever. Symptoms usually clear up after a week and in the majority of cases remain reasonably mild providing a course of antibiotics is completed to reduce the risk of complications.
Children or adults diagnosed with scarlet fever are advised to stay at home until at least 24 hours after the start of antibiotic treatment to avoid passing on the infection.
Dr Theresa Lamagni, PHE's head of streptococcal infection surveillance said: "We will continue to closely monitor these increases and work with healthcare professionals to try and halt the spread of infection."

http://sfari.org/news-and-opinion/news/2014/girls-protected-from-autism-study-suggests

Girls protected from autism, study suggests

It takes more mutations to trigger autism in women than in men, which may explain why men are four times more likely to have the disorder

By Jessica Wright and SFARI.org

It takes more mutations to trigger autism in women than in men, which may explain why men are four times more likely to have the disorder, according to a study published 26 February in the American Journal of Human Genetics1.
The study found that women with autism or developmental delay tend to have more large disruptions in their genomes than do men with the disorder. Inherited mutations are also more likely to be passed down from unaffected mothers than from fathers.
Together, the results suggest that women are resistant to mutations that contribute to autism.
“This strongly argues that females are protected from autism and developmental delay and require more mutational load, or more mutational hits that are severe, in order to push them over the threshold,” says lead researcher Evan Eichler, professor of genome sciences at the University of Washington in Seattle. “Males on the other hand are kind of the canary in the mineshaft, so to speak, and they are much less robust.”
The findings bolster those from previous studies, but don't explain what confers protection against autism in women. The fact that autism is difficult to diagnose in girls may mean that studies enroll only those girls who are severely affected and who may therefore have the most mutations, researchers note.
“The authors are geneticists, and the genetics is terrific,” says David Skuse, professor of behavioral and brain sciences at University College London, who was not involved in the study. “But the questions about ascertainment are not addressed adequately.”

Genetic burden:

The new study draws from the Simons Simplex Collection (SSC), a database of families that have one child with autism and unaffected parents and siblings. (This project is funded by the Simons Foundation, SFARI.org’s parent organization.) In a 2011 study, researchers found that girls with autism in the SSC tend to have more large duplications or deletions of regions of the genome, called copy number variants (CNVs), than do boys with the disorder, although this disparity does not reach statistical significance2.

For the new study, Eichler and his colleagues cataloged the number of CNVs in 109 girls and 653 boys with autism from the SSC. They found that females are twice as likely as males to carry CNVs that are at least 400 kilobases long. (The larger the CNV, the more likely it is to disrupt important genes.) When the researchers analyzed only CNVs that encompass risk genes for neurodevelopmental disorders, they found that females with autism are three times as likely as males with the disorder to carry CNVs that encompass these genes.
Females with autism also carry slightly more rare mutations that change a single DNA nucleotide than the men do. These are the "nastiest of nasty mutations," says Eichler, because they interfere with the protein's function.
The researchers saw a similar but smaller effect for CNVs in a larger group of 9,206 males and 6,379 females referred for genetic testing: 75 percent of this group turned out to have developmental delay, intellectual disability or autism. Women in this group are 1.28 times more likely than men to carry large CNVs that include risk factors for these disorders. Many autism-linked mutations arise spontaneously, or de novo, and about 80 percent of these come from the father.
Eichler and his colleagues found that women are far more likely than men to transmit the inherited mutations that confer autism risk. Of the 27 large CNVs the researchers identified in the SSC group, 70 percent, or 19, were inherited from the mother. Mothers had similarly passed down about 57 percent of the 3,561 CNVs detected in the neurodevelopmental group.
Eichler intends to extend this work in a bigger study to assess whether certain mutations are more likely than others to be inherited. "I think it's really critical to identify these inherited components," he says. "We know they're there, but we need to really focus on identifying the specific genes so we can advise [parents] a little more about recurrence."
However, it's unclear whether this gender bias is the result of genetics or reflects differences in diagnosis or the way females manifest symptoms of the disorder. Girls with autism tend to actively compensate for their symptoms in ways that boys don't, which may account for the discrepancy, says Skuse.
As a result, the females enrolled in studies may tend to be severely affected and carry multiple mutations.
"There is some suggestion that higher-functioning females are out there in the general population, but they're not being referred," he says. The study also does not address why women with autism transmit more mutations, or how they are protected from autism.
"We need to ask what it is about brain development that makes it such that females are protected - because ultimately that is what we want know," says Aravinda Chakravarti, director of the Center for Complex Disease Genomics at the Johns Hopkins University School of Medicine in Baltimore. "We need to re-create that developmental environment."
The most obvious explanation for autism's gender bias is that because men have only one X chromosome, they are hypersensitive to mutations in this chromosome. In line with this theory, several autism-linked genes are located on the X chromosome. However, most of the mutations that show a gender bias in the new study are not on the X chromosome, suggesting that other factors must be involved.
This article has been modified from the original. An earlier version incorrectly stated that 80 percent of the genetic risk factors for autism arise spontaneously. The exact contribution of spontaneous genetic variants to autism is not known.
1: Jacquemont S. et al. Am. J. Hum. Genet. Epub ahead of print (2014) PubMed
2: Levy D. et al. Neuron 70, 886-897 (2011) PubMed

http://bit.ly/1enM3k1

A burst of orange light wakes up our 'circadian eye'

Feeling dopey? Refresh your "circadian eye" with a burst of orange light.

20:00 10 March 2014 by Kat Arney

Light is a powerful wake-up call, enhancing alertness and activity. Its effect is controlled by a group of photoreceptor cells in the eyeball that make the light-sensing pigment melanopsin. These cells, which work separately to the rods and cones needed for vision, are thought to help reset animals' body clocks - or circadian rhythms. Studies with people who are blind suggest this also happens in humans, although the evidence isn't conclusive. To find out how melanopsin wakes up the brain, Gilles Vandewalle at the University of Liege, Belgium, and his team gave 16 people a 10-minute blast of blue or orange light while they performed a memory test in an fMRI scanner. They were then blindfolded for 70 minutes, before being retested under a green light. People initially exposed to orange light had greater brain activity in several regions related to alertness and cognition when they were retested, compared with those pre-exposed to blue light.

Light switch

Vandewalle thinks that melanopsin is acting as a kind of switch, sending different signals to the brain depending on its state. Orange light, which has the longer wavelength, is known to make the pigment more

light-sensitive, but blue light has the opposite effect. Green light lies somewhere in the middle. The findings suggest that pre-exposure to orange light pushes the balance towards the more light-sensitive form of melanopsin, enhancing the response in the brain.
"We knew that light had a non-visual impact on cognitive brain responses but the photoreceptors involved were not definitely established" says Vandewalle. "Our findings constitute compelling evidence in favour of a cognitive role for melanopsin," he says, adding that more thought should be given to the impact of different colours of light in environments such as schools.
Stuart Peirson from the University of Oxford's Nuffield Laboratory of Ophthalmology says the findings are intriguing but he points out that several previous studies have suggested that blue light enhances alertness and is more effective at resetting circadian rhythms. "More work is clearly needed to understand the differences between these results," he says. *Journal reference: PNAS, DOI: 10.1073/pnas.1320005111*

http://www.eurekalert.org/pub_releases/2014-03/w-gft030714.php#rssowlmlink

Glucosamine fails to prevent deterioration of knee cartilage, decrease pain

A short-term study found that oral glucosamine supplementation is not associated with a lessening of knee cartilage deterioration among individuals with chronic knee pain.

Findings published in Arthritis & Rheumatology, a journal of the American College of Rheumatology (ACR) journal, indicate that glucosamine does not decrease pain or improve knee bone marrow lesions - more commonly known as bone bruises and thought to be a source of pain in those with osteoarthritis (OA). According to the ACR 27 million Americans over 25 years of age are diagnosed with OA - the most common form or arthritis and primary cause of disability in the elderly. Patients may seek alternative therapies to treat joint pain and arthritis, with prior research showing glucosamine as the second most commonly-used natural product. In fact, a 2007 Gallup poll reports that 10% of individuals in the U.S. over the age of 18 use glucosamine, with more than $2 billion in global sales of the supplement.
For this double-blind, placebo-controlled trial, Dr. C. Kent Kwoh from the University of Arizona in Tucson and colleagues, enrolled 201 participants with mild to moderate pain in one or both knees. Participants were randomized and treated daily with 1500 mg of a glucosamine hydrochloride in a 16-ounce bottle of diet lemonade or placebo for 24 weeks. Magnetic resonance imaging (MRI) was used to assess cartilage damage. Trial results show no decrease in cartilage damage in participants in the glucosamine group compared to the placebo group. Researchers report no change in bone marrow lesions in 70% of knees, 18% of knees worsened and 10% improved. The control group had greater improvement in bone marrow lesions compared to treated participants, with neither group displaying a worsening of bone marrow lesions. Glucosamine was not found to decrease urinary excretion of C-telopeptides of type II collagen (CTX-II) - a predictor of cartilage destruction. The joints on glucosamine (JOG) study is the first to investigate whether the supplement prevents the worsening of cartilage damage or bone marrow lesions. Dr. Kwoh concludes, "Our study found no evidence that drinking a glucosamine supplement reduced knee cartilage damage, relieved pain, or improved function in individuals with chronic knee pain."
This study was funded by the Beverage Institute for Health & Wellness, The Coca-Cola Company and the National Institute of Arthritis, Musculoskeletal and Skin Diseases (P60 AR054731).
Full citation: "The Joints on Glucosamine (Jog) Study: The Effect of Oral Glucosamine on Joint Structure, A Randomized Trial." C. Kent Kwoh, Frank W. Roemer, Michael J. Hannon, Carolyn E. Moore, John M. Jakicic, Ali Guermazi, Stephanie M. Green, Rhobert W. Evans and Robert Boudreau. Arthritis & Rheumatology; Published Online: March 11, 2014 (DOI: 10.1002/art.38314).

http://bit.ly/1i8bb2V

Elephants can decipher human voices better than we can

When it comes to predation, human voices are not created equal

By Arielle Duhaime-Ross

Humans can tell a lot about one another just by listening to a voice. Age and gender are among the first pieces of information we pick up on when listening to a stranger speak, and studies have even shown that humans can determine a person's physical strength by listening to a recording of their voice. This ability is incredibly useful, because it can help us determine whether someone poses a threat without ever having to see them. Other animals can do this too, and have also been known to analyze sounds made by their predators. But African elephants may have taken this ability to the next level, as a new study suggests that elephants might be even better at decoding human voices than we are.
The study, published today in Proceedings of the National Academy of Sciences, was initially designed to find out whether the wild elephants of Amboseli National Park, in Kenya, could use the acoustic information contained in human language to distinguish the threat posed by the local Maasai tribes - an ethnic group known

for its hunting practices - from the lesser threat posed by the agricultural Kamba ethnic group. In both cases, the recordings featured men saying "Look, look over there, a group of elephants is coming," in their respective languages.

It didn't take long for the scientists to realize that these elephants had no trouble figuring out which male voices were cause for alarm and which weren't, so they upped the ante by having elephants listen to recordings of Maasai women, who rarely hunt, as well as men. Once again, the elephants had no trouble figuring out who posed a danger to their calves. When they heard the male voices, the elephants would bunch together defensively or retreat, but they barely budged when they heard a woman speak. A third test revealed that the elephants didn't feel threatened by the voices of Maasai boys either. "Elephants have this amazing ability to discern predators on a fine scale," says Graeme Shannon, lead co-author of the study and a wildlife ecologist at Colorado State University. "They can ascribe different levels of threats to certain groups."

That's when things got tricky. Thinking they could outsmart the elephants, researchers decided to digitally alter the voices to make the Maasai women sound male and the Maasai men sound female. But the elephants weren't fooled. They retreated just as much after hearing the feminized male voices as they had before the voice manipulation - something that humans themselves aren't capable of doing, Shannon says. "That was really intriguing because the recordings sounded good to us," he says. "We thought we were being quite clever when we changed the voices."

"It's not so much that they can tell male from female voices, but that they tell the two languages apart," says Frans de Waal, an animal behaviorist at Emory University who did not participate in the study, "and are not fooled by digital manipulation of the voice, which suggests that they use different gender cues than we do - or probably do." Joshua Plotnik, an elephant researcher at the University of Cambridge, agrees. "This suggests that the complexity of elephant communication may rival that of most other mammals on the planet."

Humans aren't the only animals that elephants can "decode" by voice alone. A 2011 study, for example, demonstrated that elephants can detect the sex of a lion based solely on its roar. But elephants react very differently to lions than they do to humans, Shannon explains. "With the lions, the elephants were vocal and made themselves known." Sometimes they would even mob the remotely activated speakers that played the recordings. This was not the case with the Maasai voices "because that would escalate the risk," he says. "They tailored their response to the predatory threat by making sure they never really encountered the speaker - they moved away."

The ability to distinguish whether a predator is worth fussing over is extremely important for wild populations competing with other animals over food and space. "If they responded to every single stimuli that actually has a fitness cost," Shannon says, "because they would stop feeding and run every time."

Today, the wild elephants of Amboseli National Park are doing well. Despite a 2009 drought that killed off many of its older females, the park continues to harbor over 58 families of elephants. And officials have, thus far, been able to keep poaching to a minimum. Yet as this study demonstrates, the humans and elephants who frequent the park don't always coexist peacefully. "Perhaps this information can be used to develop more comprehensive conflict-mitigation techniques that take the elephants' perspective and decision-making process into account." Plotnik says. "I find it very sad that humans have driven elephants to the point that they now need to learn to adapt to humans as a threat."

http://www.eurekalert.org/pub_releases/2014-03/jhu-ccd031114.php#rssowlmlink

Cancer cells don't take 'drunken' walks through the body

For cells moving through three-dimensional spaces within the body, the random walk model doesn't hold true

Because of results seen in flat lab dishes, biologists have believed that cancers cells move through the body in a slow, aimless fashion, resembling an intoxicated person who cannot walk three steps in a straight line. This pattern, called a random walk, may hold true for cells traveling across two-dimensional lab containers, but Johns Hopkins researchers have discovered that for cells moving through three-dimensional spaces within the body, the "drunken" model doesn't hold true.

This finding, reported in the March 4 online Early Edition of Proceedings of the American Academy of Sciences, is important because it should lead to more accurate results for scientists studying how cancer spreads through the body, often leading to a grim prognosis. To address this dimensional disagreement, the study's authors have produced a new mathematical formula that they say better reflects the behavior of cells migrating through 3D environments.

The research was supervised by Denis Wirtz, the university's Theophilus H. Smoot Professor, with appointments in the departments of Chemical and Biomolecular Engineering, Pathology and Oncology within

Johns Hopkins' Whiting School of Engineering and School of Medicine. Wirtz said the discovery reinforces the current shift toward studying how cells move in three dimensions. His lab team has conducted earlier studies showing that that cells in 2D and 3D environments behave differently, which affects how cancer migrates within the body.

"Cancer cells that break away from a primary tumor will seek out blood vessels and lymph nodes to escape and metastasize to distant organs," Wirtz said. "For a long time, researchers have believed that these cells make their way to these blood vessels through random walks. In this study, we found out that they do not. Instead, we saw that these cells will follow more direct, almost straight-line trajectories. This gives them a more efficient way to reach blood vessels -- and a more effective way to spread cancer."

For researchers trying to understand how metastasis occurs, he added, this discovery has critical implications. "This means that the time these cancer cells need to make their way out of connective tissues is much shorter than previous estimates," said Wirtz, who was recently named the university's vice provost for research.

The co-lead authors on the PNAS paper were Pei-Hsun Wu, a postdoctoral fellow, and Anjil Giri, a doctoral student, both in the Department of Chemical and Biomolecular Engineering.

Wu said the team knew that the Persistent Random Walk math model, developed for characterizing cell movements in flat Petri dishes, was also being used in 3D testing, yielding questionable results in the latter. "It has been used for both kinds of experiments because it's easy and convenient," Wu said. "But it really doesn't fit well when you are working in 3D. Our new math model works better in both 2D and 3D testing."

The researchers discovered that cells in a 3D matrix exhibit different magnitudes of movement in different directions. To address this, the team members enhanced the original formula by identifying the primary and secondary directions in which the cells move, along with the speeds at which the cells travel and their persistence. In cell studies, persistence refers to how far the cells move in a fairly straight line before changing direction.

"Cells that are moving through a 3D environment seem to be more directional than those moving across a flat 2D surface," co-lead author Giri said. "The unpredictable 'random walk' is not prevalent in a 3D environment."

The team's improved math model for studying cell migration was published with their journal article, and the researchers hope other scientists who are trying to understand and prevent cancer metastasis will quickly adopt it. Although the team members used fibrosarcoma cancer cells in the PNAS study, they said the new model can also be used to help understand the behavior of other cell types, including those that move through the body to help fight infections and to speed the healing of wounds.

Coauthors of the study were Sean X. Sun, an associate professor in the Whiting School's Department of Mechanical Engineering, and Wirtz, who directs the Johns Hopkins Physical-Sciences Oncology Center and is affiliated with the School of Medicine's Sidney Kimmel Comprehensive Cancer Center. The research was supported by National Institutes of Health Grants R01CA174388 and U54CA143868.

Short video of cell movements at: http://youtu.be/UOk2VomIxWQ

The PNAS journal article is at: http://www.pnas.org/content/early/2014/03/04/1318967111.full.pdf+html

http://phys.org/news/2014-03-hours-homework-night-counterproductive.html#rssowlmlink

Study suggests more than two hours of homework a night may be counterproductive

Education scholar Denise Pope has found that too much homework has negative effects on student well-being and behavioral engagement.

4 hours ago by Clifton B. Parker

A Stanford researcher found that too much homework can negatively affect kids, especially their lives away from school, where family, friends and activities matter. "Our findings on the effects of homework challenge the traditional assumption that homework is inherently good," wrote Denise Pope, a senior lecturer at the Stanford Graduate School of Education and a co-author of a study published in the Journal of Experimental Education.

The researchers used survey data to examine perceptions about homework, student well-being and behavioral engagement in a sample of 4,317 students from 10 high-performing high schools in upper-middle-class California communities. Along with the survey data, Pope and her colleagues used open-ended answers to explore the students' views on homework.

Median household income exceeded $90,000 in these communities, and 93 percent of the students went on to college, either two-year or four-year. Students in these schools average about 3.1 hours of homework each night.

"The findings address how current homework practices in privileged, high-performing schools sustain students' advantage in competitive climates yet hinder learning, full engagement and well-being," Pope wrote.

Pope and her colleagues found that too much homework can diminish its effectiveness and even be counterproductive. They cite prior research indicating that homework benefits plateau at about two hours per

night, and that 90 minutes to two and a half hours is optimal for high school. Their study found that too much homework is associated with:

Greater stress: 56 percent of the students considered homework a primary source of stress, according to the survey data. Forty-three percent viewed tests as a primary stressor, while 33 percent put the pressure to get good grades in that category. Less than 1 percent of the students said homework was not a stressor.

Reductions in health: In their open-ended answers, many students said their homework load led to sleep deprivation and other health problems. The researchers asked students whether they experienced health issues such as headaches, exhaustion, sleep deprivation, weight loss and stomach problems.

Less time for friends, family and extracurricular pursuits: Both the survey data and student responses indicate that spending too much time on homework meant that students were "not meeting their developmental needs or cultivating other critical life skills," according to the researchers. Students were more likely to drop activities, not see friends or family, and not pursue hobbies they enjoy.

A balancing act

The results offer empirical evidence that many students struggle to find balance between homework, extracurricular activities and social time, the researchers said. Many students felt forced or obligated to choose homework over developing other talents or skills. Also, there was no relationship between the time spent on homework and how much the student enjoyed it. The research quoted students as saying they often do homework they see as "pointless" or "mindless" in order to keep their grades up.

"This kind of busy work, by its very nature, discourages learning and instead promotes doing homework simply to get points," Pope said. She said the research calls into question the value of assigning large amounts of homework in high-performing schools. Homework should not be simply assigned as a routine practice, she said. "Rather, any homework assigned should have a purpose and benefit, and it should be designed to cultivate learning and development," wrote Pope.

High-performing paradox

In places where students attend high-performing schools, too much homework can reduce their time to foster skills in the area of personal responsibility, the researchers concluded. "Young people are spending more time alone," they wrote, "which means less time for family and fewer opportunities to engage in their communities."

Student perspectives

The researchers say that while their open-ended or "self-reporting" methodology to gauge student concerns about homework may have limitations – some might regard it as an opportunity for "typical adolescent complaining" – it was important to learn firsthand what the students believe.

Explore further: Some characteristics increase the likelihood of getting married and living together

More information: Mollie Gallowaya, Jerusha Connerb & Denise Popec, "Nonacademic Effects of Homework in Privileged, High-Performing High Schools." The Journal of Experimental Education Volume 81, Issue 4, 2013, pages 490-510, DOI: 10.1080/00220973.2012.745469

http://scitechdaily.com/new-analyses-may-imply-existence-dark-matter-particle/#rssowlmlink

New Analyses May Imply the Existence of a Dark Matter Particle

UCLA Physics Symposium Implies the Existence of a Dark Matter Particle

Dark matter, the mysterious substance estimated to make up approximately more than one-quarter of the mass of the universe, is crucial to the formation of galaxies, stars and even life but has so far eluded direct observation. At a recent UCLA symposium attended by 190 scientists from around the world, physicists presented several analyses that participants interpreted to imply the existence of a dark matter particle.

The likely mass would be approximately 30 billion electron-volts, said the symposium's organizer, David Cline, a professor of physics in the UCLA College of Letters and Science and one of the world's experts on dark matter.

The physicists at the February 26–28 event were in agreement that "there seems to be an excess in the available data that could be due to dark matter," Cline said. "At this symposium, it was obvious that excitement is building in the fields of dark matter theory and, especially, detection," said Cline, who noted that there are several ways dark matter can be observed and that all were discussed at the UCLA meeting.

"Because dark matter makes up the bulk of the mass of galaxies and is fundamental in the formation of galaxies and stars, it is essential to the origin of life in the universe and on Earth," Cline said.

The first evidence for dark matter was discovered in 1933 using the Mt. Wilson telescope outside of Los Angeles. More recently, various theoretical models and detector improvements have made it possible to search for dark matter particles at extremely sensitive levels - some of the most sensitive measurements made by any scientists in the world.

One search technique involves using the vast amount of dark matter in our galaxy. The NASA Fermi Satellite Telescope, an international collaboration involving NASA, the Goddard Space Flight Center and the SLAC

National Accelerator Laboratory, searches for gamma rays - very high-energy light particles - from this dark matter.
There are models of dark matter that would allow a signal in the galactic dark matter consistent with the claims at the meeting and provide a small interaction consistent with the "null results" in the direct dark matter searches all over the world.
Much larger direct dark matter detectors are being planned in the U.S., Italy, Canada and China (including Xenon 3 Ton, LUX-ZEPLIN 7 Ton and DarkSide, which will weigh five tons). These larger detectors potentially could see a dark matter signal in the next few years, Cline said.
Dark matter is widely thought to be a kind of massive elementary particle that interacts weakly with ordinary matter. Physicists refer to these particles as WIMPS, for weakly interacting massive particles, and think they originated from the Big Bang. WIMPs are thought to be streaming constantly through the solar system and the Earth.
Another search method is to look for an interaction of a WIMP with xenon or argon nuclei and others (like germanium) in very low-background laboratories deep underground in Italy, the U.S., Canada, China and other countries. While these experiments have seen no signal of a WIMP above 30 billion electron volts, "there is no incompatibility with the interesting excess in the FERMI data," Cline said.
The discovery of the Higgs boson, which won the 2013 Nobel Prize in physics, plays a role in the search for dark matter, Cline said, adding that this topic was discussed in detail at the meeting. Dark matter, he said, could consist of axions, WIMPs or sterile neutrinos, all of which were discussed at the symposium.
The UCLA dark matter symposium is convened every two years; this was the 11th such meeting. Cline said he and his colleagues hope to clarify the dark matter puzzle at the 2016 symposium. See more on the conference: https://hepconf.physics.ucla.edu/dm14 It was at this same dark matter symposium in 1998 that two groups of scientists reported that the universe is accelerating, as well as expanding, a finding Cline described as "one of the greatest discoveries in the history of science."

http://www.eurekalert.org/pub_releases/2014-03/hfhs-snf031114.php#rssowlmlink

Substance naturally found in humans is effective in fighting brain damage from stroke

A molecular substance that occurs naturally in humans and rats was found to "substantially reduce" brain damage after an acute stroke and contribute to a better recovery, according to a newly released animal study by researchers at Henry Ford Hospital.

DETROIT –The study, published online before print in Stroke, the journal of the American Heart Association, was the first ever to show that the peptide AcSDKP provides neurological protection when administered one to four hours after the onset of an ischemic stroke. This type of a stroke occurs when an artery to the brain is blocked by a blood clot, cutting off oxygen and killing brain tissue with crippling or fatal results.
"Stroke is a leading cause of death and disability worldwide," said Li Zhang, M.D., a researcher at Henry Ford and lead author of the study. "Our data showed that treatment of acute stroke with AcSDKP alone or in combination with tPA substantially reduced neurovascular damage and improved neurological outcome."
Commonly called a "clot-buster," tPA, or tissue plasminogen activator , is the only FDA-approved treatment for acute stroke. However, tPA must be given shortly after the onset of stroke to provide the best results. It also has the potential to cause a brain hemorrhage.
The Henry Ford study found that this narrow "therapeutic window" is extended for up to four hours after stroke and the therapeutic benefit of tPA is amplified when tPA is combined with AcSDKP. Further, the researchers discovered that AcSDKP alone is an effective treatment if given up to one hour after the brain attack.
The researchers tested the actions of both substances on laboratory rats in which acute stroke had been induced. It was already known that the peptide AcSDKP provides anti-inflammatory effects and helps protect the heart when used to treat a variety of cardiovascular diseases. The Henry Ford scientists reasoned that the peptide may have similar neurological benefits.
Significantly, they found that AcSDKP can readily cross the so-called "blood brain barrier" that blocks other neuroprotective substances.
A battery of behavioral tests was given to the lab rats both before and after stroke was induced to measure the effects of AcSDKP administered alone one hour after onset and combined with tPA four hours after stroke. Besides finding that both methods "robustly" decreased neurological damage associated with stroke, they did so without increasing the incidence of brain hemorrhage or the formation of additional blood clots.
"With the increased use of clot-busting therapy in patients with acute stroke, both the safety and effectiveness of the combined treatment shown in our study should encourage the development of clinical trials of AcSDKP with tPA," Dr. Zhang says.
Study funding: NIH RO1 NS 079612 (ZGZ)

http://www.eurekalert.org/pub_releases/2014-03/uop-sfp031114.php#rssowlmlink

Scientists from Penn and CHOP confirm link between missing DNA and birth defects

Researchers have laid the foundation for identifying the underlying molecular mechanism of a puzzling array of disabilities and potentially treating them

In 2010, scientists in Italy reported that a woman and her daughter showed a puzzling array of disabilities, including epilepsy and cleft palate. The mother had previously lost a 15-day-old son to respiratory failure, and the research team noted that the mother and daughter were missing a large chunk of DNA on their X chromosome. But the researchers were unable to definitively show that the problems were tied to that genetic deletion.

Now a team from the University of Pennsylvania and The Children's Hospital of Philadelphia has confirmed that those patients' ailments resulted from the genetic anomaly. Creating mice that lacked the same region of DNA, the Penn and CHOP researchers showed that these animals suffered the same problems that afflicted the mother, daughter and son - cleft palate, epilepsy and respiratory difficulties, a condition called human Xq22.1 deletion syndrome. And, by clarifying the syndrome's genetic basis, the researchers have laid the foundation for identifying the underlying molecular mechanism of these troubles and potentially treating them at their biological root.

"This study has demonstrated that deleting this region in mice causes them to respond like humans with the same deletion," said P. Jeremy Wang, senior author on the study and professor in the Penn School of Veterinary Medicine's Department of Animal Biology. "Now that we have a mouse model, we can dissect and try to genetically pinpoint which genes are responsible."

Wang co-led the study with his postdoctoral researcher Jian Zhou. Additional coauthors included Penn Vet's N. Adrian Leu and CHOP's Ethan Goldberg, Lei Zhou and Douglas Coulter. The study appears in the journal Human Molecular Genetics.

To investigate the effects of missing this portion of DNA, more than 1 million base pairs long, the Penn team crossed existing mice that had particular deletions in their DNA to create a mouse that lacked the entire stretch that the human patients were missing. They quickly observed that all male mice died at birth due to respiratory failure. Females, who would have one normal X chromosome and one X chromosome with this missing stretch of genetic material, survived but had varying degrees of symptoms including epilepsy, cleft palate and other developmental problems.

"We believe this is because of skewed X chromosome inactivation," Wang said. "In females one of the X chromosomes' expression is randomly 'silenced' so that males and females have an equal dosage of genetic material from this sex chromosome under normal circumstances. In this case, if more female cells silence the X chromosome that has the deletion, the effects of the syndrome won't be as severe."

To narrow down which part of the deleted genetic material was responsible for the observed birth defects, the researchers genetically engineered one type of mice that lacked the first two-thirds of the original genetic deletion and another type that lacked the final third. Unexpectedly, the mice lacking the two-thirds of the region on the X chromosome, which included 17 genes, did not display any respiratory failure, cleft palate or epilepsy.

"These mice were fine," Wang said. "It was very surprising to us that deleting this many genes on the X chromosome did not cause apparent problems for the mice."

This was not the case for the mice missing the last 350 kilobase pairs of the region of interest. These mice had the same suite of problems as mice missing the entire region: males died after birth and females had cleft palates, higher rates of death soon after birth, developmental delays and had seizures.

After ruling out the genes in this smaller region that have no equivalent in humans, the researchers were left with only four genes. All four belong to the same family of genes and encode proteins that are involved in cellular signaling.

"These proteins are involved in the neuronal circuitry and activity of neurotransmitters," Wang said. "That is probably why we see that females lacking one copy of these X-linked genes have epilepsy."

Wang and colleagues plan to continue studying these four genes to determine which lead to the developmental problems such as cleft palate and epilepsy when they are missing. The information gained from this and future studies could inform prenatal testing, Wang said, giving doctors advance warning to treat possible respiratory or other problems in newborns.

Understanding how the lack of these genes leads to epilepsy could also help guide treatments for the condition.

"Epilepsy and cleft palate affect tens of thousands of children in the U.S. alone each year," Wang said, "and respiratory failure is a particular problem in premature and low birth weight babies. Finding the causative genes for these conditions could have some very clinically important implications."

The study was supported by funding from the National Institutes of Health.

http://www.medscape.com/viewarticle/821770?src=rss

Anesthesia, Surgery May Double Dementia Risk

Anesthesia and surgery significantly increase the risk for dementia, new research suggests.

Megan Brooks

A large population-based study conducted by investigators at the Neurological Institute in Taipei Veterans General Hospital, in Taipei City, Republic of China, showed that the risk of developing dementia nearly doubled within 3 to 7 years of anesthesia and surgery. In addition, the average time to dementia diagnosis was shorter in patients who had anesthesia and surgery compared with their counterparts who did not undergo these procedures. The study adds to "growing concerns that anesthetic agents may have neurodegenerative complications," study investigator Jong-Ling Fuh, MD, of the Neurological Institute, told Medscape Medical News.

"In vitro and animal studies showed that inhaled anesthetic drugs can promote amyloid beta oligomerization and impair memory. However, it remains controversial whether anesthesia and surgery contribute to the development of dementia in human studies," she said. "This population-based study provides statistically sound evidence for the association of dementia with anesthesia and surgery. Our findings support the view that patients who undergo anesthesia and surgery may be at increased risk of dementia."

"Although we do not know how to mitigate the risk of dementia after anesthesia and surgery at this point, physicians and surgeons should be more vigilant about the possible development of long-term cognitive decline postoperatively in patients who have undergone anesthesia and surgery," Dr. Fuh added.

The study was published in the March issue of the British Journal of Psychiatry.

Need for More Research

Using the Taiwan National Health Insurance Research Database, Dr. Fuh and colleagues extracted the records of 24,901 patients aged 50 years and older who underwent anesthesia for surgery between 2004 and 2007, and a control group of 110,972 randomly selected individuals matched for age and sex. They excluded anyone with a history of cancer, dementia, Parkinsonism, stroke, or brain operations. During 3 to 7 years of follow-up, 661 patients in the anesthesia group (2.65%) and 1539 in the control group (1.39%) were diagnosed with dementia. Alzheimer's disease accounted for the majority of these cases. Dementia occurred sooner in the anesthesia group (mean 907 days) than in the control group (mean, 1104 days; $P < .0001$).

After adjusting for hypertension, hyperlipidemia, depression, and Charlson index, patients who underwent anesthesia and surgery had an estimated 1.99-fold increased risk of developing dementia (95% confidence interval [CI], 1.81 - 2.17; $P < .001$). The risk for dementia after anesthesia was increased similarly in men and women. The risk was greatest with regional anesthesia (adjusted hazard ratio [HR], 1.80; 95% CI, 1.57 - 2.07), followed by intravenous/intramuscular anesthesia (HR, 1.60; 95% CI, 1.11 - 2.30) and general anesthesia (HR, 1.46; 95% CI, 1.28 - 1.68).

Of the 8 types of surgery, 5 were associated with an increased risk for dementia (dermatologic, musculoskeletal, genitourinary, digestive, and eye surgery). Ear, nose, and throat (ENT), respiratory, and cardiovascular surgery was not associated with increased dementia risk. Dr. Fuh said "caution must be exercised in asserting causality between development of dementia and anesthesia-associated neurotoxicity. More clinical studies are needed to investigate the association and causality between anesthesia with surgery and subsequent dementia."

Red Flags and Caveats

Commenting on the findings for Medscape Medical News, Roderic G. Eckenhoff, MD, professor and vice-chair of research, Department of Anesthesia and Critical Care, University of Pennsylvania in Philadelphia, who was not involved in the study, said that sometimes surgery is necessary, but in cases of elective surgery, patients may want to think twice.

However, he cautioned that the study has some "big red flags" and said this "is an area in need of further clarification." "If it's surgery, is it the actual surgery, or the anesthesia, or is it the stress of being in the hospital? It's probably all those things combined, but it's probably the surgical procedure itself that causes the largest risk, at least that's what we believe," Dr. Eckenhoff said. "This is a good additional study, and its real strength is its size," Dr. Eckenhoff said.

"Even when corrected for comorbidity, they found a significant effect of having had surgery in the past and risk for dementia. The level of risk is about consistent with some of the other studies performed," he noted.

What's "very concerning," he said, is that the demographics and comorbidity are "significantly different" in the surgery group and the control group, "although they did try to correct for that."

Still, "a big red flag and qualifier with this study is that the patients needing surgery are in fact different than the patients who don't need surgery. It may be those differences and not the fact that they had surgery itself that account for the difference in propensity for getting dementia," Dr. Eckenhoff said.

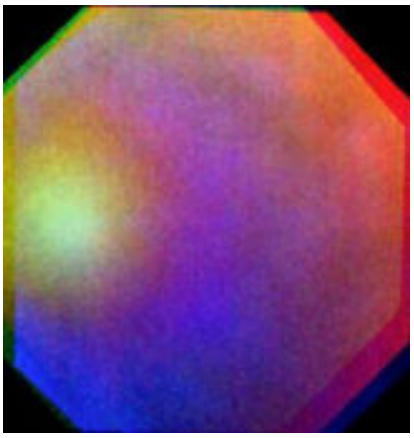
"I think in the end we are going to find that there are small populations of people that are more vulnerable to another insult like surgery and who go downhill more quickly afterwards. The challenge is to figure out who those people are, and that's going to require really good biomarkers," said Dr. Eckenhoff.
The study was supported by Taipei Veterans General Hospital and other noncommercial entities. The authors have disclosed no relevant financial relationships. *Br J Psychiatry. 2014;204:188-193. Abstract*

http://bit.ly/1eqJKga

First alien rainbow image holds clues to Venus mystery

A rare type of rainbow called a "glory" has been spotted in Venus's atmosphere, the first time such a ring of colour has been imaged on another planet.

18:14 11 March 2014 by Lisa Grossman



The glory's shape and size could help solve a decades-old mystery about the hazy planet's makeup. "A full glory has never been seen before outside of the terrestrial environment," says Wojciech Markiewicz at the Max Planck Institute for Solar System Research in Gottingen, Germany, who was part of the team that spotted the glory on Venus.
Ordinary rainbows, and glories, are both caused by sunlight filtering through cloud droplets, which on Earth consist of water particles. But where ordinary rainbows are typically seen from the ground, glories are only seen from above and look like smaller concentric circles, like a saint's halo.
Scientists think glories occur when sunlight bounces about inside the droplets and ends up leaving in the same direction it came from, making a ring of light that can only be seen if you're precisely between the sun and the centre of the glory. The particles must also be nearly spherical and almost all the same size.

The Venusian "glory" in false colours showing ultraviolet, visible, and near-infrared wavelengths. The centre of the concentric circles is the pale yellow patch at left, and the glory extends over at least 1200 kilometres **(Image: ESA/MPS/DLR/IDA)**

Bacterial culprit?

Ever since the first spectra of Venus was taken in the 1920s, scientists have known that the hazy planet's atmosphere contains sulphuric acid "clouds", which could create glories. But there was another, unidentified component in the atmosphere that absorbed light in the ultraviolet range. Scientists have come up with a variety of possible culprits, but none has been confirmed. "Even such bizarre things as bacteria were proposed, but no one really knows what it is," says Markiewicz. In 2011, he and his colleagues manoeuvred the European Space Agency's Venus Express spacecraft into position to hunt for Venusian glories, and on 24 July they were successful, as they reported last month in the journal Icarus.
The glory they spotted is 1200 kilometres wide, meaning the particles at the cloud tops must be all of the same size for a swatch of sky at least that big. The team found that sulphuric acid droplets alone cannot explain the glory, but droplets coated with elemental sulphur or mixed in with ferric chloride fit the data well.
"This could be the so-called unknown absorber that people had been trying to identify for years," Markiewicz says. "We cannot say for sure, but we can say that this is one more piece of the puzzle for the whole thing."
Journal reference: Icarus, DOI: 10.1016/j.icarus.2014.01.030

http://phys.org/news/2014-03-largest-yellow-hypergiant-star.html#rssowlmlink

Largest yellow hypergiant star spotted

VLT spots largest yellow hypergiant star

HR 5171, the brightest star just below the centre of this wide-field image, is a yellow hypergiant, a very rare type of stars with only a dozen known in our galaxy. Its size is over 1,300 times that of the Sun -- one of the 10 largest stars found so far. Observations with ESO's Very Large Telescope Interferometer have shown that it is actually a double star, with the companion in contact with the main star. Credit: ESO/Digitized Sky Survey 2
ESO's Very Large Telescope has revealed the largest yellow star - and one of the 10 largest stars found so far. This hypergiant has been found to measure more than 1,300 times the diameter of the Sun, and to be part of a double star system, with the second component so close that it is in contact with the main star. Observations spanning over 60 years also indicate that this remarkable object is changing very rapidly.
Using ESO's Very Large Telescope Interferometer (VLTI), Olivier Chesneau (Observatoire de la Côte d'Azur, Nice, France) and an international team of collaborators have found that the yellow hypergiant star HR 5171 A is absolutely huge - 1300 times the diameter of the Sun and much bigger than was expected. This makes it the largest yellow star known. It is also in the top ten of the largest stars known - 50% larger than the famous red supergiant Betelgeuse - and about one million times brighter than the Sun.

"The new observations also showed that this star has a very close binary partner, which was a real surprise," says Chesneau. "The two stars are so close that they touch and the whole system resembles a gigantic peanut."
The astronomers made use of a technique called interferometry to combine the light collected from multiple individual telescopes, effectively creating a giant telescope up to 140 metres in size. The new results prompted the team to thoroughly investigate older observations of the star spanning more than sixty years, to see how it had behaved in the past.

Yellow hypergiants are very rare, with only a dozen or so known in our galaxy - the best-known example being Rho Cassiopeiae. They are among the biggest and brightest stars known and are at a stage of their lives when they are unstable and changing rapidly. Due to this instability, yellow hypergiants also expel material outwards, forming a large, extended atmosphere around the star.

HR 5171, the brightest star just below the centre of this wide-field image, is a yellow hypergiant, a very rare type of stars with only a dozen known in our galaxy. Its size is over 1,300 times that of the Sun -- one of the 10 largest stars found so far. Observations with ESO's Very Large Telescope Interferometer have shown that it is actually a double star, with the companion in contact with the main star. Credit: ESO/Digitized Sky Survey 2

Despite its great distance of nearly 12 000 light-years from Earth, the object can just about be seen with the naked eye by the keen-sighted. HR 5171 A has been found to be getting bigger over the last 40 years, cooling as it grows, and its evolution has now been caught in action. Only a few stars are caught in this very brief phase, where they undergo a dramatic change in temperature as they rapidly evolve.
By analysing data on the star's varying brightness, using observations from other observatories, the astronomers confirmed the object to be an eclipsing binary system where the smaller component passes in front and behind the larger one as it orbits. In this case HR 5171 A is orbited by its companion star every 1300 days. The smaller companion is only slightly hotter than HR 5171 A's surface temperature of 5000 degrees Celsius.
Chesneau concludes "The companion we have found is very significantas it can have an influence on the fate of HR 5171 A, for example, stripping off its outer layers and modifying its evolution."
This new discovery highlights the importance of studying these huge and short-lived yellow hypergiants, and could provide a means of understanding the evolutionary processes of massive stars in general.
This research was presented in a paper "The yellow hypergiant HR 5171 A: Resolving a massive interacting binary in the common envelope phase", by Chesneau et al., to appear in the journal Astronomy & Astrophysics.
arxiv.org/pdf/1401.2628v2.pdf

http://www.bbc.com/news/uk-wales-26534408

Pioneering 3D printing reshapes patient's face in Wales

Stephen Power says the operation was "totally life-changing"

By Hywel Griffith BBC Wales correspondent

A survivor of a serious motorbike accident has had pioneering surgery to reconstruct his face using a series of 3D printed parts. Stephen Power, from Cardiff, is thought to be one of the first trauma patients in the world to have 3D printing used at every stage of the procedure. Doctors at Morriston Hospital, Swansea, had to break his cheekbones again before rebuilding his face. Mr Power said the operation had been "life-changing".
The UK has become one of the world's pioneers in using 3D technology in surgery, with advances also being made by teams in London and Newcastle. While printed implants have previously been used to help correct congenital conditions, this operation used custom-printed models, guides, plates and implants to repair impact injuries months after they were sustained.
Despite wearing a crash helmet Mr Power, 29, suffered multiple trauma injuries in the accident in 2012, which left him in hospital for four months. "I broke both cheekbones, top jaw, my nose and fractured my skull," he said. "I can't remember the accident - I remember five minutes before and then waking up in the hospital a few months later."
A model and implant produced using 3D printing A skull model and implants produced using 3D printing
In order to try to restore the symmetry of his face, the surgical team used CT scans to create and print a symmetrical 3D model of Mr Power's skull, followed by cutting guides and plates printed to match.
Maxillofacial surgeon Adrian Sugar says the 3D printing took away the guesswork that can be problematic in reconstructive work.
"I think it's incomparable - the results are in a different league from anything we've done before," he said. "What this does is it allows us to be much more precise. Everybody now is starting to think in this way -

guesswork is not good enough." The procedure took eight hours to complete, with the team first having to refracture the cheekbones with the cutting guides before remodelling the face.

'Life changing'

A medical-grade titanium implant, printed in Belgium, was then used to hold the bones in their new shape.

Looking at the results of the surgery, Mr Power says he feels transformed - with his face now much closer in shape to how it was before the accident. "It is totally life-changing," he said. "I could see the difference straightaway the day I woke up from the surgery."

Having used a hat and glasses to mask his injuries before the operation, Mr Power has said he already feels more confident. "I'm hoping I won't have to disguise myself - I won't have to hide away," he said. "I'll be able to do day-to-day things, go and see people, walk in the street, even go to any public areas."

The project was the work of the Centre for Applied Reconstructive Technologies in Surgery (Cartis), which is a collaboration between the team in Swansea and scientists at Cardiff Metropolitan University.

Design engineer Sean Peel has said the latest advance should encourage greater use of 3D printing in the NHS. "It tends to be used for individual really complicated cases as it stands, in quite a convoluted, long-winded design process," he said. "The next victory will be to get this process and technique used more widely as the costs fall and as the design tools improve." Mr Power's operation is currently being featured in an exhibition at the Science Museum in London, called 3D Printing: The Future.

http://nyti.ms/1d07qYj

Pause Is Seen in a Continent's Peopling

Using a new method for exploring ancient relationships among languages, linguists have found evidence further illuminating the peopling of North America about 14,000 years ago.

By NICHOLAS WADE MARCH 12, 2014

Their findings follow a recent proposal that the ancestors of Native Americans were marooned for some 15,000 years on a now sunken plain before they reached North America. This idea, known as the Beringian standstill hypothesis, has been developed by geneticists and archaeologists over the last seven years. It holds that the ancestors of Native Americans did not trek directly across the land bridge that joined Siberia to Alaska until the end of the last ice age, 10,000 years ago. Rather, geneticists say, these ancestors must have lived in isolation for some 15,000 years to accumulate the amount of DNA mutations now seen specifically in Native Americans.

Archaeologists examining deep sea cores from the Bering Strait believe that a special ecological zone known as shrub tundra existed there during the Last Glacial Maximum, an exceptionally cold period that lasted from about 30,000 to 15,000 years ago. Though often referred to as a bridge, the now sunken region, known as Beringia, was in fact a broad plain. It was also relatively warm, and supported trees such as spruce and birch, as well as grazing animals.

Writing in the journal Science last month, John F. Hoffecker, an archaeologist at the University of Colorado, summarized the evidence for thinking the Beringian plain was the refuge for the ancestral Native American population identified by the geneticists. "The shrub tundra zone in central Beringia represents the most plausible home for the isolated standstill population," he and colleagues wrote.

Dr. Hoffecker believes that the ancestral Native Americans could have kept warm with fires of animal bones and wood, and that their range was restricted by the availability of wood. "The paleoecological data is consistent with the idea of a refugium, and the wood might be a key variable," he said in an interview.

Dene-Yeniseian Out-of-Beringia. ***This polar projection map of Asia and North America shows the approximate terminal Pleistocene shoreline. The center of geographic distribution of Yeniseian and Na-Dene language is in Beringia. From this center burgundy arrows extend toward the North American coast and into Siberia. A blue arrow indicates Interior dispersals of Na-Dene.*** **doi:10.1371/journal.pone.0091722.g004**

Linguists have until now been unable to contribute to this synthesis of genetic and archaeological data. The first migrations to North America occurred between 15,000 and 10,000 years ago, but most linguists have long

believed that language trees cannot be reconstructed back further than 8,500 years. Vocabulary changes so fast that the signal of relationship between two languages is soon swamped by the noise of borrowed words and fortuitous resemblances.

But in 2008, Edward Vajda, a linguist at Western Washington University, said he had documented a relationship between Yeniseian, a group of mostly extinct languages spoken along the Yenisei River in central Siberia, and Na-Dene.

The Na-Dene languages are spoken in Alaska and western Canada, with two outliers in the American Southwest, Navajo and Apache. His assertion that the two families of languages had descended from a common tongue implied that he was seeing back in time at least 12,000 years or so, to the arrival of Na-Dene speakers in North America.

Many linguists accepted Dr. Vajda's analysis, despite its time depth. He relied heavily on structural features of language, which turn out to be more resistant to change than vocabulary. In particular, he looked at Yeniseian and Na-Dene verbs, since languages in both groups have a template of fixed positions before and after the verb for specifying various attributes.

Building on Dr. Vajda's success, two linguists, Mark A. Sicoli of Georgetown University and Gary Holton of the University of Alaska, have assessed the relationship of the two language families based on shared grammatical features, rather than vocabulary.

In a paper published in the journal PLoS One on Wednesday, they report their surprising finding that Na-Dene is not a descendant of Yeniseian, as would be expected if the Yeniseian speakers in Siberia were the source population of the Na-Dene migration. Rather, they say, both language families are descendants of some lost mother tongue. Their explanation is that this lost language was spoken in Beringia, and that its speakers migrated both east and west. The eastward group reached North America and became the Na-Dene speakers, while the westward group returned to Siberia and settled along the Yenisei River.

The Na-Dene migration from Beringia came after the main migration of 15,000 years ago, but the relationship between the two populations remains to be settled. "There may have been multiple streams of people moving out of that single source at different times," said Dennis H. O'Rourke, an anthropological geneticist at the University of Utah.

If Yeniseian represents a return migration from Beringia, the question of the source population in Siberia of Native Americans is thrust back into obscurity. "If Yeniseian is off the table as a back-migration, there is no other candidate," Dr. Sicoli said.

Several Yeniseian languages are known only from czarist fur tax records. Pumpokol, Arin, Assan and Kott have not been spoken for two centuries. The only surviving language, Ket, has fewer than 200 living speakers.

http://www.eurekalert.org/pub_releases/2014-03/uoa-wgp031014.php#rssowlmlink

Water-rich gem points to vast 'oceans' beneath the Earth: UAlberta study

A University of Alberta diamond scientist has found the first terrestrial sample of a water-rich gem that yields new evidence about the existence of large volumes of water deep beneath the Earth.

An international team of scientists led by Graham Pearson, Canada Excellence Research Chair in Arctic Resources at the U of A, has discovered the first-ever sample of a mineral called ringwoodite. Analysis of the mineral shows it contains a significant amount of water - 1.5 per cent of its weight - a finding that confirms scientific theories about vast volumes of water trapped 410 to 660 kilometres beneath the Earth, between the upper and lower mantle.

"This sample really provides extremely strong confirmation that there are local wet spots deep in the Earth in this area," said Pearson, a professor in the Faculty of Science, whose findings were published March 13 in Nature. "That particular zone in the Earth, the transition zone, might have as much water as all the world's oceans put together."

Where it is: Researchers say the rongwoodite reveals the Earth's transition zone could be a vast reservoir of water

University of Alberta

Ringwoodite is a form of the mineral peridot, believed to exist in large quantities under high pressures in the transition zone. Ringwoodite has been found in meteorites but, until now, no terrestrial sample has ever been unearthed because scientists haven't been able to conduct fieldwork at extreme depths.

Pearson's sample was found in 2008 in the Juina area of Mato Grosso, Brazil, where artisan miners unearthed the host diamond from shallow river gravels. The diamond had been brought to the Earth's surface by a volcanic rock known as kimberlite - the most deeply derived of all volcanic rocks.

The discovery that almost wasn't

Pearson said the discovery was almost accidental in that his team had been looking for another mineral when they purchased a three-millimetre-wide, dirty-looking, commercially worthless brown diamond. The ringwoodite itself is invisible to the naked eye, buried beneath the surface, so it was fortunate that it was found by Pearson's graduate student, John McNeill, in 2009.

"It's so small, this inclusion, it's extremely difficult to find, never mind work on," Pearson said, "so it was a bit of a piece of luck, this discovery, as are many scientific discoveries."

The sample underwent years of analysis using Raman and infrared spectroscopy and X-ray diffraction before it was officially confirmed as ringwoodite. The critical water measurements were performed at Pearson's Arctic Resources Geochemistry Laboratory at the U of A. The laboratory forms part of the world-renowned Canadian Centre for Isotopic Microanalysis, also home to the world's largest academic diamond research group.

The study is a great example of a modern international collaboration with some of the top leaders from various fields, including the Geoscience Institute at Goethe University, University of Padova, Durham University, University of Vienna, Trigon GeoServices and Ghent University.

For Pearson, one of the world's leading authorities in the study of deep Earth diamond host rocks, the discovery ranks among the most significant of his career, confirming about 50 years of theoretical and experimental work by geophysicists, seismologists and other scientists trying to understand the makeup of the Earth's interior.

Scientists have been deeply divided about the composition of the transition zone and whether it is full of water or desert-dry. Knowing water exists beneath the crust has implications for the study of volcanism and plate tectonics, affecting how rock melts, cools and shifts below the crust.

"One of the reasons the Earth is such a dynamic planet is the presence of some water in its interior," Pearson said. "Water changes everything about the way a planet works."

http://dailym.ai/1ghjZyA

Revealed: The vast reservoir hidden beneath the Earth's crust that holds as much water as ALL of the oceans

First time researchers have ever found ringwoodite, a mineral in the Earth's mantle - after discovering it in a $20 diamond

By Mark Prigg

Scientists have discovered a vast reservoir of water under the Earth's mantle they say could be larger than all the ocean's combined. Canadian researchers say analysis of a rare mineral points to the huge store of water deep in Earth's mantle, 400-600 kilometres (250-375 miles) beneath our feet.

It echoes the hundred and fifty year old novel, 'Journey to the Centre of the Earth', in which French science-fiction forerunner Jules Verne pictured a vast sea that lay deep under our planet's surface.

The evidence comes from a water-loving mineral called ringwoodite that came from the so-called transition zone sandwiched between the upper and lower layers of Earth's mantle, they said in the journal Nature.

Analysis shows that 1.5% of the rock comprises molecules of water. The find backs once-contested theories that the transition zone, or at least significant parts of it, is water-rich, the investigators said.

'This sample really provides extremely strong confirmation that there are local wet spots deep in the Earth in this area,' said Graham Pearson of Canada's University of Alberta, who led the research. 'That particular zone in the Earth, the transition zone, might have as much water as all the world's oceans put together.'

Ringwoodite is named after Australian geologist Ted Ringwood, who theorised that a special mineral was bound to be created in the transition zone because of the ultra-high pressures and temperatures there.

A piece of this mineral has been a long-sought goal.

It would resolve a long-running debate about whether the poorly-understood transition zone is bone-dry or water-rich. But, until now, ringwoodite has only ever been found in meteorites. Geologists had simply been unable to delve deep enough to find any sample on Earth.

Good fortune, though, changed all this.

WHAT DOES IT MEAN?

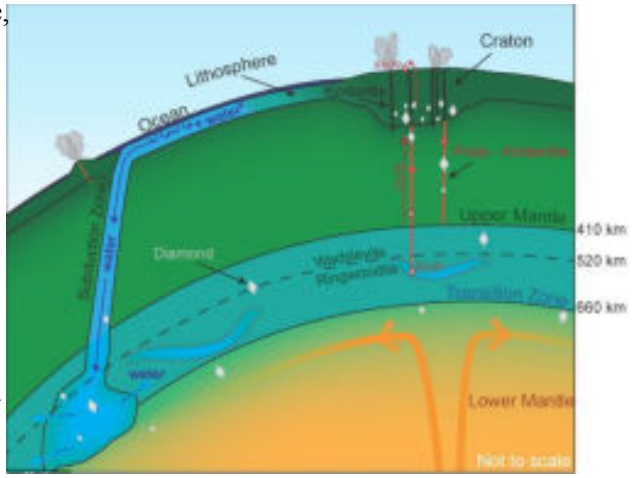
The new theory, backed up by seismic data suggest that water is stored in the transition zone of Earth's mantle.

It is thought to host minerals called ringwoodite and wadsleyite that can store water like a sponge.

If water does exists in huge volumes beneath Earth's crust, it is bound to have a big impact on the mechanics of volcanoes and the movement of tectonic plates.

In 2008, amateur gem-hunters digging in shallow river gravel in the Juina area of Mato Grasso, Brazil, came across a tiny, grubby stone called a brown diamond. Measuring just three millimetres (0.12 inches) across and

commercially worthless, the stone was acquired by the scientists when they were on a quest for other minerals. But the accidental acquisition turned out to be a bonanza. In its interior, they found a microscopic trace of ringwoodite -- the very first terrestrial evidence of the ultra-rare rock.
'It's so small, this inclusion, it's extremely difficult to find, never mind work on,' Pearson said in a press release, paying tribute to the diligent work of grad student John McNeill. 'It was a bit of a piece of luck, this discovery, as are many scientific discoveries.' The team theorise that the brown diamond rocketed to the surface during a volcanic eruption, hitchhiking in a stream of kimberlite, the deepest of all volcanic rocks.
Years of analysis, using spectroscopy and X-ray diffraction, were needed in specialised labs to confirm the find officially as ringwoodite. Scientists have debated for decades about whether the transition zone has water, and if so, how much of the precious stuff there might be. None, though, has embraced Verne's fancy of a subterranean sea with a rocky coastline dotted with forests of giant mushrooms and petrified trees.
Hans Keppler, a geologist at the University of Bayreuth in Germany, cautioned against extrapolating the size of the subterranean water find from a single sample of ringwoodite. And he also said the water was likely to be locked up in specific rocks, in a molecular form called hydroxyl. 'In some ways it is an ocean in Earth's interior, as visualised by Jules Verne... although not in the form of liquid water,' Keppler said in a commentary also published by Nature. The implications of the discovery are profound, Pearson suggested.



Schematic partial cross section of the Earth showing the location of ringwoodite, which make up approximately 60% by volume of this part of the transition zone. The diamond containing the water-bearing ringwoodite inclusion found by originated from approximately 500 km beneath the Earth's surface, where a large mass of water may accumulate by the subduction and recycling of oceanic lithosphere, into the transition zone. **Katy Mather**

If water exists in huge volumes beneath Earth's crust, it is bound to have a big impact on the mechanics of volcanoes and the movement of tectonic plates.
'One of the reasons the Earth is such a dynamic planet is the presence of some water in its interior. Water changes everything about the way a planet works,' said Pearson.

http://www.eurekalert.org/pub_releases/2014-03/uom-bcg031214.php#rssowlmlink

Breast cancer gene could play critical role in obesity and diabetes

BRCA 1 is expressed in muscle and protects against metabolic disease

College Park, Md. -- The gene known to be associated with breast cancer susceptibility, BRCA 1, plays a critical role in the normal metabolic function of skeletal muscle, according to a new study led by University of Maryland School of Public Health researchers. Dr. Espen Spangenburg, associate professor of kinesiology, and his laboratory team are the first to identify that the BRCA1 protein is expressed in the skeletal muscle of both mice and humans, and that it plays a key role in fat storage, insulin response and mitochondrial function in skeletal muscle cells. The research is published in the Journal of Lipid Research.
"Our findings suggest that certain mutations in the BRCA1 gene may put people at increased risk for metabolic diseases like obesity and type 2 diabetes," said Dr. Spangenburg. "Without BRCA1, muscle cells store excess fat and start to look diabetic. We believe that the significance of the BRCA1 gene goes well beyond breast cancer risk."
Dr. Spangenburg and colleagues, including researchers from the University of Maryland School of Medicine, Brigham Young University, Karolinska Institutet in Sweden, and East Carolina University, found that the BRCA1 protein exists in both mouse and in human skeletal muscle. This is the first evidence since the discovery of BRCA1 in 1994 that the gene is expressed in human muscle cells.
They further established that the protein produced by the BRCA 1 gene binds with a protein known to play an important role in the metabolism of fat in muscle cells known as Acetyl-CoA carboxylase or ACC. After a period of exercise, the BRCA 1 protein binds to ACC, which helps "turns it off." This deactivation of ACC encourages the utilization of fatty acids by the muscle.
Once they established that the two proteins complex together, they sought to answer if BRCA1 plays a critical role in regulating muscle metabolic function. To do so, they "knocked out" the gene so that it was no longer being expressed in the muscle cells cultured from healthy, active and lean female subjects. This was done using shRNA technology specific for BRCA1 in human myotubes (skeletal muscle fiber cells).

The result was that the muscle cells started to look diseased. The removal of BRCA1 from the cells, which simulated what could happen in the cells of a person with a BRCA1 mutation, resulted in increased lipid storage, decreased insulin signaling, reduced mitochondrial function and increased oxidative stress. These are all key risk factors for the development of metabolic diseases, such as obesity, type 2 diabetes and cardiovascular disease.

"Our findings make it clear that BRCA1 plays a protective role against the development of metabolic disease," Dr. Spangenburg explains. "This gene needs to be there, and should be considered a target to consider in the treatment of type 2 diabetes and/or obesity."

"BRCA1 is a Novel Regulator of Metabolic Function in Skeletal Muscle" was written by Kathyrn C. Jackson, Eva-Karin Gidlund, Jessica Norrbom, Ana P. Valencia, David M. Thomson, Rosemary A. Schuh, P. D. Neufer and Espen E. Spangenburg and published in the Journal of Lipid Research. http://www.jlr.org/content/early/2014/02/24/jlr.M043851.abstract

http://www.bbc.co.uk/nature/26549963#rssowlmlink

'Shocking' scale of pangolin smuggling revealed

Official records show that pangolins are being illegally traded on a "shocking" scale, according to a report.

By Ella Davies Reporter, BBC Nature

The globally threatened animals are sought for their scales which are used in traditional Chinese medicine. Annual seizures have been estimated at roughly 10,000 animals but experts warn the illegal trade is far greater Chinese enforcement officials worked with researchers from the UK to assess the extent of the problem. Zhao-Min Zhou, from the Public Security Bureau for Forests in China's Yunnan province, worked with researchers from the University of Oxford to analyse official records of pangolins seized from smugglers. The findings are published in the journal Frontiers in Ecology and the Environment.

"The numbers of pangolins traded are shocking, and all the more so considering the pharmaceutical pointlessness of the trade. This trade is intolerably wasteful," said Prof Macdonald, director of the University of Oxford's Wildlife Conservation Research Unit (WildCRU), and a co-author of the paper. He praised the leadership of Mr Zhou in the study, which gives conservationists the first glimpse of official records of seizures. The research team uncovered records that 2.59 tonnes of scales, representing approximately 4,870 pangolins, along with 259 intact pangolins (220 living; 39 dead) have been seized since 2010, resulting in 43 enforcement cases.

There are eight species of pangolin, four of which are found in Asia and four of which live in Africa. Chinese and Sunda pangolins are listed as Endangered by the International Union for the Conservation of Nature. Indian and Philippine pangolins are considered Near Threatened, as are Africa's giant and white-bellied species. The animals roll into a ball for protection but this only makes it easier for poachers to collect and transport them unnoticed.

Surveying the bodies of trafficked pangolins Mr Zhou examines the bodies of seized pangolins

In traditional Chinese medicine, roasted pangolin scales are thought to detoxify and drain pus, relieve palsy, and stimulate lactation. Rapid economic growth in Asia has resulted in soaring demand in recent years.

Pangolins by post

In addition to smuggling whole animals, traffickers use the postal system to transport their contraband. In the report, Prof Macdonald and colleagues highlight that last November, Beijing customs officials intercepted five parcels of pangolin scales weighing 70kg each. They subsequently discovered a further tonne of scales had been shipped in this way since April, the equivalent of 1,660 individual animals.

Prolific smugglers have received prison sentences from 11 years to life but with demand out-stripping supply, the trade is only becoming more lucrative. According to the report, pangolin scales are currently worth £360 ($600) per kilo, twice the amount they traded for in 2008. Pangolins only give birth to one offspring per year and conservationists warn that current declines are unsustainable.

Richard Thomas, from the wildlife trade monitoring network TRAFFIC, described the animals as "overlooked" in comparison with the more "charismatic" targets of smugglers. "Poor old pangolins are a bit of a forgotten species. There's been a lot of attention to the big iconic animals: elephants, rhinos, tigers but not much attention to pangolins." He explained that Asian species of pangolin are protected under CITES legislation and have a "zero quota", meaning their removal from the wild for international trade is illegal.

TRAFFIC staff in Asia are helping to train customs and postal workers to help them detect smuggling attempts and raise awareness of the animals' plight. "We've uncovered a disastrous situation and currently all the omens for the pangolin are bad but hopefully by drawing attention to this useless trade, international opinion may contribute to changing the situation of the pangolin," said Prof Macdonald.

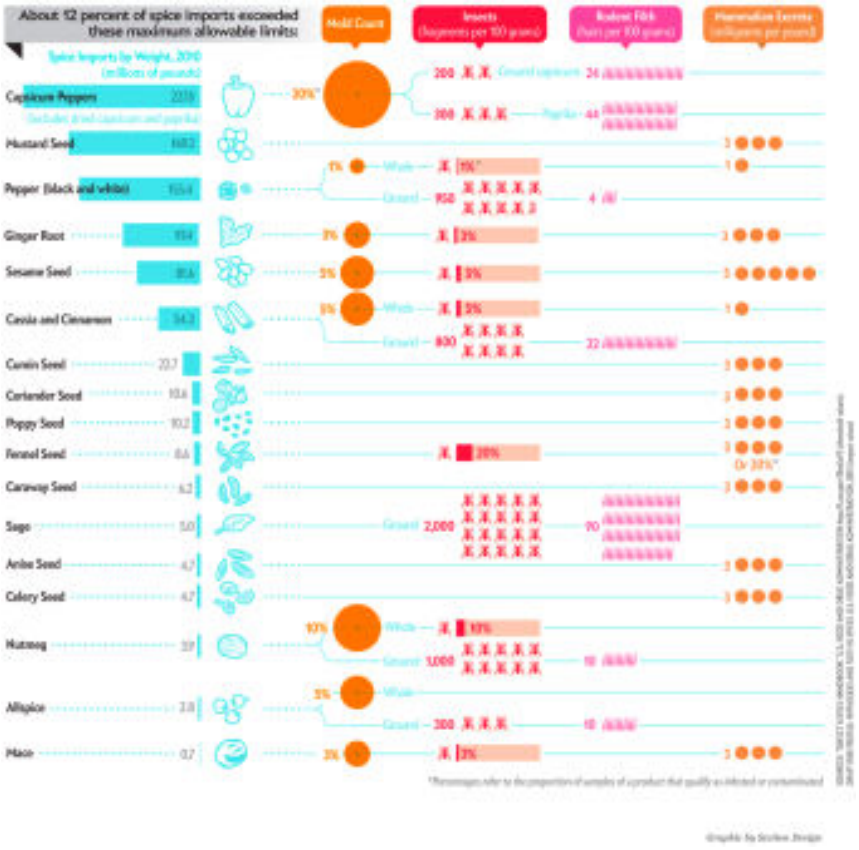
http://www.scientificamerican.com/article/spice-imports-carry-lots-of-filth

Spice Imports Carry Lots of Filth

Imported seasonings are rife with all sorts of extras

Mar 1, 2014 |By John Matson

Some spices contain ingredients you won't find in any recipes. The Food and Drug Administration recently found that spices entering the U.S. are nearly twice as likely as the average FDA-regulated foodstuff to contain Salmonella pathogens or unacceptable amounts of filth. Roughly 12 percent of spice imports, which make up the bulk of the U.S. supply, exceeded federal limits on the "maximum levels of natural or unavoidable defects," such as insect body parts and animal hair. In sufficiently small amounts, the FDA reasons, such defects "pose no inherent hazard to health."



Those limits might seem rather loose - a small, two-ounce jar of paprika must contain roughly 170 insect fragments or 25 rodent hairs to be considered adulterated. But whereas the odd instance of egregious filth involves objects large enough to be spotted by consumers, many contaminants are merely microscopic fragments, according to the FDA.

http://phys.org/news/2014-03-husband-health-attitude-loom-large.html#rssowlmlink

Husband's health and attitude loom large for happy long-term marriages

A recent study from U Chicago researchers shows that a husband's agreeable personality and good health are crucial for preventing conflict among older couples who have been together a long time.

Phys.org - A husband's agreeable personality and good health appear crucial to preventing conflict among older couples who have been together a long time, according to a study from University of Chicago researchers.

The report found that such characteristics in wives play less of a role in limiting marital conflict, perhaps because of different expectations among women and men in durable relationships.

"Wives report more conflict if their husband is in poor health," said the study's lead author, James Iveniuk, PhD candidate in the Department of Sociology. "If the wife is in poor health, there doesn't seem to be any difference in terms of the quality of the marriage for the husband."

The study, "Marital Conflict in Older Couples: Positivity, Personality, and Health," reports results from a national survey with data analyzed from 953 heterosexual couples who were married or cohabitating. The study participants ranged in age from 63 to 90 years old and the average length of their relationships was 39 years.

The survey of older adults participating in the National Social Life Health and Aging Project, funded by the National Institute on Aging, compared the characteristics of the husbands to the characteristics of their wives and vice versa based on interviews with each person in which they were asked to describe themselves.

Iveniuk and co-authors found many gender differences when they examined personality traits including openness to experience, conscientiousness, extraversion, agreeableness and anxiety. They added a new measure called "positivity," an overarching characteristic described as a person's overall desire to be seen in a positive light. "Wives whose husbands show higher levels of positivity reported less conflict. However, the wives' positivity had no association with their husbands' reports of conflict," Iveniuk said.

Co-author Linda J. Waite, Lucy Flower Professor of Urban Sociology and director of the Center on Aging at NORC, says the study's measurement of marital conflict could be summarized as, "How much does your spouse

bother you?" The clashes are not primarily about fighting or violence, but rather whether one spouse criticizes the other, makes too many demands, or generally gets on the other person's nerves.
Another finding is that men who describe themselves as neurotic or extraverts tend to have wives who complain more about the quality of the marriage. Men with self-described neurotic wives may consider worrying to be a more "gender-appropriate" role for women. Husbands reported more criticism and demands from their wives overall, but also higher levels of emotional support.
"Several previous studies have been about the implications of marital status on health," Waite says. "This research allows us to examine individual marriages and not 'married people.' We have the reports on the quality of the marriage from each person, about their own personality and their own health."
The researchers suggest that future studies might examine the question of whether low levels of conflict in marriages require not only the absence of frustrating factors, such as poor health and negative traits, but also a better balance of emotional responsibilities between husbands and wives. They say some of those differences between husbands and wives may change as researchers study younger couples entering later life as compared to the current generation of older couples who may have more conventional gender roles.
The study was published by the Journal of Marriage and Family.
More information: Iveniuk, J., Waite, L. J., Laumann, E., McClintock, M. K. and Tiedt, A. D. (2014), "Marital Conflict in Older Couples: Positivity, Personality, and Health." Journal of Marriage and Family, 76: 130–144. doi: 10.1111/jomf.12085

http://scitechdaily.com/new-study-shows-irx3-likely-fat-gene/#rssowlmlink

New Study Shows that IRX3 Is Likely the "Fat Gene"

Scientists Discover that the Obesity Associated Elements within FTO Interact with IRX3

A new study shows that the IRX3 gene controls body mass and regulates body composition, and appears to be the functional obesity gene. Mutations within the gene FTO have been implicated as the strongest genetic determinant of obesity risk in humans, but the mechanism behind this link remained unknown. Now, an international team of scientists has discovered that the obesity-associated elements within FTO interact with IRX3, a distant gene on the genome that appears to be the functional obesity gene. The FTO gene itself appears to have only a peripheral effect on obesity. The study appears online March 12 in Nature.
"Our data strongly suggest that IRX3 controls body mass and regulates body composition," said senior study author Marcelo Nobrega, PhD, associate professor of human genetics at the University of Chicago. "Any association between FTO and obesity appears due to the influence of IRX3."
Mutations to introns (noncoding portions) of the gene FTO have been widely investigated after genome-wide association studies revealed a strong link between FTO and obesity and diabetes. Yet overexpressing or deleting FTO in animal models affects whole body mass and composition, not just fat, and experiments have failed to show that these obesity-linked introns affect the function of the FTO gene itself.
Hoping to explain these observations, Nobrega and his team mapped the behavior of promoters - regions of DNA that activate gene expression - located within one million base pairs on either side of the FTO gene. In adult mice brains, where FTO was thought to affect metabolic function, they discovered that the promoter that turns on FTO did not interact with obesity-associated FTO introns.
"Instead, we found that the promoter for IRX3, a gene several hundred thousand base pairs away, did interact with these introns, as well as a large number of other elements across the vast genetic distance we studied," said co-author Jose Luis Gomez-Skarmeta, PhD, a geneticist at the Andalusian Center of Developmental Biology in Sevilla, Spain. The researchers found a similar pattern of interactions in humans after analyzing data from the ENCODE project, which they confirmed with experiments on human cells.
Using data from 153 brain samples from individuals of European ancestry, they discovered that the mutations to FTO introns that affected body weight are associated with IRX3 expression, but not FTO. Obesity-related FTO introns enhanced the expression of IRX3, functioning as regulatory elements. The FTO gene itself did not appear to play a role in this interaction. "Regulatory elements are switches that turn genes on and off. What we've found is that the switches that control IRX3 are far away from the gene and actually inside the FTO gene", says Nobrega.

IRX3 deficient mice are thin

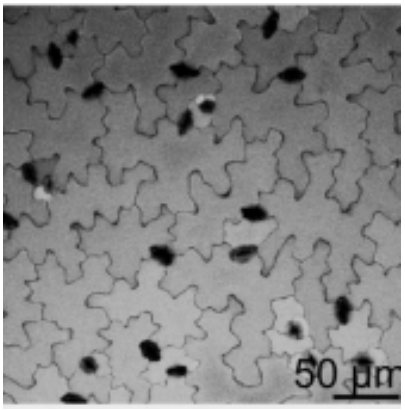
To verify the role of IRX3, the researchers engineered mice without the IRX3 gene. These mice were significantly leaner than their normal counterparts. They weighed about 30 percent less, primarily through reduced fat.
The decrease in weight gain occurred despite normal levels of food consumption and physical activity. When fed a high-fat diet, mice without IRX3 retained the same weight and fat levels as on normal diets. Normal mice fed a high-fat diet gained almost twice as much weight. Fat cells in IRX3-deficient mice were smaller, and increased levels of brown fat were observed. In addition, these mice were better able to process glucose.

"These mice are thin. They lose weight primarily through the loss of fat. But they are not runts," said co-author Chin-Chung Hui, PhD, professor of molecular genetics at the University of Toronto. "They are also completely resistant to high-fat diet-induced obesity. They have much better ability to handle glucose, and seem protected against diabetes."
The researchers also discovered that mice with altered IRX3 function in the hypothalamus, the portion of the brain known to regulate feeding behavior and energy expenditure, showed an identical pattern of leanness as mice which completely lacked IRX3. Hypothalamic function of IRX3, therefore, appears to control body mass and composition in these animals, indicating that the genetic predisposition to obesity is wired in the brain.
IRX3 codes for a protein that regulates other genes, and is present both in and outside the brain, in organs and cells such as fat cells. Nobrega and his team are currently investigating how IRX3 interacts with genes and molecules that it regulates, and hope to identify targets for the development of novel therapies against obesity and diabetes.
"IRX3 is probably a master regulator of genetic programs in the cells where it is expressed," Nobrega said. "We're interested in what its targets are and what they alter. The goal is to identify downstream targets of IRX3 that become models for drug targeting."
The study, "Obesity-associated variants within FTO form long-range functional connections with IRX3," was funded by the National Institutes of Health. Additional authors include Scott Smemo, Juan Tena, Kyoung-Han Kim, Eric Gamazon, Noboru Sakabe, Carlos Gomez-Marın, Ivy Aneas, Flavia Credidio, Debora Sobreira, Nora Wasserman, Ju Hee Lee, Vijitha Puviindran, Davis Tam, Michael Shen, Joe Eun Son, Niki Alizadeh Vakili, Hoon-Ki Sung, Silvia Naranjo, Rafael Acemel, Miguel Manzanares, Andras Nagy, Nancy Cox, Chi-Chung Hui and Jose Luis Gomez-Skarmeta.
Publication: Scott Smemo, et al., "Obesity-associated variants within FTO form long-range functional connections with IRX3," Nature, 2014; doi:10.1038/nature13138

http://www.eurekalert.org/pub_releases/2014-03/uoc--pbd031314.php#rssowlmlink

Plant biology discovery furthers scientists' understanding of plant growth and development

UC Riverside scientists discover auxin sensing and signaling complex on plant cell surface that explains why leaf epidermal cells have jigsaw puzzle-piece shapes



The lab of Zhenbiao Yang, a professor of cell biology at UC Riverside, has made a discovery that helps explain why leaf epidermal cells have jigsaw puzzle-piece shapes. **Credit: Yang Lab, UC Riverside.**

RIVERSIDE, Calif. - Auxin, a small molecule, is a plant hormone discovered by Charles Darwin about 100 years ago. Over the years that followed it became understood to be the most important and versatile plant hormone controlling nearly all aspects of plant growth and development, such as bending of shoots toward the source of light (as discovered by Darwin), formation of new leaves, flowers, and roots, growth of roots, and gravity-oriented growth. Just how a small molecule like auxin could play such a pivotal role in plants baffled plant biologists for decades.
Then, about ten years ago, an auxin sensing and signaling system was discovered in the cell's nucleus, but it could not explain all the diverse roles of auxin.
Now, plant cell biologists at the University of California, Riverside have discovered a new auxin sensing and signaling complex, one that is localized on the cell surface rather than in the cell's nucleus. The discovery provides new insights into the mode of auxin action, the researchers say.
"This is a new milestone in auxin biology and will ignite interest in the field," said Zhenbiao Yang, a professor of cell biology in the Department of Botany and Plant Sciences, and the leader of the research project. "Our findings conclusively demonstrate the existence of an extracellular auxin sensing system in plants, which had long been proposed but remained elusive. Further, we have uncovered the decades-long mystery of how ABP1, an auxin-binding protein, works to control plant developmental processes."
ABP1 was identified more than 40 years ago, but its role was hotly debated among plant biologists because its mode of action remained unclear - until the recent discovery by Yang's team.
The team also showed that the cell surface auxin sensing system involves "transmembrane receptor kinases" (TMKs) - enzymes widespread throughout eukaryotes that typically act as cell surface sensors for extracellular stimuli and translate them into intracellular responses.
"This breakthrough discovery of the cell surface ABP1/TMK auxin sensing system dramatically elevates the level of our understanding of how auxin plays diverse roles," said Natasha Raikhel, a distinguished professor of plant cell biology at UC Riverside, who was not involved in the research. "This signaling mechanism now

serves as a paradigm for elucidating the molecular mechanisms underlying various auxin-modulated developmental processes and patterns. In addition to their major impact on the field of plant development and morphogenesis and plant signal transduction, Yang's discoveries also provide novel means of engineering plants with desired morphological traits and growth patterns."
Study results appear in the Feb. 28 issue of Science.
Yang's lab has been studying molecular mechanisms for the formation of the jigsaw puzzle-piece shape of pavement cells in leaf epidermis of the Arabidopsis plant, a small flowering plant widely used in plant biology laboratories as a model organism. It is the interlocking feature of these cells that provides the required physical strength and integrity for flat, thin leaves.
In previous work, the lab found that auxin activated the formation of the puzzle piece shape through ABP1 and ABP1-dependent activation of "ROP GTPases," which are pivotal regulatory proteins that act as a molecular switch in gating incoming signals from the cell surface. It was unclear, however, whether ABP1 was a cell surface auxin receptor. Also, just how it led to the activation of ROP GTPases remained unknown.
"But now we have identified a family of TMKs that physically and functionally interact with ABP1 to perceive and transduce auxin signal at the cell surface," Yang said. "We show that ABP1 and TMKs form a new auxin sensing complex at the cell surface and that TMKs transmit extracellular auxin signals to ROP GTPases located just inside of the cell membrane. This novel auxin sensing and signaling system makes possible the formation of the jigsaw shape of leaf epidermal cells and many other auxin-mediated processes."
Next, Yang's team plans to investigate whether there are additional components in the cell surface auxin sensing complex, what specific pathways are regulated by the cell surface auxin sensor, and why plants need both the nuclear and extracellular auxin sensors.
Yang was joined in the study by researchers at UCR; the National University of Singapore; the Chinese Academy of Sciences; the University of Wisconsin; Ghent University, Belgium; the Institute of Science and Technology, Austria; the University of North Carolina, Chapel Hill; and Masaryk University, the Czech Republic.
The research was supported by a grant to Yang from the National Institute of General Medical Sciences.

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Study suggests potential association between soy formula and seizures in children with autism

A University of Wisconsin-Madison researcher has detected a higher rate of seizures among children with autism who were fed infant formula containing soy protein rather than milk protein.

David Tenenbaum, 608-265-8549, djtenenb@wisc.edu

MADISON - The study found excess seizures among girls and in the total sample of 1,949 children. The soy-seizure link reached borderline significance among boys, who comprised 87 percent of the children described in the database under study. Seizures - caused by uncontrolled electrical currents in the brain - occur in many neurological disorders including epilepsy, Alzheimer's disease, Down syndrome and autism. About 25 percent of infant formula sold in the United States is based on soy protein.
Study author Cara Westmark, a senior scientist in the UW-Madison department of neurology, says her investigation was sparked by mouse studies of a drug that, it was hoped, would inhibit seizures by blocking signals that excite nerve cells. "It was pure serendipity that we happened to look at soy," she says.
To simplify the mouse study, she replaced the standard lab chow, which had a variable composition, with a diet containing purified ingredients. Unexpectedly, that diet reduced the rate of seizures by 50 percent compared to standard chow, Westmark says.
"We were intrigued that a dietary alteration was as effective as many medicines in reducing seizure incidence and wanted to pursue that finding," she says. "We found that the main difference between the diets was the protein source. The standard diet was soy-based, while the purified diet was casein, or dairy, based."
The mechanism of action is unknown, but Westmark points to the high level of plant-derived estrogens in soy products as a possible cause of the excess seizures.
People eat a lot of soy products, and when Westmark began to look for the effect in people, she decided to focus on infants, who may consume nothing but formula. Knowing that people with autism have a higher rate of seizures, Westmark turned to a database from the Simons Foundation Autism Research Initiative.
And that led to the new study, published today in the journal PLOS ONE, which showed that children with autism who were fed soy formula had 2.6 times as many febrile seizures as the children fed non-soy formula in the database. That means 4.2 percent of the soy group had a seizure associated with a fever, compared to 1.6 percent of the others.
To put it another way, the vast majority of both groups did not have seizures. "This is not saying that all autistic children who eat soy-based formula are going to develop seizures," says Westmark.

And yet that increase is worrying, Westmark says. "The prevalence of autism is increasing and currently affects one American child in 88. Soy is a widespread ingredient in many food products and 25 percent of infant formulas are soy based, so this is something that needs to be studied. If the child is lactose intolerant, there are alternatives that a pediatrician can recommend."
The study, Westmark says, was not the kind of randomized clinical trial that can prove causation. "We can say that we have a potential association between the use of soy-based formula and seizures in autistic children; we can't say that this is cause and effect. We were fortunate to be granted access to the SFARI database, but it was not set up to answer the questions we were asking."
Although it's possible that seizures could also be more frequent among children who consume soy formula but do not have a developmental disability, "There is no data available at this time to support that," Westmark says. Still, the study raises concerns, since seizures cause neurological damage and repeated seizures - epilepsy - can develop into a lifelong problem. "This needs to be studied more thoroughly," Westmark says. "If soy formula is lowering the threshold for seizures or increasing the incidence of seizures, we need to know that."

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Stroke survivors may lose month of healthy life for 15-minute delay in treatment

American Heart Association Rapid Access Journal Report

Every 15-minute delay in delivering a clot-busting drug after stroke robs survivors of about a month of disability-free life, according to a new study in the American Heart Association journal Stroke. On the other hand, speeding treatment by just one minute means another 1.8 days of healthy life, researchers said.
"'Save a minute; save a day' is the message from our study, which examined how even small reductions in treatment delays might benefit patients measurably in the long run," said Atte Meretoja, M.D., Ph.D., M.Sc., lead author of the study and associate professor of neurology at the University of Melbourne in Australia.
The clot-busting drug tissue plasminogen activator (tPA) to treat ischemic stroke, should be given within 4.5 hours of symptom onset. However, the sooner it's given, the better the outcome.
"Clot-busting treatment works equally well, irrespective of race, ethnicity or gender," Meretoja said. "Speedy restoration of blood flow to the brain is crucial for brain cell survival everywhere."
The world's fastest stroke services in Helsinki, Finland and Melbourne, Australia, take an average 20 minutes from hospital arrival to start of treatment, he said. Most American, Australian and European centers take 70-80 minutes. "In this study, we wanted to quantify the importance of speed in the hope that concrete easy-to-relate-to figures will inspire medical services to measure and improve their game for the benefit of our stroke patients," Meretoja said.
Meretoja and colleagues used evidence from the combined major clot-busting trials reported to date. They applied those findings to 2,258 consecutive stroke patients from Australia and Finland to calculate what the patient outcomes would have been if they had been treated faster or slower.
They found:

For every minute the treatment could be delivered faster, patients gained an average 1.8 days of extra healthy life.
Although all patients benefited from faster treatment, younger patients with longer life expectancies gained a little more than older patients.

"In stroke treatment, every minute saved gives patients days of healthy life," Meretoja said. "Patients should never wait a single minute for stroke signs, such as face droop, arm weakness or speech disturbance, to go away. They should call for help immediately. Additionally, most emergency medical services and hospitals have the ability to reduce response and treatment delays significantly, and we have described how to do this."
The study's findings are generalizable to the U.S. population, he said. F.A.S.T. is an easy way to remember the sudden signs of stroke. When you spot the signs, call 9-1-1 for help right away.
Co-authors are Mahsa Keshtkaran, M.Sc., Jeffrey L Saver, M.D.; Turgut Tatlisumak, M.D.; Mark W Parsons, M.D.; Markku Kaste, M.D.; Stephen M Davis, M.D.; Geoffrey A Donnan, M.D.; and Leonid Churilov, Ph.D. Author disclosures are on the manuscript.
The Australian National Health and Medical Research Council funded the study.

http://www.eurekalert.org/pub_releases/2014-03/cp-hat030614.php#rssowlmlink

Humans' ability to digest milk stems from the advent of cattle domestication in Africa

Study published in advance of upcoming Cell Symposium on the Evolution of Modern Humans in Sitges, Spain Mar. 16-18

Most people lose the ability to digest the milk sugar lactose after weaning, but some populations retain high levels of an enzyme called lactase, which allows them to break down lactose in adulthood. In a study published March 13th in the American Journal of Human Genetics, researchers identified genetic factors associated with lactase persistence in African populations and found that this trait became more prevalent in recent history in

conjunction with the introduction and spread of cattle domestication in Africa. The findings provide strong evidence that lactase persistence evolved in human populations as a dietary adaptation.
"To date, there has never been a large-scale study of lactase persistence that included such a large set of geographically and ethnically diverse populations," says study author Sarah Tishkoff of the University of Pennsylvania. "Our study sheds light on both the genetic basis and evolutionary history of a biologically relevant trait in humans and the origins of pastoralism in Africa."
Individuals with northern European ancestry, as well as African, Arabian, and Central Asian pastoral populations with a tradition of fresh-milk production and consumption, retain high levels of lactase into adulthood. DNA sequence variations linked to lactase persistence have been identified in European populations, but until recently, little was known about genetic factors associated with this trait in African pastoral populations.
In the new study, Tishkoff, along with Alessia Ranciaro, also of the University of Pennsylvania, and collaborators around the globe sought to address this gap in knowledge. The researchers performed a large-scale sequencing analysis of all of the genomic regions thought to influence the activity of the lactase-encoding LCT gene in 819 individuals from 63 diverse African populations and in 154 non-Africans from nine different populations in Europe, the Middle East, and Central and East Asia. They identified several single-nucleotide variants - DNA sequence variations affecting a single nucleotide - associated with lactase persistence. Moreover, their genetic analysis revealed strong evidence of recent positive selection affecting several variants associated with this trait in African populations, most likely in response to the cultural development of pastoralism. The origins of these variants coincided with the introduction of cattle domestication in Africa about 10,000 years ago and its subsequent spread through pastoral migrations.

http://www.eurekalert.org/pub_releases/2014-03/tiof-dcb031314.php#rssowlmlink

DNA can be damaged by very low-energy radiation

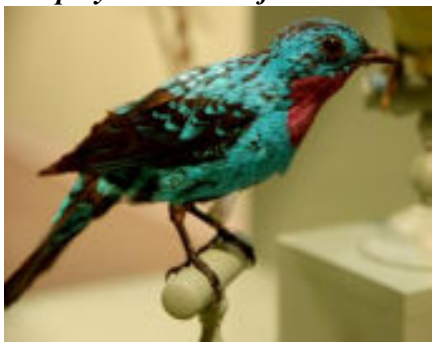
How safe are 'eye-safe' lasers?

"Very low-energy radiation also damages DNA: how safe are "eye-safe" lasers?"
Damage to DNA by high energy radiation constitutes the most lethal damage occurring at the cellular level. Surprisingly, very low-energy interactions - with OH radicals, for instance - can also induce DNA damage, including double strand breaks. It is known that single strand breaks in the DNA backbone are amenable to repair but most double strand breaks are irreparable. The propensity with which slow OH radicals damage DNA depends on their rotational energy: rotationally "hot" OH is more proficient in causing double breaks. These novel findings are from experiments conducted on DNA in a physiological environment. Intense femtosecond laser pulses are propagated through water (in which DNA plasmids are suspended), creating plasma channels within water, resulting in generation, in situ, of electrons and OH radicals. It is shown that use of long laser wavelength light (1350 nm and 2200 nm) ensures only OH-induced damage to DNA is accessed.
It is noteworthy that industry presently characterizes as "eye-safe" lasers that emit at wavelengths longer than 1300 nm. But it is such wavelengths that are proficient at inducing damage to DNA: how safe is "eye-safe" when DNA in the eye can be readily damaged?

http://www.eurekalert.org/pub_releases/2014-03/hu-biw031414.php#rssowlmlink

Brighter inks, without pigment

Nanostructured capsules could bring about paints and electronic displays that never fade



Cambridge, Mass. - Among the taxidermal specimens in Harvard's Museum of Comparative Zoology, past centuries-old fur coats, arises a flicker of brilliant blue. This is the spangled cotinga. Surprisingly, the cotinga is about as old as everything in the room, but its color is still as dazzling as the day it was brought to the museum. The cotinga—or rather its feathers—achieve this effect through structural color.
Unlike color that we usually think of, which arises from paints and dyes absorbing certain wavelengths of light and reflecting the remainder, structural color is created when an object's very nanostructure amplifies a specific wavelength. Cells in the cotinga's feathers have a series of tiny pores spaced just right so that blues (and not much of anything else) are reflected back to our eyes.

This is a spangled cotinga, formerly on display at the Harvard Museum of Natural History. **Credit: Photo courtesy of Curious Expeditions/Flickr under Creative Commons license CC BY-NC-SA 2.0.**

Because of this, if the feathers were thoroughly pulverized, the formation of pores and therefore the color would be lost. It also means that the same color could be produced from an entirely different material, if one could recreate the same pattern made by the feathers' pores.

Researchers led by Vinothan N. Manoharan at the Harvard School of Engineering and Applied Sciences want to recreate this effect, giving man-made materials structural color. Producing structural color is not easy, though; it often requires a material's molecules to be in a very specific crystalline pattern, like the natural structure of an opal, which reflects a wide array of colors. But the pores on the cotinga's feathers lack a regular order and are therefore a prime target for imitation.

Manoharan's lab has devised a system where microcapsules are filled with a disordered solution of even smaller particles suspended in water. When the microcapsule is partly dried out, it shrinks, bringing the particles closer and closer together. Eventually the average distance between all the particles will give rise to a specific reflected color from the capsule. Shrink the capsule a bit more, and they become another color, and then another. "There's an average distance between particles, even though there is no ordering in the particles. It's that average distance that is important in determining the color," says Manoharan, Gordon McKay Professor of Chemical Engineering and Professor of Physics at Harvard. The findings have been published in the journal Angewandte Chemie.

The current project expands on research conducted at Yale University in 2009, which aimed to mimic the cotinga's hue and showed that dried aggregates of solid particles could create blues. Jin-Gyu Park was a postdoctoral researcher there and is now a research associate in Manoharan's group at Harvard SEAS, which specializes in the physics of colloidal suspensions. With Park as lead author, the new paper demonstrates the production of colors across the spectrum, and the new encapsulation system.

The tunable color capsules present interesting technological opportunities, says Manoharan. For example, a whole spectrum of new paints might be created using suspended capsules. "Right now, the red dye carmine comes from an insect called a cochineal," says Manoharan. "People would like to move away from that because it's very labor-intensive, and getting that color involves harvesting a lot of insects."

A microcapsule shrinks as it dries, arriving at its final color. **Image courtesy of Jin-Gyu Park, Harvard School of Engineering and Applied Sciences.**

Rather than harvesting from nature or preparing specialty chemicals, one for each color, these capsules could provide a universal and direct path to any desired color. The capsules might also offer a safety advantage. The reason for using natural dyes like carmine is that many synthetic dyes are toxic. The new color capsules can be made with particles of almost any material in the right structural formation, so toxicity can be easily avoided.

Most compelling of all, however, is that some structural colors found in nature can last indefinitely as long as the colored object remains intact. "Most color you get in paints, coatings or cosmetics, even, comes from the selective absorption and reflection of light. What that means is that the material is absorbing some energy, and that means that over time, the material will fade," says Manoharan.

The sun's energy pummels the molecules in conventional pigments. Eventually, the molecules simply deteriorate and no longer absorb the colors they used to, leading to sun bleaching. Manoharan's group is currently testing their innovation to see if it can create an effectively ageless color.

Electronic display technology—for example, e-readers—might also benefit from this advance. The microcapsules could be used in displays that create pixels with colored particles rather than LEDs, liquid crystals, or black-and-white "electronic ink." "We think it could be possible to create a full-color display that won't fade over time," says Manoharan. "The dream is that you could have a piece of flexible plastic that you can put graphics on in full color and read in bright sunlight."

The Harvard Office of Technology Development has filed a provisional patent and is working with Manoharan's lab to pursue the commercialization of the color capsule technology.

Manoharan's and Park's coauthors were Sofia Magkiriadou, a Ph.D. student in physics at the Harvard Graduate School of Arts and Sciences; Shin-Hyun Kim and Tae Min Choi at the Korea Advanced Institute of Science and Technology; and Young-Seok Kim at Korea Electronics Technology Institute.

This research was supported by an International Collaboration grant from the Ministry of Trade, Industry & Energy of Korea, and by the Harvard Materials Research Science and Engineering Center through the U.S. National Science Foundation (NSF). The work was performed in part at the NSF-supported Center for Nanoscale Systems at Harvard University.

http://www.wired.com/wiredscience/2014/03/dead-tourists-and-a-dangerous-pesticide/#rssowlmlink

Dead Tourists and a Dangerous Pesticide

Some four years ago, a family in the small city of Layton, located in northern Utah, wanted to get rid of the lawn-destroying voles living in their yard.

By Deborah Blum

They called a local pest control company. And the applicator - as the resulting criminal investigation revealed - 0 took a total warfare approach, seeding the lawn with more than a pound of pellets containing the fumigant aluminum phosphide. Within a few days, their two youngest daughters - one four years old, one just over a year

in age — were dead. The tidy little home seemed suddenly so dangerous that the National Guard was called in to do the toxicity readings. They found — perhaps not surprisingly — dismaying levels of phosphine gas which had been released by the pellets as they interacted with moisture in the air.

800px-Aluminum Phosphide **(Wikimedia Commons)**

Phosphine gas is notoriously lethal (enough so that it was featured recently in a murderous episode of Breaking Bad). The pure gas is colorless and odorless so it carries no warning sign. It's a fast, systematic, and corrosive killer; it "denatures" and breaks down a range of enzymes and proteins inside the body, including the ones responsible for moving oxygen through the body, and severely damages the heart. And, as a follow up investigation noted, has no known antidote.

Within a few months after the Utah deaths, the U.S. Environmental Protection Agency tightened the restrictions on the use of aluminum phosphide. The longstanding buffer zone of 15 feet from a residential building was expanded to a far more cautious distance of 100 feet. Only professional operators could buy the compound and they had to follow careful procedures to use it (in Canada, it takes six months to be certified in its use).

People who admired its low-cost efficiency — aluminum phosphide came into use in the 1950s and it is both cheap and destructive to pests from from voles to bedbugs — protested the restrictions, insisting that the pesticide was getting a bad rap. But the agency didn't budge. "Phosphine fumigants are poisons and must be kept away from where our children live," one administrator said flatly.

No argument from me. The chemistry of aluminum phosphide is so potent that studies show that people who accidentally inhale dust from the pellets, or swallow some of the material, can produce phosphine gas internally as the compound reacts with moisture in the body or even stomach acids. And it's this rather appalling picture — and the issue of careful regulation — that leads us now to a still mysterious series of tourist deaths in Southeast Asia.

I first wrote about these deaths in 2012, after two young sisters from Quebec died in their hotel on Thailand's resort island of Ko Phi Phi Don. What caught my attention first was the improbable list of possible causes offered by Thai authorities, everything from poisonous mushrooms to cocktails laced with the mosquito repellent DEET. It rapidly became obvious they were among a surprising number of young women who had suffered undiagnosed poisoning deaths in Southeast Asia, some in the Phi Phi islands, others elsewhere in Thailand, and still others in Vietnam. My emphasis was on the unsolved nature of those deaths and the sorrow and frustration of their families.

Now a team of investigative journalists from Canada have published a report suggesting that the young sisters — Audrey and Noémi Bélanger — appear to have been killed by aluminum phosphide/phosphine gas exposure. The experts they consulted say the bodies showed all the signs of this kind of acute poisoning, including bluing of the fingernails and toenails, which is a classic symptom of the kind of rapid oxygen-deprivation produced by this poison. The report, which also appears on the Canadian Broadcasting Company's Fifth Estate program, cites evidence that some of the other travelers, such as a Norwegian woman who also died in the Phi Phi Islands, showed similar symptoms.

Interestingly enough I heard recently from a source in Thailand that aluminum phosphide is also suspected in the Vietnam deaths. In both cases, the theory is that the pesticide was used in hotels to kill off bedbugs, which are resistant to many other toxins. Thai authorities have responded that this pesticide is not allowed or used in hotels but the Canadian reporters heard otherwise from some of the hotel operators. In fact, aluminum phosphide poisoning is a known problem across much of Asia and the Middle East. The compound is sold widely as both a grain fumigant and as a handy pesticide. It's not a surprise that it turns up far too often as a cause of death, accidental, suicidal, and occasionally homicidal. One study of poisonings in northwest India, for instance, cited it was the number one cause of poisoning deaths in that region.

And if you go to this Wikipedia entry on aluminum phosphide poisoning, you will find that almost all the citations derive from research done in India and other Asian countries. And there are more beyond that, such as this one from Iran and this one, interestingly enough, from a scientist from Thailand. Public health authorities in Saudi Arabia recently collaborated on a dark-themed film about the aluminum phosphide/phosphine gas problem there, hoping that public awareness would reduce the risks. The YouTube film, "Phosphine," has racked up more than 3.5 million views.

"Public awareness must increase in the community and society must not wait until the authorities arrive, they must act quickly in order to save their lives," a Saudi epidemiologist tells the viewers in the film. My take on that is just a little different. First, the authorities need — and this is equally true in the United States — to do a

better job in monitoring — and when needed, yes, restricting — our use of very poisonous compounds. It's unreasonable to expect everyone to have awareness of the full range of toxic chemical compounds.
And, yes, we also should do a better job of raising community awareness, of helping people figure out what chemical compounds are memorably dangerous. We need to teach everyone kid-glove respect for the compounds that matter. So that when someone on a lovely little resort island suggests using aluminum phosphide to fumigate the rooms, or when a pest exterminator decides to go for an overdose, there's always someone to remember that this is a very, very bad idea.
And then the sisters from Canada get their chance to dance on the beach before they go home. And the little girls in Utah get their chance to grow up.

http://bit.ly/1d6aesB

Echoes of the big bang? South pole telescope detects 'primordial gravitational waves'

There is intense speculation among cosmologists that a US team is on the verge of confirming they have detected "primordial gravitational waves" – an echo of the big bang in which the universe came into existence 14bn years ago.

By Stuart Clark, The Guardian

Rumours have been rife in the physics community about an announcement due on Monday from the Harvard-Smithsonian Center for Astrophysics. If there is evidence for gravitational waves, it would be a landmark discovery that would change the face of cosmology and particle physics.
Gravitational waves are the last untested prediction of Albert Einstein's General Theory of Relativity. They are minuscule ripples in the fabric of the universe that carry energy across space, somewhat similar to waves crossing an ocean. Convincing evidence of their discovery would almost certainly lead to a Nobel prize.
"If they do announce primordial gravitational waves on Monday, I will take a huge amount of convincing," said Hiranya Peiris, a cosmologist from University College London. "But if they do have a robust detection … Jesus, wow! I'll be taking next week off."
The discovery of gravitational waves from the big bang would offer scientists their first glimpse of how the universe was born. The signal is rumoured to have been found by a specialised telescope called Bicep (Background Imaging of Cosmic Extragalactic Polarization) at the south pole. It scans the sky at microwave frequencies, where it picks up the fossil energy from the big bang.
For decades, cosmologists have thought that the signature of primordial gravitational waves could be imprinted on this radiation. "It's been called the Holy Grail of cosmology," says Peiris, "It would be a real major, major, major discovery."
Martin Hendry at the University of Glasgow works on several projects designed to directly detect gravitational waves. "If Bicep have made a detection," he says, "it's clear that this new window on the universe is really opening up."
According to theory, the primordial gravitational waves will tell us about the first, infinitessimal moment of the universe's history. Cosmologists believe that 10-34 seconds after the big bang (a decimal point followed by 33 zeros and a one) the universe was driven to expand hugely. Known as inflation, the theory was dreamed up to explain why the universe is so remarkably uniform from place to place. But it has always lacked some credibility because no one can find a convincing physical explanation for why it happened.
Now researchers may be forced to redouble their efforts. "The primordial gravitational waves have long been thought to be the smoking gun of inflation. It's as close to a proof of that theory as you are going to get," says Peiris. This is because cosmologists believe only inflation can amplify the primordial gravitational waves into a detectable signal.
"If a detection has been made, it is extraordinarily exciting. This is the real big tick-box that we have been waiting for. It will tell us something incredibly fundamental about what was happening when the universe was 10-34 seconds old," said Prof Andrew Jaffe, a cosmologist from Imperial College, London, who works on another telescope involved in the search called Polarbear.
But extracting that signal is fearsomely tricky. The microwaves that carry it must cross the whole universe before arriving at Earth. During the journey, they are distorted by intervening clusters of galaxies.
"It's like looking at the universe through bubbled glass," said Duncan Hanson of McGill University in Montreal, Canada, who works on the South Pole Telescope, a rival that sits next to Bicep.
He says that the distortion must be removed in a convincing way before anyone can claim to have made the detection. The prize for doing that, however, would be the pinnacle of a scientific career. "The Nobel Prize would be for the detection of the primordial gravitational waves," said Hanson.
"Yeah, I would give them a prize," agreed Jaffe.
The announcement will be made on Monday at 4pm GMT.

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Honey is a new approach to fighting antibiotic resistance: How sweet it is!

Honey, that delectable condiment for breads and fruits, could be one sweet solution to the serious, ever-growing problem of bacterial resistance to antibiotics, researchers said here today.

DALLAS - Medical professionals sometimes use honey successfully as a topical dressing, but it could play a larger role in fighting infections, the researchers predicted. Their study was part of the 247th National Meeting of the American Chemical Society (ACS), the world's largest scientific society.

The meeting, attended by thousands of scientists, features more than 10,000 reports on new advances in science and other topics. It is being held at the Dallas Convention Center and area hotels through Thursday.

"The unique property of honey lies in its ability to fight infection on multiple levels, making it more difficult for bacteria to develop resistance," said study leader Susan M. Meschwitz, Ph.D. That is, it uses a combination of weapons, including hydrogen peroxide, acidity, osmotic effect, high sugar concentration and polyphenols — all of which actively kill bacterial cells, she explained. The osmotic effect, which is the result of the high sugar concentration in honey, draws water from the bacterial cells, dehydrating and killing them.

In addition, several studies have shown that honey inhibits the formation of biofilms, or communities of slimy disease-causing bacteria, she said. "Honey may also disrupt quorum sensing, which weakens bacterial virulence, rendering the bacteria more susceptible to conventional antibiotics," Meschwitz said. Quorum sensing is the way bacteria communicate with one another, and may be involved in the formation of biofilms. In certain bacteria, this communication system also controls the release of toxins, which affects the bacteria's pathogenicity, or their ability to cause disease.

Meschwitz, who is with Salve Regina University in Newport, R.I., said another advantage of honey is that unlike conventional antibiotics, it doesn't target the essential growth processes of bacteria. The problem with this type of targeting, which is the basis of conventional antibiotics, is that it results in the bacteria building up resistance to the drugs.

Honey is effective because it is filled with healthful polyphenols, or antioxidants, she said. These include the phenolic acids, caffeic acid, p-coumaric acid and ellagic acid, as well as many flavonoids. "Several studies have demonstrated a correlation between the non-peroxide antimicrobial and antioxidant activities of honey and the presence of honey phenolics," she added. A large number of laboratory and limited clinical studies have confirmed the broad-spectrum antibacterial, antifungal and antiviral properties of honey, according to Meschwitz.

She said that her team also is finding that honey has antioxidant properties and is an effective antibacterial. "We have run standard antioxidant tests on honey to measure the level of antioxidant activity," she explained. "We have separated and identified the various antioxidant polyphenol compounds. In our antibacterial studies, we have been testing honey's activity against E. coli, Staphylococcus aureus and Pseudomonas aeruginosa, among others."

Bioactive constituents in honey: Antimicrobial and antibiofilm effects

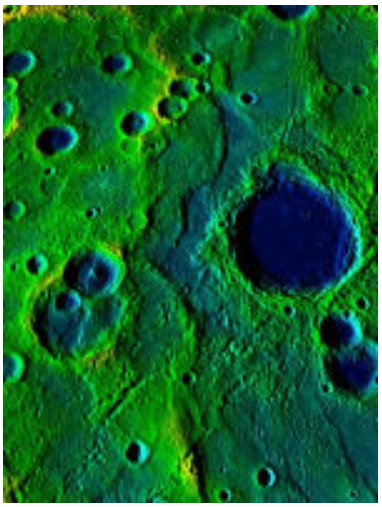
Abstract

Honey is the oldest natural sweetener and has been known for its medicinal uses since ancient times. A large number of in vitro and limited clinical studies have confirmed the broad-spectrum antimicrobial (antibacterial, antifungal, and antiviral) properties of honey, which are mainly attributed to a combination of hydrogen peroxide, acidity, osmotic effect, high sugar concentration, and antioxidants. However, the precise mode of antibacterial action is only just beginning to be understood. Several studies have demonstrated a correlation between the non-peroxide antimicrobial and antioxidant activities of honey and the presence of honey phenolics. Although the specific polyphenols found in honey vary with nectar source and region, the most common phenolics found in honey include the phenolic acids caffeic acid, p-coumaric acid, and ellagic acid and the flavonoids quercetin, apigenin, galangin, pinocembrin, kaempferol, luteolin, and chrysin. The antimicrobial properties of honey might only represent one facet of its anti-infective potential and may involve other mechanisms. Recently, the effect of honey on the inhibition and prevention of bacterial biofilm formation and the interruption of bacterial cell-cell communication systems has been investigated but the constituents responsible for this effect have not been determined. In order to understand the unusual ability that honey has to fight infections, we have investigated additional constituents of honey that may provide alternative modes of antibacterial action.

http://www.eurekalert.org/pub_releases/2014-03/ci-mcm031314.php#rssowlmlink

Mercury's contraction much greater than thought

New global imaging and topographic data from MESSENGER* show that the innermost planet has contracted far more than previous estimates.



Washington, D.C.- The results are based on a global study of more than 5,900 geological landforms, such as curving cliff-like scarps and wrinkle ridges, that have resulted from the planet's contraction as Mercury cooled. The findings, published online March 16, 2014, in Nature Geoscience, are key to understanding the planet's thermal, tectonic, and volcanic history, and the structure of its unusually large metallic core.

Unlike Earth, with its numerous tectonic plates, Mercury has a single rigid, top rocky layer. Prior to the MESSENGER mission only about 45% of Mercury's surface had been imaged by a spacecraft. Old estimates, based on this non-global coverage, suggested that the planet had contracted radially by about ½ to 2 miles (0.8 to 3 kilometers) substantially less than that indicated by models of the planet's thermal history. Those models predicted a radial contraction of about 3 to 6 miles (5 to 10 kilometers) starting from the late heavy bombardment of the Solar System, which ended about 3.8 billion years ago.

This image shows a long collection of ridges and scarps on the planet Mercury called a fold-and-thrust belt. The belt stretches over 336 miles (540 kilometers). The colors correspond to elevation—yellow-green is high and blue is low.

Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

The new results, which are based on the first comprehensive survey of the planet's surface, show that Mercury contracted radially by as much as 4.4 miles (7 kilometers)—substantially more than the old estimates, but in agreement with the thermal models. Mercury's modern radius is 1,516 miles (2,440 kilometers).

"These new results resolved a decades-old paradox between thermal history models and estimates of Mercury's contraction," remarked lead author of the study, Paul Byrne, a planetary geologist and MESSENGER visiting investigator at Carnegie's Department of Terrestrial Magnetism. "Now the history of heat production and loss and global contraction are consistent. Interestingly, our findings are also reminiscent of now-obsolete models for how large-scale geological deformation occurred on Earth when the scientific community thought that the Earth only had one tectonic plate. Those models were developed to explain mountain building and tectonic activity in the nineteenth century, before plate tectonics theory."

Byrne and his coauthors identified a much greater number and variety of geological structures on the planet than had been recognized in previous research. They identified 5,934 ridges and scarps attributed to global contraction, which ranged from 5 to 560 miles (9 to 900 kilometers) in length.

The researchers used two complementary techniques to estimate the contraction from their global survey of structures. Although the two estimates of radius change differed by 0.6 to 1 mile (1 to 1.6 kilometers), both were substantially greater than old estimates.

"I became interested in the thermal evolution of Mercury's interior when the Mariner 10 spacecraft sent back images of the planet's great scarps in 1974–75, but the thermal history models predicted much more global contraction than the geologists inferred from the scarps then observed, even correcting for the fact that Mariner 10 imaged less than half of Mercury's surface," noted Sean Solomon, principal investigator of the mission, former director of Carnegie's Department of Terrestrial Magnetism, and current director of the Lamont-Doherty Earth Observatory at Columbia University. "This discrepancy between theory and observation, a major puzzle for four decades, has finally been resolved. It is wonderfully affirming to see that our theoretical understanding is at last matched by geological evidence."

http://bit.ly/1iUd3PS

Alzheimer's molecules may have powered early life

Amyloid plaques, a hallmark of diseases like Alzheimer's, are bad news for humans – but they could have been drivers of the earliest life on Earth.

18:00 16 March 2014 by Colin Barras

A new study shows that these amyloid clusters can behave as catalysts, backing a theory that they helped trigger the reactions that sustain life, long before modern enzymes appeared.

Without enzymes, life's metabolic reactions simply wouldn't occur. But making enzymes from scratch isn't easy. They are normally large, complicated proteins folded into a specific three-dimensional shape. It's difficult to see how these large proteins could have popped out of the primordial soup fully formed. Even if they did, nature faced another problem. There are 20 naturally occurring amino acids, which are the building blocks for all

proteins, and each enzyme is made up of a unique sequence of at least 100 amino acids. This means there is a mind-bogglingly vast number – 20100 – of possible enzymes, each with a different amino acid sequence and a slightly different 3D structure.
But very few of these 3D structures will work effectively as enzymes because they have to be an exact fit for the substrate they react with – in the same way that a lock can only be opened by one particular key. Even with millions of years to work at the problem, says Ivan Korendovych at Syracuse University in New York, nature would have struggled to build and test all possible enzyme molecules to identify the relatively few that catalyse today's metabolic reactions.

Primordial peptides

Korendovych's latest research points to amyloids as a potential solution. Unlike enzymes, amyloids contain very short chains of amino acids, called peptides. "You can imagine that these short peptides could form in primordial soup," says Korendovych. Amyloids are generated spontaneously when you mix a bunch of these short peptides together. Each amyloid is a complicated 3D structure, not too different in appearance from an enzyme. But can they behave like enzymes too?
To find out, Korendovych and colleagues designed seven very simple peptides, each one made of seven amino acids. They then allowed molecules of each type of peptide to spontaneously clump together to form an amyloid, adding zinc ions to help the process along, because metals like zinc can have catalytic properties. Four of the seven peptides formed amyloids that could catalyse the hydrolysis of organic molecules called esters – a reaction that some enzymes catalyse too. "No one has shown before that peptides this short can self-assemble to become enzyme-like catalysts," says Korendovych.
The result suggests that amyloids could have resolved nature's early enzyme problem – and not just because short peptides would have formed relatively easily in the primordial soup.
"Let's assume all 20 naturally occurring amino acids existed back then," says Korendovych. "If your peptides each contain seven amino acids, then that's 207 possible peptides – that's a much smaller library than the 20100 possibilities if your peptides each contain 100 amino acids."

Catalytic clusters

Once nature had made all or even part of this relatively small library of short peptides, various combinations of them would naturally cluster together to form a vast number of amyloids, each with a different 3D structure. At a later date, the amyloids that worked as catalysts could have acted as a sort of blueprint that nature could use to build the large enzyme molecules that exist today – perhaps, says Korendovych, because the large enzyme molecules are fundamentally better suited for catalysing reactions than amyloids fashioned from short peptides.
"It's an outstanding paper," says Ehud Gazit at Tel Aviv University in Israel, who helped develop the short peptide theory for the origin of enzymes, but was not involved in this paper. Gazit says the idea began with the observation that some amyloid structures formed by short peptides have basic catalytic properties. "This study brings it to a new level by demonstrating catalytic properties comparable to enzymes," he says.
James Milner-White at the University of Glasgow, UK, agrees that the amyloid theory has legs, but says the new study could have provided a more convincing demonstration. "It's certainly an interesting finding, but they have not chosen the right metal ion here – all of the evidence suggests that in the early oceans iron and nickel were high in concentration but zinc was low." He says the theory would be even more convincing if Korendovych's team can get the same results using iron or nickel.
Journal reference: Nature Chemistry, DOI: 10.1038/nchem.1894

http://www.eurekalert.org/pub_releases/2014-03/acs-scc031214.php#rssowlmlink

Study: Colon cancer incidence rates decreasing steeply in older Americans

Growing use of colonoscopy credited for drop

WASHINGTON, D.C. – Colon cancer incidence rates have dropped 30 percent in the U.S. in the last 10 years among adults 50 and older due to the widespread uptake of colonoscopy, with the largest decrease in people over age 65. Colonoscopy use has almost tripled among adults ages 50 to 75, from 19 percent in 2000 to 55 percent in 2010. The findings come from Colorectal Cancer Statistics, 2014, published in the March/April issue of CA: A Cancer Journal for Clinicians. The article and its companion report, Colorectal Cancer Facts & Figures, were released today by American Cancer Society researchers as part of a new initiative by the National Colorectal Cancer Roundtable to increase screening rates to 80 percent by 2018.
Colorectal cancer, commonly called colon cancer, is the third most common cancer and the third leading cause of cancer death in men and women in the United States. Its slow growth from precancerous polyp to invasive cancer provides a rare opportunity to prevent cancer through the detection and removal of precancerous growths. Screening also allows early detection of cancer, when treatment is more successful. As a result,

screening reduces colorectal cancer mortality both by decreasing the incidence of disease and by increasing the likelihood of survival.

Using incidence data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program and the Centers for Disease Control and Prevention's National Program of Cancer Registries, as provided by the North American Association of Central Cancer Registries (NAACCR), researchers led by Rebecca Siegel, MPH found that during the most recent decade of data (2001 to 2010), overall incidence rates decreased by an average of 3.4 percent per year. However, trends vary substantially by age. Rates declined by 3.9 percent per year among adults aged 50 years and older, but increased by 1.1 percent per year among men and women younger than 50. That increase was confined to tumors in the distal colon and rectum, patterns for which a rise in obesity and emergence of unfavorable dietary patterns has been implicated.

Most strikingly, the rate of decline has surged among those 65 and older, with the decline accelerating from 3.6 percent per year during 2001-2008 to 7.2 percent per year during 2008-2010. The "larger declines among Medicare-eligible seniors likely reflect higher rates of screening because of universal insurance coverage," the authors write. "In 2010, 55 percent of adults aged 50 to 64 years reported having undergone a recent colorectal cancer screening test, compared with 64 percent of those aged 65 years and older."

Like incidence, mortality rates have also declined most rapidly within the past decade. From 2001 to 2010, rates decreased by approximately 3 percent per year in both men and women, compared with declines of approximately 2 percent per year during the 1990s.

"These continuing drops in incidence and mortality show the lifesaving potential of colon cancer screening; a potential that an estimated 23 million Americans between ages 50 and 75 are not benefiting from because they are not up to date on screening," said Richard C. Wender, M.D., American Cancer Society chief cancer control officer. "Sustaining this hopeful trend will require concrete efforts to make sure all patients, particularly those who are economically disenfranchised, have access to screening and to the best care available."

The data is being released at the launch of a nationwide effort to increase colorectal cancer screening rates to 80% by 2018. Public health leaders, including Assistant Secretary for Health Howard Koh, MD, MPH and American Cancer Society CEO, John R. Seffrin, PhD will join dozens of members of the National Colorectal Cancer Roundtable (NCCRT) at the National Press Club in Washington, D.C. on March 17th at 1:00 PM EDT. The NCCRT, an organization co-founded by the American Cancer Society and the U. S. Centers for Disease Control and Prevention, will focus on dramatically increasing colorectal cancer screening rates in the U.S. over the next four years, and increasing awareness of the potential for early detection and prevention of this cancer.

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