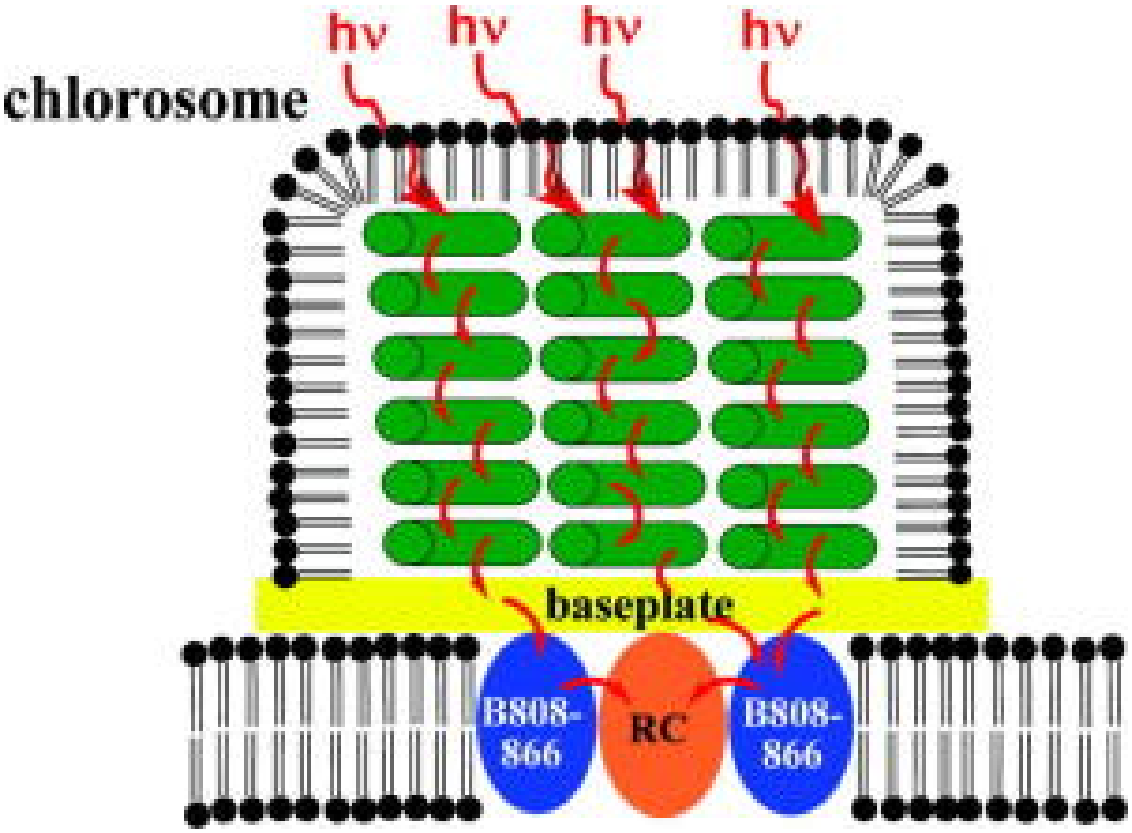
Infoteca's E-Journal

An Electronic Compilation of Scientific and Cultural Information by
Sistema de Infotecas Centrales, Universidad Autónoma de Coahuila

CONTENTS

Neutron Analysis Yields Insight Into Bacteria for Solar Energy



Chlorosomes (shown in green) capture and transfer light energy to the reaction center for photosynthesis in bacteria. New research from Oak Ridge National Laboratory reveals that the chlorosomes maintain their structure even under extreme conditions. (Credit: Image courtesy of DOE/Oak Ridge National Laboratory)

ScienceDaily (Mar. 23, 2011) — Structural studies of some of nature's most efficient light-harvesting systems are lighting the way for new generations of biologically inspired solar cell devices.

Researchers from Washington University in St. Louis and the Department of Energy's Oak Ridge National Laboratory used small-angle neutron scattering to analyze the structure of chlorosomes in green photosynthetic bacteria. Chlorosomes are efficient at collecting sunlight for conversion to energy, even in low-light and extreme environments.

"It's one of the most efficient light harvesting antenna complexes found in nature," said co-author and research scientist Volker Urban of ORNL's Center for Structural Molecular Biology, or CSMB.

Neutron analysis performed at the CSMB's Bio-SANS instrument at the High Flux Isotope Reactor allowed the team to examine chlorosome structure under a range of thermal and ionic conditions.

"We found that their structure changed very little under all these conditions, which shows them to be very stable," Urban said. "This is important for potential biohybrid applications -- if you wanted to use them to harvest light in synthetic materials like a hybrid solar cell, for example."

The size, shape and organization of light-harvesting complexes such as chlorosomes are critical factors in electron transfer to semiconductor electrodes in solar devices. Understanding how chlorosomes function in nature could help scientists mimic the chlorosome's efficiency to create robust biohybrid or bio-inspired solar cells.

"What's so amazing about the chlorosome is that this large and complicated assembly is able to capture light effectively across a large area and then funnel the light to the reaction center without losing it along the way," Urban said. "Why this works so well in chlorosomes is not well understood at all."

"We're trying to find out general principles that are important for capturing, harvesting and transporting light efficiently and see how nature has solved that," Urban said.
Small-angle neutron scattering enabled the team to clearly observe the complicated biological systems at a nanoscale level without damaging the samples.
"With neutrons, you have an advantage that you get a very sharp contrast between these two phases, the chlorosome and the deuterated buffer. This gives you something like a clear black and white image," Urban said.
The team, led by Robert Blankenship of Washington University, published its findings in the journal *Langmuir*. The research was supported through the Photosynthetic Antenna Research Center, an Energy Frontier Research Center funded by DOE's Office of Science. Both HFIR and the Bio-SANS facility at ORNL's Center for Structural Molecular Biology are also supported by DOE's Office of Science.
ORNL is managed by UT-Battelle for the Department of Energy's Office of Science.
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Oak Ridge National Laboratory**.

Journal Reference:

1. Kuo-Hsiang Tang, Liying Zhu, Volker S. Urban, Aaron M. Collins, Pratim Biswas, Robert E. Blankenship. **Temperature and Ionic Strength Effects on the Chlorosome Light-Harvesting Antenna Complex**. *Langmuir*, 2011; 110315121146005 DOI: 10.1021/la104532b

http://www.sciencedaily.com/releases/2011/03/110323140136.htm

Plant Oil May Hold Key to Reducing Obesity-Related Medical Issues, Researcher Finds

Sterculic oil is extracted from seeds of the Sterculia foetida tree. The oil contains unique fatty acids known to suppress a bodily enzyme associated with insulin resistance, which could indirectly help with reducing belly fat. (Credit: Keith Montgomery/University of Missouri)

ScienceDaily (Mar. 23, 2011) — Scientists have known for years that belly fat leads to serious medical problems, including diabetes, cardiovascular disease, hypertension and stroke. Now, a University of Missouri researcher has found a plant oil that may be able to reduce belly fat in humans.

In his latest study, James Perfield, assistant professor of food science in the College of Agriculture, Food and Natural Resources (CAFNR), found that a specific plant oil, known as sterculic oil, may be a key in the fight against obesity. Sterculic oil is extracted from seeds of the *Sterculia foetida* tree. The oil contains unique fatty acids known to suppress a bodily enzyme associated with insulin resistance, which could indirectly help with reducing belly fat. Previous studies show that reducing the enzyme in rodents improves their metabolic profile, improving insulin sensitivity and reducing chances for later chronic diseases.

"This research paves the way for potential use in humans," Perfield said. "Reducing belly fat is a key to reducing the incidence of serious disease, and this oil could have a future as a nutritional supplement."

To study the compound, Perfield added sterculic oil to the feed of rats that are genetically disposed to have a high amount of abdominal fat. He tested the rats over the course of 13 weeks and found that rats given a diet supplemented with sterulic oil had less abdominal fat and a decreased likelihood of developing diabetes. Perfield gave the rats a relatively small dose of oil each day, comparable to giving three grams to a 250-pound human.

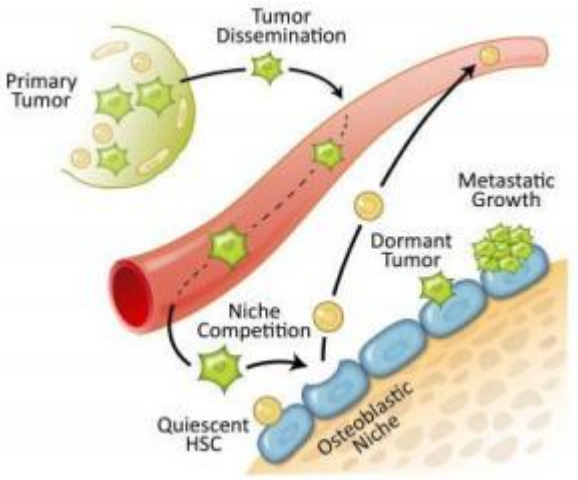
Belly fat, clinically known as intra-abdominal fat, is between internal organs and the torso. Intra-abdominal fat is composed of "adipose" deposits. Unusually high adipose levels trigger health problems that may induce insulin resistance, which causes the body to have difficulty maintaining blood sugar levels. Initially, the body is able to compensate by producing more insulin, but eventually the pancreas is unable to produce enough insulin, thus increasing excess sugar in the bloodstream and setting the stage for diabetes, cardiovascular disease and other obesity-associated health disorders.

Perfield plans to conduct further studies of sterulic oil in hopes of developing a natural nutritional supplement. He says future research will focus on the effectiveness of the oil in humans, as well as any side effects.
"The oil from this seed is very similar to other vegetable oils," Perfield said. "It shares many of the same chemical properties, which could allow it to be easily substituted with other oils. While eating the seed directly may be possible, it's easier to control the amount of oil if you extract it directly."
Perfield presented the research at the Diabetes, Insulin Resistance and Metabolic Dysfunction Symposium in Keystone, Colo. The research was funded by the Diabetes Action Research and Education Foundation, MU Food for the 21st Century, and CAFNR.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Missouri-Columbia**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110323140144.htm

Prostate Cancer Spreads to Bones by Overtaking the Home of Blood Stem Cells



This is a drawing of prostate cancer cells in the bone marrow niche. (Credit: University of Michigan)

ScienceDaily (Mar. 23, 2011) — Like bad neighbors who decide to go wreck another community, prostate and breast cancer usually recur in the bone, according to a new University of Michigan study.

Now, U-M researchers believe they know why. Prostate cancer cells specifically target and eventually overrun the bone marrow niche, a specialized area for hematopoietic stem cells, which make red and white blood cells, said Russell Taichman, professor at the U-M School of Dentistry and senior author of the study.

Once in the niche, the cancer cells stay dormant and when they become active again years later, that's when tumors recur in the bone. The implication is that this may give us a window as to how dormancy and recurrence take place.

Taichman and a team of researchers looked in the bone marrow and found cancer cells and hematopoietic stem cells next to one another competing for the same place. The finding is important because it demonstrates that the bone marrow niche plays a central role in bone metastasis -- cancers that spread into the bone -- giving researchers a new potential drug target.

Drugs could be developed to keep the types of cancers that likely recur in the bone from returning, Taichman said. For example, these drugs could either halt or disrupt how the cancer cells enter or behave in the niche, or keep the cancer cells from out-competing the stem cells.

Cancer cells act a lot like stem cells in that they must reproduce, so the U-M research group hypothesized that prostate cancer cells might travel to the niche during metastasis. One of the jobs of the niche is to keep hematopoietic stem cells from proliferating -- which may be the case for cancer cells, as well, the researchers found.

So why does cancer recur? Say a person has a tumor and surgeons cut it out or do radiation, but it recurs in the bone marrow five years later, Taichman said. Those cancer cells had been circulating in the body well before the tumor was discovered, and one place those cancer cells hid is the niche.

"So what have the cancer cells been doing during those five years? Now we have a partial answer -- they've been sitting in this place whose job it is to keep things from proliferating and growing," Taichman said.

"Our work also provides an explanation as to why current chemotherapies often fail in that once cancer cells enter the niche, most likely they stop proliferating," said Yusuke Shiozawa, lead author of the study. "The problem is that most of the drugs we use to try to treat cancer only work on cells that are proliferating."

Metastases are the most common malignant tumors involving the skeleton, and nearly 70 percent of patients with breast and prostate cancer have bone involvements. Roughly 15 percent to 30 percent of patients with lung, colon, stomach, bladder, uterus, rectum, thyroid or kidney cancer have bone lesions.

Researchers aren't quite sure how the cancer cells out-compete the stem cells in the niche. However, they do know the stem cells were displaced because when cancer cells were in the niche scientists also found evidence of immature blood stem cells in the blood stream, instead of in the marrow where they were supposed to be, Taichman said.

"Eventually the entire blood system is going to collapse," he said. "For example, the patient ultimately becomes anemic, gets infections, and has bleeding problems. We really don't know why people with prostate cancer die. They end up dying from different kinds of complications in part because the marrow is taken over by cancer."

The next step is to find out how the tumor cell gets into the niche and becomes dormant, and exactly what they do to the stem cells when they are there. Researchers also want to know if other types of cancer cells, such as breast cancer, also go to the niche.

The study appears online in the *Journal of Clinical Investigation*.

Co-authors are: Elizabeth Pedersen, Aaron Havens, Younghun Jung, Anjali Mishra, Jeena Joseph, Jin Koo Kim, Anne Ziegler, Michael Pienta, Jingcheng Wang, Junhui Song and Paul Krebsbach of the U-M School of Dentistry; Lalit Patel, Chi Ying, Robert Loberg and Kenneth Pienta of the departments of Urology and Internal Medicine at the U-M Medical School.

Email or share this story:

| More

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Michigan**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Yusuke Shiozawa, Elisabeth A. Pedersen, Aaron M. Havens, Younghun Jung, Anjali Mishra, Jeena Joseph, Jin Koo Kim, Lalit R. Patel, Chi Ying, Anne M. Ziegler, Michael J. Pienta, Junhui Song, Jingcheng Wang, Robert D. Loberg, Paul H. Krebsbach, Kenneth J. Pienta, Russell S. Taichman. **Human prostate cancer metastases target the hematopoietic stem cell niche to establish footholds in mouse bone marrow**. *Journal of Clinical Investigation*, 2011; DOI: 10.1172/JCI43414

http://www.sciencedaily.com/releases/2011/03/110323140237.htm

Research Produces Novel Sensor With Improved Detection Selectivity

UC's William Heineman will present on a UC-developed sensor that combines a variety of testing means (electrochemistry, spectroscopy and selective partitioning) into one device. The three methods are represented in the above photo illustration. (Credit: Photo by Andrew Higley, UC / Illustration by Lisa Ventre, UC)

ScienceDaily (Mar. 23, 2011) — A highly sensitive sensor that combines a variety of testing means (electrochemistry, spectroscopy and selective partitioning) into one device has been developed at the University of Cincinnati. It's already been tested in a variety of settings -- including testing for components in nuclear waste.

The sensor is unusual in that most sensors only have one or two modes of selectivity, while this sensor has three. In practical terms, that means the UC sensor has three different ways to find and identify a compound of interest. That's important because settings like a nuclear waste storage tank are a jumbled mix of chemical and radioactive wastes. The sensor, however, would have a variety of applications, including testing in other environments and even medical applications.

Research related to this novel sensor will be presented at the American Chemical Society biannual meeting March 27-31 in Anaheim, Calif., in a presentation titled "Using Spectroelectrochemistry to Improve Sensor Selectivity."

That presentation will be made March 28 by William Heineman, distinguished research professor of chemistry at the University of Cincinnati. He is one of six international scientists invited to speak by electrochemistry students involved in planning a conference symposium. Heineman has published more than 400 research articles on the topics of spectroelectrochemistry, electroanalytical chemistry, bioanalytical chemistry and chemical sensors, and has won numerous national and international awards for his work.

Research on this sensor concept began more than a decade ago and has received support from the United States Department of Energy for most of that time. "They wanted a sensor that can be lowered in a tank to make lots of measurements quickly or have the option of leaving it in there to monitor what's going on over months or a year," said Heineman, who added that the ideal sensor is both rugged and very selective and sensitive.

The sensor has, in fact, been tested at the Hanford site, a mostly decommissioned nuclear production complex in Washington state, where it was used to detect one important component of the radioactive and hazardous wastes stored inside the giant tanks there.

The basic design and concept for this monitor could be used in many other environmental or medical settings. These include detection of toxic heavy metals and polycyclic aromatic hydrocarbons at superfund sites.

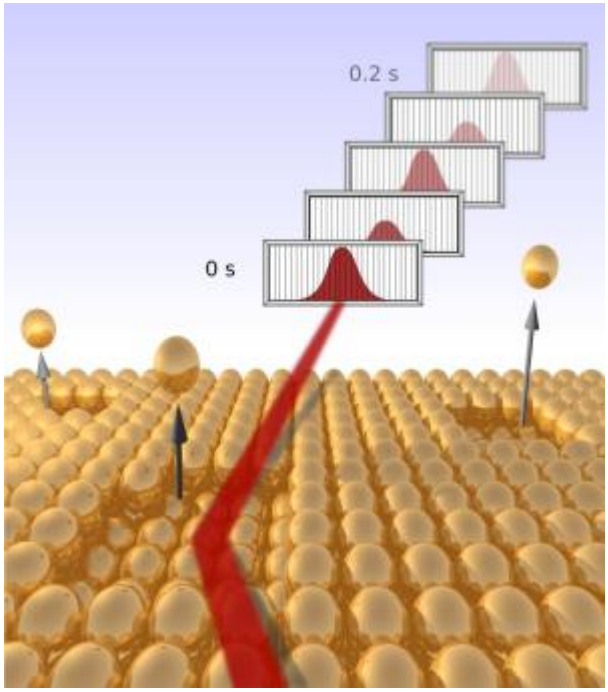
The three-way selectivity comes from the use of coatings, electrochemistry, and spectroscopy. The selective coating only allows certain compounds to enter the sensing region. For example, all negatively charged ions

might be able to enter the sensor while all positively charged ions are excluded. Next comes the electrochemistry. A potential is applied, and an even smaller group of compounds are electrolyzed. Finally, a very specific wavelength of light is used to detect the actual compound of interest.
The end result is that compounds, even those present in very low concentrations, can be detected and analyzed. This is especially important in medical monitoring and other applications requiring high selectivity and sensitivity.
"Our goal in this research was to demonstrate that the concept works, and that goal has been met as it's now been tested in several ways. Maybe that's why the students at the ACS meeting wanted to hear about it," said UC's Heineman.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Cincinnati**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110323140239.htm

Rapid Etching X-Rayed: Physicists Unveil Processes During Fast Chemical Dissolution



Graphical representation of the experiment. The X-ray beam impinges on a gold surface, which is chemically dissolving. A fast X-ray detector captures the reflected beam. From the fluctuations of the beam intensity with time, the atomic-scale changes at the surface are deduced. (Credit: Copyright: CAU; Artwork: J. Golks)

ScienceDaily (Mar. 22, 2011) — A breakthrough in the study of chemical reactions during etching and coating of materials was achieved by a research group headed by Kiel physicist, Professor Olaf Magnussen. The team from the Christian-Albrechts-Universität zu Kiel (CAU), Germany, in collaboration with staff from the European Synchrotron Radiation Facility (ESRF) in Grenoble, France, have uncovered for the first time just what happens in manufacturing processes, used for the formation of metal contacts thinner than a human hair in modern consumer electronics, such as flat-screen television.

The results appear in the *Journal of the American Chemical Society*.

For their research the scientists used the intense X-ray radiation of the experimental station ID32, one of the ESRF's instruments. The X-ray beam was directed onto a gold surface while it dissolved in diluted hydrochloric acid. Because the reflected X-rays are sensitive to tiny changes in the atomic arrangement at the material's surface, the metal removal during the reaction can be precisely measured.

"Such studies were only possible during very slow changes of the material so far," Olaf Magnussen explains. To gain insight into the fast reactions going on in industrially employed processes the speed of the measurements had to be increased more than a hundredfold. Even during very fast etching the removal of the metal proceeded very uniformly. "The material dissolves quasi atomic layer by atomic layer, without formation of deeper holes," Magnussen remarks. In a similar way, the team could follow the attachment of atoms during the chemical coating of materials.

Among the diverse industrial applications of chemical etching and coating are high-tech manufacturing processes, for example in the production of electronic devices. These require precisely controlled reactions. In order to optimize such etching and coating processes they are intensely studied worldwide. Until now it was only possible to analyse the finished product. With the method developed by the scientists, changes within a few thousandth seconds may be detected so that the reactions at the material's surface can be tracked on the atomic scale under realistic conditions.

Christian-Albrechts-Universität zu Kiel is a North German research university with proven international expertise in the field of nanoscience, including research using synchrotron radiation. In a number of research networks, funded by the German Federal Ministry of Education and Research, Kiel scientists develop new

methods and instruments. In addition, the CAU competes for a Cluster of Excellence in the area of nanoscience and surface science within the ongoing round of the German Excellence Initiative.
The ESRF is a European research institution, funded by 19 nations, providing and utilizing brilliant synchrotron X-rays for advanced scientific research.

Story Source:

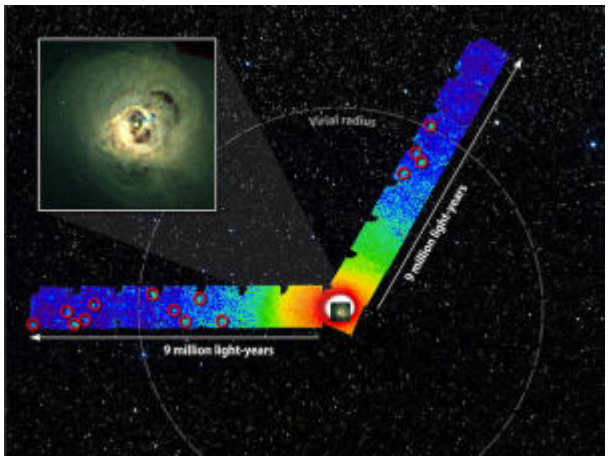
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Christian-Albrechts-Universitaet zu Kiel**.

Journal Reference:

1. Frederik Golks, Klaus Krug, Yvonne Gründer, Jörg Zegenhagen, Jochim Stettner, Olaf M. Magnussen. **High-Speed in situ Surface X-ray Diffraction Studies of the Electrochemical Dissolution of Au(001)**. *Journal of the American Chemical Society*, 2011; 133 (11): 3772 DOI: 10.1021/ja1115748

http://www.sciencedaily.com/releases/2011/03/110322105953.htm

Suzaku Shows Clearest Picture Yet of Perseus Galaxy Cluster



Suzaku explored faint X-ray emission of hot gas across two swaths of the Perseus Galaxy Cluster. The images, which record X-rays with energies between 700 and 7,000 electron volts in a combined exposure of three days, are shown in two false-color strips. Bluer colors indicate less intense X-ray emission. The dashed circle is 11.6 million light-years across and marks the so-called virial radius, where cold gas is now entering the cluster. Red circles indicate X-ray sources not associated with the cluster. Inset: An image of the cluster's bright central region taken by NASA's Chandra X-ray Observatory is shown to scale. (Credit: NASA/ISAS/DSS/A. Simionescu et al.; inset: NASA/CXC/A.)

ScienceDaily (Mar. 24, 2011) — X-ray observations made by the Suzaku observatory provide the clearest picture to date of the size, mass and chemical content of a nearby cluster of galaxies. The study also provides the first direct evidence that million-degree gas clouds are tightly gathered in the cluster's outskirts.

Suzaku is sponsored by the Japan Aerospace Exploration Agency (JAXA) with contributions from NASA and participation by the international scientific community. The findings will appear in the March 25 issue of the journal Science.

Galaxy clusters are millions of light-years across, and most of their normal matter comes in the form of hot X-ray-emitting gas that fills the space between the galaxies.

"Understanding the content of normal matter in galaxy clusters is a key element for using these objects to study the evolution of the universe," explained Adam Mantz, a co-author of the paper at NASA's Goddard Space Flight Center in Greenbelt, Md.

Clusters provide independent checks on cosmological values established by other means, such as galaxy surveys, exploding stars and the cosmic microwave background, which is the remnant glow of the Big Bang. The cluster data and the other values didn't agree.

NASA's Wilkinson Microwave Anisotropy Probe (WMAP) explored the cosmic microwave background and established that baryons -- what physicists call normal matter -- make up only about 4.6 percent of the universe. Yet previous studies showed that galaxy clusters seemed to hold even fewer baryons than this amount.

Suzaku images of faint gas at the fringes of a nearby galaxy cluster have allowed astronomers to resolve this discrepancy for the first time.

The satellite's ideal target for this study was the Perseus Galaxy Cluster, which is located about 250 million light-years away and named for the constellation in which it resides. It is the brightest extended X-ray source beyond our own galaxy, and also the brightest and closest cluster in which Suzaku has attempted to map outlying gas.

"Before Suzaku, our knowledge of the properties of this gas was limited to the innermost parts of clusters, where the X-ray emission is brightest, but this left a huge volume essentially unexplored," said Aurora Simionescu, the study's lead researcher at the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) at Stanford University.

In late 2009, Suzaku's X-ray telescopes repeatedly observed the cluster by progressively imaging areas farther east and northwest of the center. Each set of images probed sky regions two degrees across -- equivalent to

four times the apparent width of the full moon or about 9 million light-years at the cluster's distance. Staring at the cluster for about three days, the satellite mapped X-rays with energies hundreds of times greater than that of visible light.

From the data, researchers measured the density and temperature of the faint X-ray gas, which let them infer many other important quantities. One is the so-called virial radius, which essentially marks the edge of the cluster. Based on this measurement, the cluster is 11.6 million light-years across and contains more than 660 trillion times the mass of the sun. That's nearly a thousand times the mass of our Milky Way galaxy.

The researchers also determined the ratio of the cluster's gas mass to its total mass, including dark matter -- the mysterious substance that makes up about 23 percent of the universe, according to WMAP. By virtue of their enormous size, galaxy clusters should contain a representative sample of cosmic matter, with normal-to-dark-matter ratios similar to WMAP's. Yet the outer parts of the Perseus cluster seemed to contain too many baryons, the opposite of earlier studies, but still in conflict with WMAP.

To solve the problem, researchers had to understand the distribution of hot gas in the cluster, the researchers say. In the central regions, the gas is repeatedly whipped up and smoothed out by passing galaxies. But computer simulations show that fresh infalling gas at the cluster edge tends to form irregular clumps.

Not accounting for the clumping overestimates the density of the gas. This is what led to the apparent disagreement with the fraction of normal matter found in the cosmic microwave background.

"The distribution of these clumps and the fact that they are not immediately destroyed as they enter the cluster are important clues in understanding the physical processes that take place in these previously unexplored regions," said Steve Allen at KIPAC, the principal investigator of the Suzaku observations.

Goddard supplied Suzaku's X-ray telescopes and data-processing software, and it continues to operate a facility that supports U.S. astronomers who use the spacecraft.

Suzaku (Japanese for "red bird of the south") is the fifth Japanese X-ray astronomy satellite. It was launched as Astro-E2 on July 10, 2005, and renamed in orbit. The observatory was developed at JAXA's Institute of Space and Astronautical Science in collaboration with NASA and other Japanese and U.S. institutions.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Goddard Space Flight Center**.

http://www.sciencedaily.com/releases/2011/03/110324171100.htm

Developing Strategies in a Desert Watershed That Sustain Regional Water Supplies

Technician Jim Riley (left) and hydraulic engineer Dave Goodrich download water-level data from the Rostrin Basin, a flood detention pond in Sierra Vista, Arizona, which will aid in calculating the recharge rate to the ground-water aquifer. (Credit: Photo by Stephen Ausmus)

ScienceDaily (Mar. 24, 2011) — U.S. Department of Agriculture (USDA) scientists are helping meet the water demands of a riparian desert region that is home to a national conservation area and a thriving military base.

Agricultural Research Service (ARS) hydraulic engineer Dave Goodrich and hydrologist Russ Scott have been part of Arizona's Upper San Pedro Partnership (USPP)-a mix of 21 federal, state, and local groups managing the region's water-supply needs-since the association started in 1998. ARS is USDA's chief intramural scientific research agency, and this work supports the USDA priority of responding to climate change.

Fort Huachuca, which is the primary economic engine in the upper San Pedro River valley, draws its water from the aquifer that sustains the desert river, but this groundwater is being depleted more rapidly than it is replenished. In 2004, Congress directed the Department of the Interior to work with the Department of Defense, USDA and the USPP to develop water use management and conservation measures that would restore and maintain water supplies in the upper San Pedro watershed.

Goodrich and Scott both work at the ARS Southwest Watershed Research Center in Tucson, Ariz. The scientists are studying how much water is used by riparian vegetation and evaluating how storm water runoff from urban development affects groundwater reserves.

As part of this work, Goodrich and others measured storm water runoff from undeveloped land at the edge of Fort Huachuca and from a newly developed area just outside the military installation. They found that a third of the runoff from the developed site resulted just from the compaction from the surface soils during construction-and not from the installation of impervious barriers, as they had expected.

Meanwhile, Scott and his colleagues found that mesquite woodlands use much more water than cottonwood and willow trees that grow along the riverbanks. He used this finding to develop a GIS-based riparian evaporation and transpiration tool that regional land managers can use to estimate water savings by replacing mesquite with native desert grasses.

Results from this work have been published in *Global Change Biology*, the *Journal of Contemporary Water Research and Education*, *Southwest Hydrology*, and elsewhere.

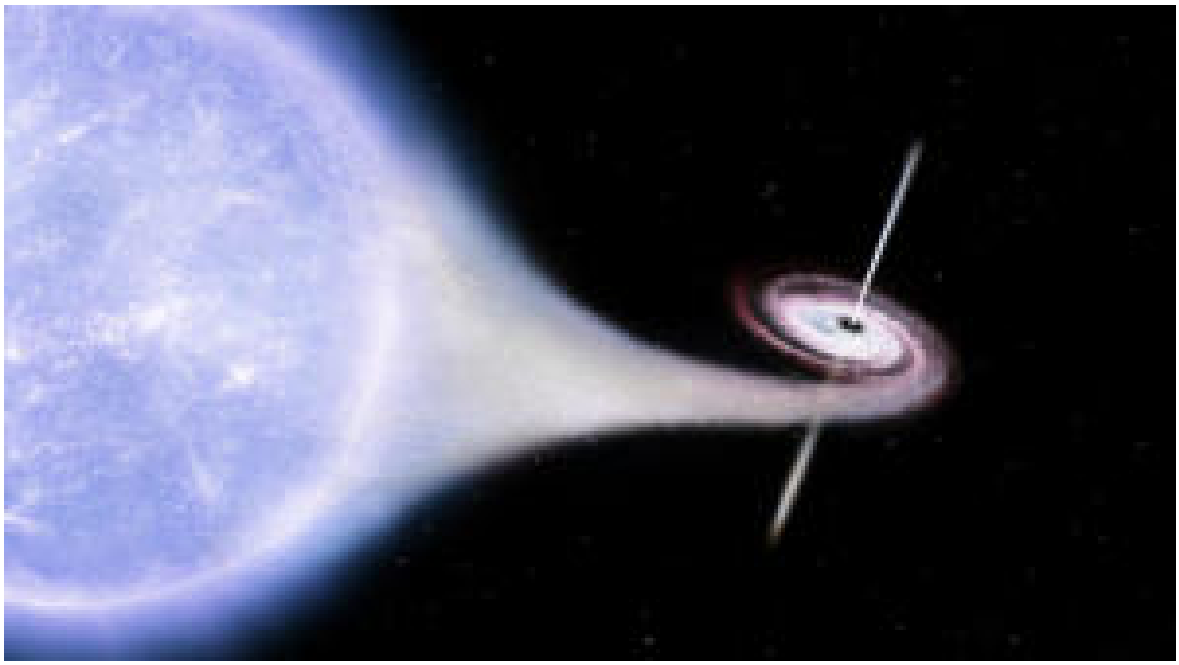
Read more about this research in the March 2011 issue of *Agricultural Research* magazine at: http://www.ars.usda.gov/is/AR/2011/mar11/river0311.htm

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Ann Perry.

http://www.sciencedaily.com/releases/2011/03/110322114829.htm

Matter Spotted a Millisecond from Black Hole -- But Is It Really Doomed?



An artist's impression of the Cygnus X-1 black hole system. Gas from a nearby supergiant star spirals down into the black hole but a small fraction is diverted by magnetic fields into jets that shoot back into space. (Credit: ESA)

ScienceDaily (Mar. 24, 2011) — ESA's Integral gamma-ray observatory has spotted extremely hot matter just a millisecond before it plunges into the oblivion of a black hole. But is it really doomed? These unique observations suggest that some of the matter may be making a great escape.

No one would want to be so close to a black hole. Just a few hundred kilometres away from its deadly surface, space is a maelstrom of particles and radiation. Vast storms of particles are falling to their doom at close to the speed of light, raising the temperature to millions of degrees.

Ordinarily, it takes just a millisecond for the particles to cross this final distance but hope may be at hand for a small fraction of them.

Thanks to the new Integral observations, astronomers now know that this chaotic region is threaded by magnetic fields.

This is the first time that magnetic fields have been identified so close to a black hole. Most importantly, Integral shows they are highly structured magnetic fields that are forming an escape tunnel for some of the doomed particles.

Philippe Laurent, CEA Saclay, France, and colleagues made the discovery by studying the nearby black hole, Cygnus X-1, which is ripping a companion star to pieces and feeding on its gas.

Their evidence points to the magnetic field being strong enough to tear away particles from the black hole's gravitational clutches and funnel them outwards, creating jets of matter that shoot into space. The particles in these jets are being drawn into spiral trajectories as they climb the magnetic field to freedom and this is affecting a property of their gamma-ray light known as polarisation.

A gamma ray, like ordinary light, is a kind of wave and the orientation of the wave is known as its polarisation. When a fast particle spirals in a magnetic field it produces a kind of light, known as synchrotron emission, which displays a characteristic pattern of polarisation. It is this polarisation that the team have found in the gamma rays. It was a difficult observation to make.

"We had to use almost every observation Integral has ever made of Cygnus X-1 to make this detection," says Laurent.

Amassed over seven years, these repeated observations of the black hole now total over five million seconds of observing time, the equivalent of taking a single image with an exposure time of more than two months. Laurent's team added them all together to create just such an exposure.
"We still do not know exactly how the infalling matter is turned into the jets. There is a big debate among theoreticians; these observations will help them decide," says Laurent.
Jets around black holes have been seen before by radio telescopes but such observations cannot see the black hole in sufficient detail to know exactly how close to the black hole the jets originate. That makes these new observations invaluable.
"This discovery of polarized emission from a black hole jet is a unique result demonstrating that Integral, which is covering the high-energy band in ESA's wide spectrum of scientific missions, continues to produce key results more than eight years after its launch," says Christoph Winkler, ESA Integral Project Scientist.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Space Agency**.

http://www.sciencedaily.com/releases/2011/03/110324153753.htm

Cutting Carbon Dioxide Could Help Prevent Droughts, New Research Shows

New research offers a novel explanation for why climates are wetter when atmospheric carbon dioxide concentrations are decreasing. (Credit: iStockphoto/Markus Gann)

ScienceDaily (Mar. 24, 2011) — Recent climate modeling has shown that reducing the concentration of carbon dioxide in the atmosphere would give Earth a wetter climate in the short term. New research from Carnegie Global Ecology scientists Long Cao and Ken Caldeira offers a novel explanation for why climates are wetter when atmospheric carbon dioxide ($CO_{2)}$ concentrations are decreasing. Their findings, published online March 24 by *Geophysical Research Letters*, show that cutting carbon dioxide concentrations could help prevent droughts caused by global warming.

Cao and Caldeira's new work shows that this precipitation increase is due to the heat-trapping property of the greenhouse gas carbon dioxide in the atmosphere. Carbon dioxide traps heat in the middle of the atmosphere. This warm air higher in the atmosphere tends to prevent the rising air motions that create thunderstorms and rainfall.

As a result, an increase in the atmospheric concentration of carbon dioxide tends to suppress precipitation. Similarly, a decrease in the atmospheric concentration of carbon dioxide tends to increase precipitation.

The results of this study show that cutting the concentration of precipitation-suppressing carbon dioxide in the atmosphere would increase global precipitation. This is important because scientists are concerned that unchecked global warming could cause already dry areas to get drier. (Global warming may also cause wet areas to get wetter.) Cao and Caldeira's findings indicate that reducing atmospheric carbon dioxide could prevent droughts caused by climate change.

"This study shows that the climate is going to be drier on the way up and wetter on the way down," Caldeira said, adding: "Proposals to cool the earth using geo-engineering tools to reflect sunlight back to space would not cause a similar pulse of wetness."

The team's work shows that carbon dioxide rapidly affects the structure of the atmosphere, causing quick changes precipitation, as well as many other aspects of Earth's climate, well before the greenhouse gas noticeably affects temperature. These results have important implications for understanding the effects of climate change caused by carbon dioxide, as well as the potential effects of reducing atmospheric carbon dioxide concentrations.

"The direct effects of carbon dioxide on precipitation take place quickly," said Cao. "If we could cut carbon dioxide concentrations now, we would see precipitation increase within the year, but it would take many decades for climate to cool."

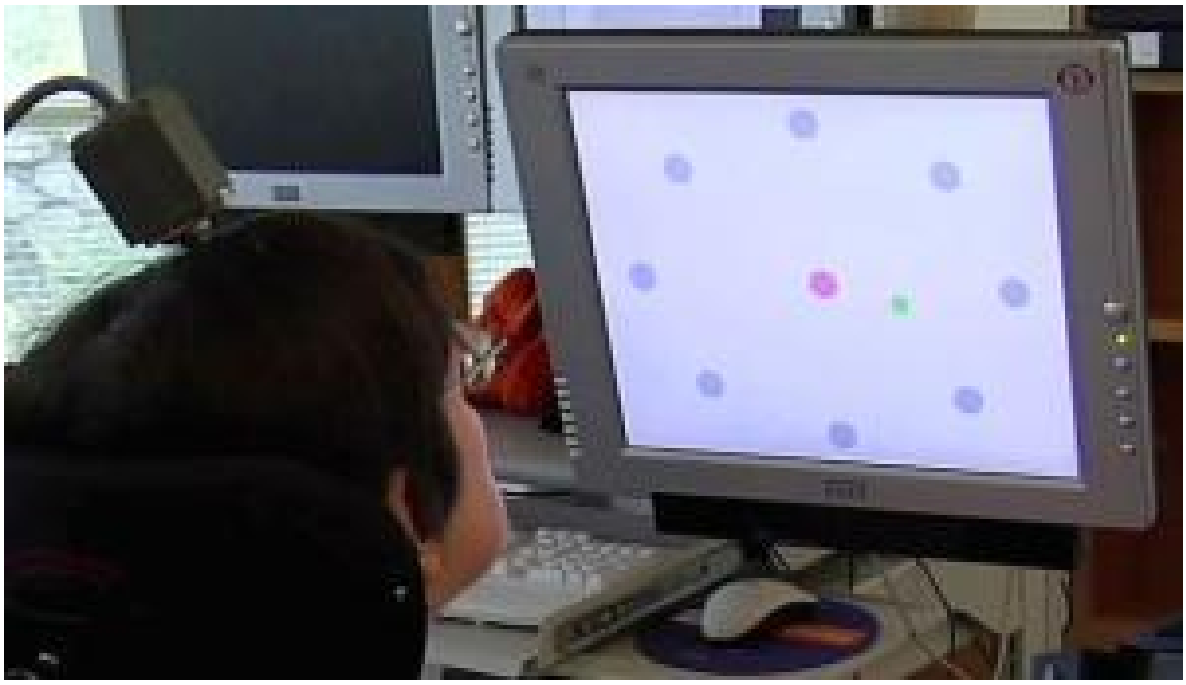
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Carnegie Institution**.

Journal Reference:

1. Long Cao, Govindasamy Bala, Ken Caldeira. **Why is there a short-term increase in global precipitation in response to diminished CO2forcing?** *Geophysical Research Letters*, 2011; 38 (6) DOI: 10.1029/2011GL046713

http://www.sciencedaily.com/releases/2011/03/110324153504.htm

BrainGate Neural Interface System Reaches 1,000-Day Performance Milestone



A brain-computer interface: A woman with paralysis controls a computer cursor on a screen by the neural activity of intending to move it with her arm and hand. The woman, identified as S3, used the investigational BrainGate system more than 1,000 days after the device was implanted. (Credit: Image courtesy of Brown University)

ScienceDaily (Mar. 24, 2011) — Demonstrating an important milestone for the longevity and utility of implanted brain-computer interfaces, a woman with tetraplegia using the investigational BrainGate system continued to control a computer cursor accurately through neural activity alone more than 1,000 days after receiving the BrainGate implant, according to a team of physicians, scientists, and engineers developing and testing the technology at Brown University, the Providence VA Medical Center, and Massachusetts General Hospital (MGH).

Results from five consecutive days of device use surrounding her 1,000th day in the device trial appeared online March 24 in the *Journal of Neural Engineering.*

"This proof of concept -- that after 1,000 days a woman who has no functional use of her limbs and is unable to speak can reliably control a cursor on a computer screen using only the intended movement of her hand -- is an important step for the field," said Dr. Leigh Hochberg, a Brown engineering associate professor, VA rehabilitation researcher, visiting associate professor of neurology at Harvard Medical School, and director of the BrainGate pilot clinical trial at MGH.

The woman, identified in the paper as S3, performed two "point-and-click" tasks each day by thinking about moving the cursor with her hand. In both tasks she averaged greater than 90 percent accuracy. Some on-screen targets were as small as the effective area of a Microsoft Word menu icon.

In each of S3's two tasks, performed in 2008, she controlled the cursor movement and click selections continuously for 10 minutes. The first task was to move the cursor to targets arranged in a circle and in the center of the screen, clicking to select each one in turn. The second required her to follow and click on a target as it sequentially popped up with varying size at random points on the screen.

From fundamental neuroscience to clinical utility

Under development since 2002, the investigational BrainGate system is a combination of hardware and software that directly senses electrical signals produced by neurons in the brain that control movement. By decoding those signals and translating them into digital instructions, the system is being evaluated for its ability to give people with paralysis control of external devices such as computers, robotic assistive devices,

or wheelchairs. The BrainGate team is also engaged in research toward control of advanced prosthetic limbs and toward direct intracortical control of functional electrical stimulation devices for people with spinal cord injury, in collaboration with researchers at the Cleveland FES Center.
The system is currently in pilot clinical trials, directed by Hochberg at MGH.
BrainGate uses a tiny (4x4 mm, about the size of a baby aspirin) silicon electrode array to read neural signals directly within brain tissue. Although external sensors placed on the brain or skull surface can also read neural activity, they are believed to be far less precise. In addition, many prototype brain implants have eventually failed because of moisture or other perils of the internal environment.
"Neuroengineers have often wondered whether useful signals could be recorded from inside the brain for an extended period of time," Hochberg said. "This is the first demonstration that this microelectrode array technology can provide useful neuroprosthetic signals allowing a person with tetraplegia to control an external device for an extended period of time."

Moving forward

Device performance was not the same at 2.7 years as it was earlier on, Hochberg added. At 33 months fewer electrodes were recording useful neural signals than after only six months. But John Donoghue -- VA senior research career scientist, Henry Merritt Wriston Professor of Neuroscience, director of the Brown Institute for Brain Science, and original developer of the BrainGate system -- said no evidence has emerged of any fundamental incompatibility between the sensor and the brain. Instead, it appears that decreased signal quality over time can largely be attributed to engineering, mechanical or procedural issues. Since S3's sensor was built and implanted in 2005, the sensor's manufacturer has reported continual quality improvements. The data from this study will be used to further understand and modify the procedures or device to further increase durability.
"None of us will be fully satisfied with an intracortical recording device until it provides decades of useful signals," Hochberg said. "Nevertheless, I'm hopeful that the progress made in neural interface systems will someday be able to provide improved communication, mobility, and independence for people with locked-in syndrome or other forms of paralysis and eventually better control over prosthetic, robotic, or functional electrical stimulation systems [stimulating electrodes that have already returned limb function to people with cervical spinal cord injury], even while engineers continue to develop ever-better implantable sensors."
In addition to demonstrating the very encouraging longevity of the BrainGate sensor, the paper also presents an advance in how the performance of a brain-computer interface can be measured, Simeral said. "As the field continues to evolve, we'll eventually be able to compare and contrast technologies effectively."
As for S3, who had a brainstem stroke in the mid-1990s and is now in her late 50s, she continues to participate in trials with the BrainGate system, which continues to record useful signals, Hochberg said. However, data beyond the 1000th day in 2008 has thus far only been presented at scientific meetings, and Hochberg can only comment on data that has already completed the scientific peer review process and appeared in publication.
In addition to Simeral, Hochberg, and Donoghue, other authors are Brown computer scientist Michael Black and former Brown computer scientist Sung-Phil Kim.

About the BrainGate collaboration

This advance is the result of the ongoing collaborative BrainGate research at Brown University, Massachusetts General Hospital, and Providence VA Medical Center. The BrainGate research team is focused on developing and testing neuroscientifically inspired technologies to improve the communication, mobility, and independence of people with neurologic disorders, injury, or limb loss.
For more information, visit www.braingate2.org.
The implanted microelectrode array and associated neural recording hardware used in the BrainGate research are manufactured by BlackRock Microsystems, LLC (Salt Lake City, UT).
This research was funded in part by the Rehabilitation Research and Development Service, Department of Veterans Affairs; The National Institutes of Health (NIH), including NICHD-NCMRR, NINDS/NICHD, NIDCD/ARRA, NIBIB, NINDS-Javits; the Doris Duke Charitable Foundation; MGH-Deane Institute for Integrated Research on Atrial Fibrillation and Stroke; and the Katie Samson Foundation.
The BrainGate pilot clinical trial was previously directed by Cyberkinetics Neurotechnology Systems, Inc., Foxborough, MA (CKI). CKI ceased operations in 2009. The clinical trials of the BrainGate2 Neural Interface System are now administered by Massachusetts General Hospital, Boston, Mass. Donoghue is a former chief

scientific officer and a former director of CKI; he held stocks and received compensation. Hochberg received research support from Massachusetts General and Spaulding Rehabilitation Hospitals, which in turn received clinical trial support from Cyberkinetics. Simeral received compensation as a consultant to CKI.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Brown University**.

Journal Reference:

1. j D Simeral, S-P Kim, M J Black, J P Donoghue, L R Hochberg. **Neural control of cursor trajectory and click by a human with tetraplegia 1000 days after implant of an intracortical microelectrode array**. *Journal of Neural Engineering*, 2011; 8: 025027 DOI: 10.1088/1741-2560/8/2/025027

http://www.sciencedaily.com/releases/2011/03/110324153706.htm

Why Yasir Qadhi Wants to Talk About Jihad

By ANDREA ELLIOTT

Todd Heisler/The New York Times
Yasir Qadhi spoke before the Eid al-Fitr prayer service in September at the Memphis Cook Convention Center.

On a chilly night in the dead of a New England winter, Yasir Qadhi hurried down the stairs of Yale University's religious-studies department, searching urgently for a place to make a private call. A Ph.D. candidate in Islamic studies, Qadhi was a fixture on the New Haven campus. He wore a trim beard and preppy polo shirts, blending in with the other graduate students as he lugged an overstuffed backpack into Blue State Coffee for his daily cappuccino. A popular teaching assistant, he exuded a sprightly intensity in class, addressing the undergraduates as "dudes."

But Qadhi had another life. Beyond the gothic confines of Yale, he was becoming one of the most influential conservative clerics in American Islam, drawing a tide of followers in the fundamentalist movement known as Salafiya. Raised between Texas and Saudi Arabia, he seemed uniquely deft at balancing the edicts of orthodox Islam with the mores of contemporary America. To many young Muslims wrestling with conflicts between faith and country, Qadhi was a rock star. To law-enforcement agents, he was also a figure of interest, given his prominence in a community considered vulnerable to radicalization. Some officials, noting his message of nonviolence, saw him as an ally. Others were wary, recalling a time when Qadhi spouted a much harder, less tolerant line. On this night, however, it was Qadhi's closest followers who were questioning him.

Two weeks earlier, on Christmas Day 2009, a young Nigerian tried to blow up a jet headed for Detroit with a bomb sewn into his underwear. The suspect had been a student of Qadhi's at the AlMaghrib Institute, which teaches Salafi theology in 21 American cities. F.B.I. agents were demanding interviews with Qadhi's students. He urged them to cooperate, but many pushed back, and Qadhi found himself caught between two seemingly irreconcilable forces: a deeply suspicious government and a young following he could lose.

In the basement of the religious-studies building, Qadhi settled into an empty room, flipped open his MacBook Pro (encased in Islamic apple green) and dialed in to an Internet conference call with more than 150

of his AlMaghrib students. “I want to be very frank here,” Qadhi said, his voice tight with exasperation. “Do you really, really think that blowing up a plane is Islamic? I mean, *ask* yourself this.”
None of the students defended the plot, but some sympathized with the suspect, said several students who participated in the call, one of whom provided a recording to The Times. Was it not possible, they asked, that he had been set up? And how could they trust the F.B.I. after all they experienced — the post-9/11 raids, the monitoring of mosques, the sting operations aimed at Muslims? A few went as far as to say that they could not turn against a fellow Muslim who was trying to fight the oppressive policies of the United States.
Qadhi paced the worn, gray carpet. “There were even Muslims on that plane!” he said. “I mean, what world are you *living* in? How angry and overzealous are you that you simply forget about everything and you think that this is the way forward?”
Over the next year, Qadhi was thrust into the center of a crucial struggle — for the minds of his young students, the trust of his government and his own future as America was waking to a new threat. Since 2008, more than two dozen Muslim-Americans have joined or sought training with militant groups abroad. They are among the roughly 50 American citizens charged with terrorism-related offenses during that time. These suspects are a mixed lot. Some converted to Islam; others were raised in the faith. They come from a range of socioeconomic backgrounds and have migrated to different fronts in their global war, from Somalia to Pakistan. Their motivations differ, but the vast majority share two key attributes: a deep disdain for American foreign policy and an ideology rooted in Salafiya.
In the spectrum of the global Salafi movement, Qadhi, who is 36, speaks for the nonmilitant majority. Yet even as he has denounced Islamist violence — too late, some say — a handful of AlMaghrib’s former students have heeded the call. In addition to the underwear-bomb suspect, the 36,000 current and former students of Qadhi’s institute include Daniel Maldonado, a New Hampshire convert who was convicted in 2007 of training with an Al Qaeda-linked militia in Somalia; Tarek Mehanna, a 28-year-old pharmacist arrested for conspiring to attack Americans; and two young Virginia men held in Pakistan in 2009 for seeking to train with militants.
Qadhi said that none of those former students had approached him for counsel. But in recent years, countless others have come to him with questions about the legitimacy of waging jihad. “We’re finding ourselves on the front line,” Qadhi said. “We don’t want to be there.”
During the months I spent in the insular world of young American Salafis, it became clear how pressing those questions are for many conservative Muslims who have come of age after 9/11. They have watched as their own country wages war in Muslim lands, bearing witness — via satellite television and the Internet — to the carnage in Iraq, the drone attacks in Pakistan and the treatment of detainees at Guantánamo. While the dozens of AlMaghrib students I interviewed condemned the tactics of militant groups, many share their basic grievances. They are searching for the correct Islamic response, turning to the ancient texts that guide their American lives. Their salvation, they say, hangs in the balance.
This is what makes Qadhi such a pivotal figure in a subculture that is little understood, even by the law-enforcement officials who monitor it. He is the rare Western cleric fluent in the language of militants, having spent nearly a decade studying Islam in Saudi Arabia, steeped in the same tradition that spawned Osama bin Laden’s splinter movement. Arguably few American theologians are better positioned to offer an authoritative rebuttal of extremist ideology. But to do that, Qadhi says he would need to address the thorny question of what kinds of militant actions *are* permitted by Islamic law. It is a forbidden topic for most American clerics, who even refrain from criticizing their country’s foreign policy for fear of being branded unpatriotic.
For an ultraconservative cleric like Qadhi, the picture is more complicated. Engaging in a detailed discussion of militant jihad — a complex subject informed by centuries of scholarship — risks drawing the scrutiny of law enforcement and, Qadhi fears, possible prosecution. If he were to acknowledge that Islamic law endorses the legitimacy of armed resistance against Western forces in Muslim territory, he could give a green light to the very students he claims he is trying to keep off the militant path. Yet by remaining silent, Qadhi says he is losing the credibility he needs to persuade them of his ultimate message: those fights are not theirs, as Westerners, to fight. “My hands are tied, and my tongue is silent,” he said.
Militant clerics abroad have filled the void, none more than Anwar al-Awlaki, the American preacher who is now believed to be in hiding in Yemen with Al Qaeda in the Arabian Peninsula. Awlaki has been linked to numerous plots against the United States, including the botched underwear bombing. He has taken to the

Internet with stirring battle cries directed at young American Muslims. “Many of your scholars,” Awlaki warned last year, are “standing between you and your duty of jihad.”

It was near midnight last October when Qadhi’s teenage acolytes surrounded him at Thomas Sweet, an ice cream parlor in New Brunswick, N.J. Puma sneakers peeked out from under long robes. Suddenly the lyrics “shake your booty” blasted over the speakers. The young men leaned in closer, unfazed. Between helpings of mango-flavored sorbet, Qadhi pontificated on medieval Islamic theology. “We have a reasonable religion,” he said. “We’re a very logical, rational group of people.”

Qadhi’s students hang on his every word. They huddle around him — between classes, during meals, even in bathrooms — pinging him with questions. Their reliance on Qadhi is a product of contemporary Islam, a decentralized religion with no clear authority. Clerics with the highest level of scholarship are considered invaluable guides, especially in the secular West.

Qadhi was in New Jersey that weekend to teach a seminar on the concept of faith-led action. During a break, a dozen young men flocked to him once again. A soft-spoken engineer lobbed the first question: Wasn’t it hypocritical for the same Western imams who supported the Afghan resistance against the Soviets to now condemn the jihad against American troops? After all, another student asked, don’t civilians in Iraq and Afghanistan “have an obligation to do something to defend themselves?”

“I am not commenting on what they should or should not do,” Qadhi replied. “I am commenting on what you should do as American Muslims.”

They had heard it before: vote, educate your neighbors, protest peacefully. But is that what Islam commands when your people are dying? The question haunts some of Qadhi’s brightest students. One of the deepest Islamic principles is that of the *ummah* — the global community that unites all Muslims. The Prophet Muhammad was said to have likened it to the human body. If one part hurts, the whole body aches.

One of Qadhi’s followers, a feisty 27-year-old New Yorker, compared his experience of watching bombs fall on Iraq to what other Americans might feel at seeing “California being ravaged day in and day out. How would you feel?” He said he understood why Qadhi could not speak expansively about the conflicts overseas. Even so, he asked, who has greater credibility: the cleric living comfortably in America or the militant “in the cave” who sacrificed everything for his beliefs? “One thing about Awlaki no one can deny,” he said, “this man is fearless.”

That Awlaki carries weight with conservative Muslims underscores both the rivalry and proximity between militant and nonmilitant Salafis. Qadhi and Awlaki have parallel pasts: they were both born in the United States, spent part of their youth in the Middle East and entered the American Salafi movement just as it was on the rise. Awlaki later spent time in a Yemeni prison and emerged in 2008 calling for Muslims to fight the West. Recordings of his sermons continued to be sold at AlMaghrib seminars even after the students were ordered to stop in November 2009, following the Fort Hood shootings that Awlaki praised. Many of the students had grown up listening to him preach on his CDs. They trusted him then, one told me, why not trust him now?

For the tiny fraction of AlMaghrib’s students who have turned to violence, many are what Qadhi refers to as “sympathizers” of militant anger. These young, politically attuned Muslims are taken with events that don’t even register with most Americans, like two recent terrorism cases in New York that drew overflow crowds, Qadhi’s students among them. “If any Muslim is oppressed anywhere, the prevailing wisdom is that we should be standing up to help them — if we’re true believers,” says Ify Okoye, an AlMaghrib volunteer from Beltsville, Md. Sometimes, she added, “you feel guilty for living here.”

Many of today’s young American Muslims are the children of educated, successful immigrants whose passage to the United States came smoothly, in contrast to Europe’s largely working-class Muslims. For years, this bolstered the theory that American Muslim youth had been spared the alienation that fostered militancy in Europe.

But alienation has many faces. America’s youngest Muslims have grown up in a newly hostile country, with mounting opposition to the construction of mosques, a national movement seeking to ban courts from consulting shariah, or Islamic law, and rising hate crimes against Muslims. While some young Muslims have sought distance, abandoning Islam and even changing their names, others have experienced a spiritual awakening. The most conservative have found a home in Salafiya.

Salafis take their name from the Arabic word “*salaf*,” meaning “ancestor.” Their movement seeks to reclaim Islam’s lost glory by purging the faith of modern influences. Salafis model their lives after the first Muslims,

beginning with the Prophet Muhammad, the seventh-century Meccan merchant to whom the Koran, it is believed, was revealed. They encourage a direct relationship with God through a literal reading of Islam's primary sources — the Koran and the Sunnah, the prophet's sayings and deeds.

Within the faith, Salafis have a reputation for intolerance and divisiveness. Like other religious conservatives, they tend to be adamant in their strict interpretations, shunning those who disagree. They denounce the veneration of saints, common among some Sufi sects. Many Salafi men insist on a fist-length beard and wear their trousers above the ankle in a desire to emulate the prophet.

While versions of Salafiya have persisted through history, its current iteration derives largely from the puritanical, 18th-century school of Saudi Islam known as Wahhabism. Today's Salafis share the same basic theology but differ on how to manifest it. Many are apolitical, while another subset engages in politics as a nonviolent means to an end — namely, an Islamic theocracy. A third fringe group is devoted to militant jihad as the only path to Islamic rule and, ultimately, heaven. All three strains have surfaced in the West, where the movement has flourished among the children of immigrants. "It's about this deep desire for certainty," Bernard Haykel, a leading Salafi expert at Princeton University, says. "They are responding to a kind of disenchantment with the modern world."

One balmy afternoon last spring, Qadhi walked across Yale's campus, stepping around a throng of teenagers he dismissed, irascibly, as "the prefreshie tour." He stopped before the tomblike building that houses the elite Skull and Bones society. Qadhi stared up at the brownstone facade, as if imagining the secrets it held. "You're set for life," he said, squinting through his sunglasses. "You get to thinking that everyone in the White House was a part of this, and it's easy to see why people think there is a conspiracy." After a pause, he added, "I don't believe those theories."

Qadhi is hardly disenchanted by the trappings of Western life. He has more than 10,000 fans on Facebook, hundreds of sermons on YouTube and a growing Twitter following. He drives a black, leather-interior Honda CR-V, often pulling into a Popeye's drive-through for popcorn shrimp and gravy-slathered biscuits. He is planning a trip to Disney World with his wife, Rumana, and their four children.

Some of Qadhi's followers find his ease with American culture perplexing, even suspicious. Yet it is his unapologetic comfort with America — his assertion that Muslims belong here as much as anyone — that has also made him a point of pride for many young Salafis. "We need to make sure that our children can live freely, and we're going to *fight* for that freedom," he told me one afternoon. "And every time I use that word, I need to make a disclaimer — I don't mean 'fight' in the Tea Party sense of overthrowing the government."

A stout five-foot-five, Qadhi chuckles easily and speaks rapidly, his hands punctuating his words with slicing motions. He is confident to a fault, often trailing a sentence with "God protect me from arrogance." In class, he can be staid and professorial, with flashes of frivolity. He once implored students to "make love, not jihad." He blends religious piety with entrepreneurial savvy. More than 20,000 people have signed up for "Like a Garment," Qadhi's new online seminar about sex in Islamic marriage. "I give explicit detail on how a man should give his wife an orgasm in a permissible manner," he explained.

Qadhi's platform is the AlMaghrib Institute, where he serves as academic dean. Founded in 2002 by Muhammad Alshareef, a Canadian cleric then living in Alexandria, Va., AlMaghrib is now an international enterprise, offering seminars in the United States, Canada and Britain. It reported nearly $1.2 million in revenue in 2009 and aspires to become a full-time Islamic seminary, albeit with an air of corporate America. During a recent retreat in the mountains of Ontario, AlMaghrib's clerics whizzed along snowy bluffs on sleds drawn by Siberian huskies. "As long as you don't touch them, it's all right," Qadhi said, referring to his interpretation of Islam's ruling on dogs.

Last June, Qadhi and his family left New Haven for the outskirts of Memphis, settling into a spacious new ranch house in a well-tended subdivision. Still at work on his doctoral thesis, Qadhi found a job teaching Islamic studies at Rhodes College, which is affiliated with the Presbyterian Church.

It is something of a curiosity that Qadhi, who was raised in Saudi Arabia, Islam's birthplace, now lives in a landscape marked by church steeples and "What would Jesus do?" bumper stickers. But the American South seems to agree with Qadhi, who often preaches on the Islamic principle of polite conduct. He takes to the gentility of his students at Rhodes, who call him sir. There is no better place to be Muslim than in America, he says, because as a minority "you feel your faith." At times, he seems oddly Pollyanna-ish about his future in Tennessee, where someone tried to torch the site of a planned mosque last year. Qadhi concedes that living

someplace like Saudi Arabia might be easier, but "it's not my land at the end of the day," he said. "I am an American. What else can I say?"

In Qadhi's current incarnation, it is hard to make out the preacher he refers to as "the old me." That Qadhi lives on via YouTube. In a television show recorded in Egypt in 2001, Qadhi, then 26, explains that one form of *kufr*, or disbelief, is adhering to man-made laws over God's law. "Can you believe it?" he says. "A group of people coming together and voting — and the majority vote will then be the law of the land. What gives you the right to prohibit something or allow something?"

His young students nod their heads. "Islam is a complete way of life, a complete submission to Allah and to the rulings of Allah," Qadhi said on the show. "It is a complete package."

Long before Salafiya came to the United States, Qadhi's father arrived in Houston from Karachi, Pakistan. It was 1963, and the young bachelor, Mazhar Kazi, enrolled at the University of Houston with his sights on a medical degree. One of the first foreign-born Muslims to settle in the area, Kazi took a job as a busboy and tended to his studies. He eventually married a microbiologist from Karachi and founded the area's first mosque.

Their son, Yasir, was born in 1975, the second of two boys. When Yasir was 5, the Kazis moved to Jedda, Saudi Arabia, intent on exposing their sons to Islam and Arabic. Kazi took a job teaching medicine at the King Abdulaziz University. The family spent summers in Houston, but the boys were mostly shaped by life in Jedda, a blend of British expat culture and strict Saudi norms. Qadhi (who later changed the spelling of his surname to reflect the correct pronunciation) was precociously bookish. On weekends, he searched the local library for Tolstoy and Hemingway. By 15, Qadhi had memorized the Koran and graduated from high school, two years early, as valedictorian. Following his father's wishes, he enrolled at the University of Houston in 1991, majoring in chemical engineering.

Qadhi had never attended a class with women and was shocked by campus life. He took refuge in the Muslim Students Association, a close-knit group of mostly Arab and South Asian immigrants. He was soon leading study circles and delivering effusive Friday sermons.

His introduction to Salafiya came in his sophomore year, when a Muslim convert from Colorado visited campus. A tall, regal man with a wispy white beard, the preacher displayed a command of Islam that Qadhi had never seen. When asked a question, he closed his eyes and recited a litany of evidence from the Koran and the Sunnah. This approach, a cornerstone of Salafiya, appealed to Qadhi's empiricism. "It's so disciplined and academic," he said. Then 17, Qadhi began driving through the night to attend Salafi camping retreats, where legendary clerics lectured from Jordan and Saudi Arabia via teleconference. He drilled into Salafiya with a discipline that defied his adolescence. At a retreat in Boulder, Colo., some of Qadhi's friends skipped out to go fishing. When they returned, Qadhi refused to share his notes. "It was very clear that this guy was going to become something and we weren't," said one of the friends, Amad Shaikh.

At another retreat, Qadhi fell under the sway of Ali al-Timimi. A cancer researcher from Maryland, Timimi had studied Islam in Saudi Arabia and helped spread the American Salafi movement, which began in the early 1980s as a patchwork of nonprofit groups subsidized by the Saudi government. Through shipments of free Korans and other texts, Salafi doctrine developed a strong presence at American mosques, prisons and Islamic schools. By the 1990s, the Salafi community numbered in the low thousands.

American Salafiya mirrored the movement abroad. It was largely apolitical until the first gulf war, when the United States set up a base in Saudi Arabia. The presence of American troops on Saudi soil, home to Islam's holiest sites, was a defining moment for Salafis, giving rise to a political awakening and fueling bin Laden's militancy. In America, some Salafi clerics began calling for political action against the Saudi regime, while others remained loyal. Qadhi was torn.

But on other matters, he steered his fellow students in Houston toward a strict code. They instituted sex segregation, policing each other for signs of deviation. When a Pakistani student organization sponsored a rock concert, Qadhi and his friends distributed fliers warning the crowds that Islam prohibited music. They did not see themselves as stakeholders in America, Shaikh recalled. Their goal was to spread Islam and then migrate to Muslim lands. "It was almost cultish," Shaikh said.

For all his stridency, Qadhi broke one significant rule: he fell in love outside the bounds of arranged marriage. The young woman, Rumana, was a quiet, graceful college student of Indian descent. But Qadhi's parents had their sights on other marriage candidates, and the courtship faded.

During college, jihad loomed in the backdrop of Qadhi's life. Like many of his peers, he was taken by the legend of the American Muslims who had fought with the Afghan mujahedeen against the Soviets. Back then, talk of jihad carried little taboo, given the United States' role in financing the resistance. Qadhi knew several men who later fought in Bosnia. Noble as it seemed, he said, "I thought there were more productive ways for me to spend my life."

He had long thought of becoming a Muslim scholar. Shortly before graduating, Qadhi applied to the Islamic University of Medina, a leading Salafi institution. After enrolling in the fall of 1996, he called Rumana. "I can't live without you," he told her. "Are you willing to live a difficult life?"

Qadhi and his new wife settled into a spare apartment, and he plunged into round-the-clock study. Life in Medina deepened his faith while narrowing his tolerance for the outside world. He came to identify with political Salafiya, denouncing secular democracies and declaring Sufis and Shia "heretics." He took up the Palestinian cause — a pathway, he said, to the anti-Semitic rhetoric that ran rampant in his circles.

In the summer of 2001, Qadhi traveled to London to teach at an Islamic conference. At the end of a class, he went into a diatribe arguing that Israel did not rightfully belong to the Jewish people. "Hitler never intended to mass-destroy the Jews," Qadhi said, telling the audience to read a book about "the hoax" of the Holocaust. He went on to say that most Islamic-studies professors in the United States are Jews who "want to destroy us."

Looking back, Qadhi said he fell down a slippery slope where criticism of Israel gave way to attacks on Jews. Beneath the vitriol, he said, was a sense of victimization — that non-Muslims were to blame for the afflictions of the Muslim world. "When you're young and naïve, it's easier to fall prey to such things," said Qadhi, who publicly recanted years later. Last August, he joined a delegation of American imams and rabbis on a visit to the Auschwitz and Dachau concentration camps, which he said left him "sick" and more embarrassed by his Hitler remarks.

"It was a pre-9/11 world," he said. "The circumstances did not dictate that we think critically."

Two months after the London episode, Qadhi was walking to his mosque in Medina when a friend came running. "Yasir, Yasir, did you hear what happened?" the young man called out. Qadhi rushed to a neighbor's apartment in search of a television, just as the second tower collapsed.

In the aftermath of 9/11, the American Salafi movement fell apart. As federal agents raided Muslim mosques, charities and businesses, the most prominent Salafis vanished from clerical life or landed in prison. Some of the movement's key figures were convicted on charges unrelated to terrorism, ranging from tax evasion to visa-immigration violations. "All of these people were jailed for different things, but if you look at them collectively, you see the Salafi movement," Idris Palmer, a onetime Salafi activist, told me.

Law-enforcement officials say that there was no policy singling out Salafis. They were rushing to root out a new enemy, with little time to grasp the theological differences separating nonviolent fundamentalists from the creed of the hijackers. Many agents did not even know what a Salafi was "and still don't," says Christopher Heffelfinger, a security analyst who consults with the government. Northern Virginia — then a nexus of the American Salafi movement given its proximity to the Saudi Embassy — became a focal point. Anwar al-Awlaki was still preaching in Virginia when federal agents raided 15 local Islamic offices and homes. "It's a war against Muslims and Islam," Awlaki bellowed in an audio address. "It's happening right here in America."

The most high-profile Virginia case involved Qadhi's onetime mentor, Ali al-Timimi, who regularly preached at a Falls Church mosque. At a dinner five days after 9/11, Timimi and some of the mosque's young congregants discussed how to respond. Prosecutors later accused Timimi of spurring the men to wage jihad against American troops overseas, saying they practiced shooting at a paintball facility. At issue in the case against Timimi were his words: his lawyers argued that he recommended that the men move to Muslim countries, while prosecutors said he was inciting jihad. They highlighted comments by Timimi unrelated to the dinner, including politically charged speeches and a statement in which he celebrated the Columbia Shuttle disaster. He was convicted and sentenced to life in prison.

From Medina, Qadhi followed the case closely. For American clerics, he said, the message was clear: those who engage in controversial rhetoric are treading on thin ice. While 9/11 had shaken Qadhi's movement, it also unsettled him personally. "No matter how strange this sounds, after having lived in Saudi Arabia for so long and also in America for so long, I could fully understand the fear, the anger, the frustration, the paranoia on both sides," Qadhi says. "I could understand 'they' and 'us.' "

Qadhi began to wrestle with some of his own beliefs. It troubled him that Salafiya, even in its nonmilitant form, had helped shape the ideology of groups like Al Qaeda. “What type of Islam are we going to teach people?” he recalled thinking. “This isolationist Islam? This Islam of ‘us’ versus ‘them’ — is that healthy? Is that what my religion is?”

At the time, Qadhi was on track to become Medina’s first American doctoral candidate. He wondered if he had a more promising future in America, where the Salafi movement, bereft of leaders, was in crisis. From Houston, Qadhi’s father — who had retired and was volunteering as a prison chaplain — encouraged his son to leave Saudi Arabia, which he believed had left Qadhi “totally brainwashed.”

“I said, ‘Come back to America; this is your land,’ ” Kazi said in an interview at his home, sitting in what he called his “Archie Bunker chair.”

In 2004, Qadhi applied to Yale. Some of his contemporaries saw the move as strategic. “It was a stepping stone,” Imam Abdullah T. Antepli, the Muslim chaplain at Duke University, told me. “He knew that with that Yale ticket, people would take him more seriously.”

Qadhi’s Saudi professors were aghast that he would switch to a Western university to study Islam. Yale’s professors were also surprised. The religious-studies department had never taken on a graduate of the Saudi educational system. “You admit someone from Saudi Arabia, you don’t know how much intolerance you let into an American university,” says Frank Griffel, a professor of Islamic studies.

But Qadhi impressed Griffel as “profoundly intelligent” and willing to engage in critical thinking. At Medina, Qadhi’s studies revolved around the search for an absolute religious truth. At Yale, the line of inquiry was markedly different. In Qadhi’s first class with Griffel in the fall of 2005, the subject was a 12th-century Sufi jurist. “You, Yasir, probably know more about this guy,” Griffel said. “But we’re going to study *how* to study him.” Qadhi was struck by this analytical approach. “The question is more historical in nature — it’s about where did this idea come from, how did it affect later ideas,” Qadhi said.

For Qadhi, the Koran remained the unequivocal word of God. But he began to think more critically about the “man-made” canon that informed Islamic theology. So much of Qadhi’s intransigence — especially toward other Muslim sects — was based on the view that his tradition was divinely ordained. He came to see Salafiya as yet another “human development” that was handed down over generations and therefore subject to imperfection. “I realized that, in many issues, only God knows the ultimate truth,” he says.

Qadhi landed on the American preaching circuit with force, and his following skyrocketed among young Salafis. America’s leading clerics were converts who had risen to prominence because they could translate an intricate theology into an American vernacular. Qadhi did the same but as the proud son of Muslim immigrants. Plus he was a Salafi — or so it seemed.

In July 2006, at a conference in Copenhagen, Qadhi did the unthinkable: he shook a woman’s hand in a spontaneous challenge to her perception of fundamentalists, he said. The woman, Mona Eltahawy, a columnist on Arab and Muslim issues, wrote about the exchange, which became known in Salafi circles as the “when-Yasir-met-Mona moment.” The handshake drew a death threat from a man in London.

The following year, Qadhi further pushed the limits, making a pact of “mutual respect and cooperation” with American clerics of the Sufi order, Salafiya’s longtime enemy. Several of Qadhi’s former Saudi professors publicly assailed him, a signal he had become too prominent for them to ignore. ☐Qadhi began to step away from the Salafi label, rebranding his movement “orthodox with a capital O.” While he remained devoted to Salafiya’s core tenets, his followers struggled to keep pace with his changes. Others remained skeptical. “Is he being instrumental and opportunistic, or has he really abandoned some of these Salafi beliefs?” said Haykel, the Princeton professor. “He’s engaged in an incredible performance of reinvention that I’m not sure he’ll be able to pull off.” The same question hovered over Qadhi’s institute, whose founder, Alshareef, once gave a sermon titled “Why the Jews Were Cursed.”

Meanwhile, as Qadhi honed a new message, he was roundly dismissed on jihadist forums as a “sellout.” One detractor was Samir Khan, a young blogger from North Carolina who eventually moved to Yemen and now runs the Al Qaeda magazine, Inspire, according to law-enforcement officials.

While Khan was still living in the United States in 2007, he wrote several blog posts about Qadhi. “He has done good, and we do not deny this,” read one. But Qadhi’s “wrongdoings,” he continued, “can destroy the Muslims.”

Suspicion surrounded Qadhi. In February 2006, he was crossing from Canada into the United States when American border agents pulled aside his van and ushered his family into a room. An agent told Qadhi he was

"waiting for permission from Washington" to let Qadhi back into the country, he recalled. They were freed more than five hours later.

It was the first sign that Qadhi was on the terrorist watch list. From then on, he and his family traveled separately. "I'm not going to be humiliated in front of my kids," he said. At airports, he became accustomed to long interviews with border agents, who downloaded his laptop hard drive and searched his cellphone. They photocopied notes he kept on his sermons and even asked for his definition of jihad. F.B.I. agents in New Haven questioned him about two American acquaintances who had been charged with terrorism-related offenses. Qadhi said he knew nothing of their activities, but the agents pressed him to report on anyone who expressed views that "might be of interest," he recalled. He refused, saying, "This is America, not Soviet Russia or East Germany."

Increasingly, Qadhi felt backed into a corner. In August 2006, at a meeting for Muslim leaders in Houston, he walked up to Daniel W. Sutherland, a Homeland Security official. "Hi, I'm a pacifist Salafi," Qadhi said to him. Looking stunned, Sutherland sat and talked with Qadhi for more than an hour.

Then in May 2008, Qadhi received an invitation from Quintan Wiktorowicz, an analyst for a government agency that was hosting a conference on counterradicalization. (Wiktorowicz was recently named a senior director at the National Security Council.) In attendance were British and American intelligence officials, including the director of Homeland Security at the time, Michael Chertoff.

During a break, Qadhi spotted a Houston acquaintance who happened to work for Chertoff. "I said, 'Don't you think it's ironic that on the one hand, you're reaching out for my expertise and wanting my help, and on the other hand, you're harassing and intimidating me as if I'm a potential terrorist?' "

In the West, jihad is often depicted as a self-contained, violent cause. But in Qadhi's world, it exists within a panoply of complex and overlapping issues. The most immediate question is not whether to fight overseas but how to make peace living in the pluralistic West.

Debates pivot on arcane theological points from the ninth century, a time when religious empires reigned, not secular nations. Classical scholars reference a world divided between *dar al-Islam*, the land of Islam, and *dar al-harb*, the land of war. But which land is America?

"If we're not at war, why is America killing Muslims throughout the world?" says Basil Gohar, 30, who has studied with Qadhi. "If we are at war, how can we live in America peacefully?"

Even absent the question of war, Western Salafis ponder their loyalties. Internet forums buzz with talk about the concept of *al-walaa wal-baraa*, which is rooted in Koranic verses dictating allegiance to Muslims over non-Muslims. Qadhi's students are divided over whether to vote, pay taxes that support the military or even celebrate Thanksgiving. "These sorts of things, they are the fault lines," says Okoye, the student from Maryland.

Qadhi sees in his students an earlier version of himself — the passionate Salafi who took comfort in a black-and-white world. He prods them to think "in colors" and find a balance between loyalty to Islam and to America. He urges them to pay taxes and vote, drawing the line at military service, given Iraq and Afghanistan. "There is no draft," he said. "Thank God for that."

For Qadhi and his students, nothing tested those loyalties more than the events after the underwear-bomb plot of December 2009. Whenever a terrorism suspect is identified, AlMaghrib runs the name through its database of alumni to see if there is a match. "Oh, my God," Qadhi said when a colleague told him that the 23-year-old suspect, Umar Farouk Abdulmutallab, had been his student.

Qadhi searched his memory. The son of a prominent banker, Abdulmutallab had been living and studying in London. He had taken two AlMaghrib classes before attending the institute's 16-day Houston conference in 2008. There, Abdulmutallab kept mostly to himself. "He never got into political issues," says Abdul-Malik Ryan, 36, a lawyer from Chicago who studied with him every morning.

As media outlets discovered the connection, AlMaghrib's leaders rushed to contain a crisis. The institute's vice president, Waleed Basyouni, reached out to the F.B.I.'s Houston field office. Agents wanted to interview all 156 students who attended the 2008 conference. "I said, 'If you start going to our students and terrifying them, and they stop coming, we will close down,' " he recalled telling the agents. " 'You would be pushing the students to go to basements, small circles, on the Internet. So it's in your benefit that this organization stay open.' "

In previous cases, F.B.I. agents dropped by the homes of some AlMaghrib students, unannounced. This time, they issued a subpoena but agreed to arrange interviews in advance and to send female agents to question the

women. The clerics urged the students to cooperate, but many balked, prompting Qadhi's 50-minute conference call from Yale.

Veering between high-pitched emotion and tedious scholarship, Qadhi argued that the case presented no conflict of loyalties because Abdulmutallab, by all appearances, committed a crime, violating both American and Islamic law.

But, one student asked, what about America's transgressions? Why was Qadhi focused on the militants? He responded that he had bluntly criticized American policies to State Department and other officials, telling them "the root cause of this terrorism is terrorism perpetrated at the state level."

Even so, Qadhi urged his students to "chill out" and use common sense. "You need to look at the repercussions of what you are going to do to yourself, to your family, to your society and to the Muslims that are around you," he said.

The students cooperated, and in subsequent meetings with the F.B.I., an agent told Qadhi and Basyouni that the bureau did not consider AlMaghrib a terrorist threat, said the clerics. (An F.B.I. spokesman declined to comment about Qadhi or the investigation.)

The Abdulmutallab episode drew a new line in the long-distance battle between Qadhi and Awlaki. The Yemeni-American cleric announced that Abdulmutallab's operation was in retaliation for American "cruise missiles and cluster bombs." By then, the United States had authorized the assassination of Awlaki, provoking outrage among many of Qadhi's students.

Qadhi seemed to be riding a pendulum of self-preservation. If he lurched too far toward appeasing the government, he risked losing his base.

That March, Qadhi rose before a crowd of thousands in Elizabeth, N.J., to finally speak about Awlaki. "I am against this preacher when he tells our youth to become militant against this country while being citizens to this country," Qadhi told the packed auditorium.

"But when my government comes and says, 'We're allowed to take him out; we're allowed to kill him; we're allowed to assassinate him,' I also put my foot down, and I say to my own government, 'Shame on you!' "

The audience listened raptly. "Be angry every time a bomb is dropped on innocent civilians in the name of the war on terror," Qadhi bellowed. "Be angry every time our tax dollars are spent to oppress yet another group of innocent Palestinians. Be angry every time more draconian measures are utilized against us in this greatest democracy on earth."

Never before had Qadhi so forcefully condemned America's policies in public. But "channel that anger," he continued, "in a productive manner." He urged a "jihad of the tongue, a jihad of the pen, a jihad that is not a military jihad."

American Muslims, Qadhi told the audience, needed to abide by the laws of their country, understanding that had they been born in Palestine or Iraq, their "responsibilities would be different." He did not elaborate.

It is this kind of ambiguity that gnaws at some of Qadhi's students. "We just get wishy-washy nonanswers," one female student told me, adding that Qadhi's "jihad of the tongue" was unconvincing. Being martyred in the battlefield, she said, is "romantic," while "lobbying your congressman is not."

The call to prayer soars through the Crowne Plaza Hotel in Houston, its lobby adorned with a fresco of the Texan flag. Every summer, AlMaghrib's most-devoted students convene here for a two-week Ilm Summit, transforming the ballroom floor — a corporate tableaux of overstuffed sofas and dim lighting — into a version of Islamic utopia.

"*Ilm*," in Arabic, means "knowledge." From dawn to night, the students immerse themselves in advanced Islamic theology and Koran recitation under the guidance of Qadhi and other clerics. The men favor long tunics, and some women wear *niqabs*, the full-face veil. Most are upper-middle-class college students of South Asian descent who pay $1,500 to attend. To the hotel's Hispanic waiters, they seem otherworldly. The men and women eat, study and even ride the elevators separately.

Yet the so-called AlMaghribis upend easy stereotypes. The women are a forceful presence in class and can be spotted on breaks engaging in fierce arm-wrestling matches. The most dominant trait among the men is a quintessentially American geekiness. Qadhi, like many of his students, is a "Star Trek" fan. His lectures are laid out on PowerPoint as students crouch over laptops. Between classes, talk often turns to the latest AlMaghribi courtship.

The mood darkened last July after Qadhi announced that agents from the local F.B.I. office would be dropping by for a "roundtable discussion." The ballroom fell to a hush as Qadhi and Basyouni led Brad

Deardorff, supervisory special agent of the Houston division, to the stage. He smiled tentatively as Qadhi began a quick speech about the need to counteract extremism. Deardorff talked about the history of militant movements, saying there was "no standard profile for an Islamist terrorist."

Then came the students' questions, submitted in writing. "How do you expect us to help you" read one question, "when there are F.B.I. informants in our mosques?"

"Jeez, that's a tough question," Deardorff said. "We don't target mosques. We do collect domestic intelligence. But mosques are buildings. Mosques don't conspire. Mosques don't blow things up."

The students stared at him incredulously. It struck some as ironic that Qadhi would engage in a public discussion with the F.B.I. about "terrorism" — which they deemed a loaded word — when the underlying theological issues remained off limits. In a poll last year on Qadhi's blog, Muslim Matters, participants ranked "jihad" as the No. 1 subject in which they wanted academic instruction.

There are several kinds of jihad, which is translated to mean "striving in the path of God." While progressive Muslims emphasize the spiritual form, Qadhi and other conservatives say that the majority of the Koran's references to jihad are to military struggle. Qadhi's interpretation makes him neither a hardline militant nor a pure pacifist. While he unequivocally denounces violence against civilians, he believes Muslims have the right to defend themselves from attack. But he says "offensive jihad"— the spread of the Islamic state by force — is permissible only when ordered by a legitimate caliph, or global Muslim ruler, which is nonexistent in today's world.

Such fine distinctions were less pronounced before 9/11, when Qadhi and others preached openly about the glory of Islam's early military triumphs. In a decade-old sermon about one of Islam's landmark battles, Qadhi said, "once a prophet has become ready for jihad, for fighting, then he will not take off his armor until he has actually met the enemy."

By the time he returned to the United States in 2005, AlMaghrib had canceled a popular class on Islam's military history, and its instructors largely avoided current events. Some students inferred from Qadhi's silence a tacit support for militant groups. "Everyone was always like: 'We know he believes it. He can't say it publicly,' " recalled Lauren Morgan, who is 26 and a former student of Qadhi's. She said she and other students had openly sympathized with militants. "I think if you're going down the Salafi interstate, the jihadi exit is open for you," Morgan said. "It's there."

Many students first heard Qadhi denounce jihadist movements almost a year after the London bombings. That same month, June 2006, AlMaghrib released a statement calling terrorism "a perversion of the true Islamic teachings."

The central contest between Qadhi and militants like Awlaki hinges on a rather abstruse point: how to define America in Islamic terms. Qadhi likens his country to Abyssinia, the seventh-century African kingdom that gave refuge to the prophet's followers. In exchange for upholding the laws of the land, they were allowed to worship freely — a contract Qadhi equates to an American passport or visa. Breaking the contract by joining militant groups at war with America constitutes treachery, Qadhi says, which is forbidden in Islam. Awlaki, by contrast, compares America with ancient Mecca, where the prophet's followers were persecuted, forcing them to flee and later fight back.

Critics take issue with the technical nature of the debate. Qadhi's students, they argue, could conclude that joining a militant group is permissible provided they renounce their citizenship. This is further complicated by his refusal to address whether the Islamist uprisings in Iraq and Afghanistan constitute legitimate jihads. Saying yes would open the door to public recriminations, but denying the legitimacy of those insurgencies would fly in the face of Islamic law, says Andrew F. March, a professor at Yale who specializes in Islamic law. "The conflicts in Iraq, Afghanistan and Palestine are unambiguous examples of jihad or war against an outside invader," March says. "There is no mainstream juridical opinion that says that Muslims cannot resist that."

Under mounting pressure from students, Qadhi and another AlMaghrib scholar, Abu Eesa Niamatullah, considered teaching a course on the *fiqh*, or jurisprudence, of jihad. "What stopped us?" Niamatullah says. "Picture two bearded guys talking about the *fiqh* of jihad. We would be dead. We would be absolutely finished."

On Oct. 18, Qadhi posted a 5,000-word essay on his blog, trying to jump-start a discussion on jihad. He argued that extremists cherry-pick verses from the Koran to justify actions antithetical to the faith, while United States policy also plays a central role in radicalizing Muslim youth. What Abdulmutallab did not hear

at AlMaghrib, Qadhi lamented, “was a discourse regarding the current political and social ills that he felt so passionately about, and a frank dialogue about the Islamic method for correcting such ills.”
“It is an awkward position to be in,” he wrote of his situation. “How can one simultaneously fight against a powerful government, a pervasive and sensationalist-prone media *and* a group of overzealous, rash youth who are already predisposed to reject your message, because they view you as being a part of the establishment (while, ironically, the ‘establishment’ never ceases to view you as part of the radicals)?”
One week later, Qadhi was flying through Dallas. He had traveled free of hassle for nine months and seemed to be off the watch list. But now, border agents were stopping him. They wanted to ask a few questions. “Here we go again,” he said.
Qadhi’s ambiguous relationship with the government reflects a quandary facing the Obama administration: whether to engage with Muslims across the ideological spectrum. While many American Muslim leaders have been hit by accusations of extremism, Qadhi is a natural target. Self-described terrorism watchdogs refer to AlMaghrib as “Jihad U.,” and last year, a Fox News reporter called Qadhi a “wolf in sheep’s clothing.”
While Qadhi hardly seems the caricature of his critics’ rendering — the stealth Islamist plotting a shariah takeover of the White House — his views reflect a vision that many Americans would find objectionable. He hopes that the world will someday fully adhere to his faith, he said, conceding that it would most likely be “not in my lifetime.” Egypt’s recent uprising, he wrote on his blog, illustrates that change cannot come from militancy but “begins in the heart and in the home, and it shall eventually reach the streets and shake the foundations of government.”
As the administration confronts domestic radicalization, some government analysts say they have much to learn from clerics like Qadhi. “We’re trying to get our arms around how to engage with Yasir and people like him,” a senior counterterrorism official told me. “It’s a new issue.” One concern, officials told me, is their uncertainty about how world events might harden the thinking of clerics like Qadhi.
In the search for answers, the Obama administration has studied counterradicalization approaches overseas. In Europe, some policy makers argue that nonmilitant fundamentalists are the problem, not the solution, because their rigid interpretation of Islam fuels the very radicalization they profess to fight. The British government was rebuked for providing funds to nonmilitant Salafi organizations.
The U.S. Constitution would prevent such financing. But the question remains to what extent the administration will consult with nonviolent fundamentalists or help them by creating what Qadhi and others call “a safe space” in which Muslims are free to discuss controversial issues without the fear of repercussions. “There is a way to stop extremism,” he claimed, “but it’s not palatable for Americans.”
Qadhi recently went live with a Web site devoted to issues of jihad. He is calling it The J Word.
Other American clerics have also begun to speak out, most notably Imam Zaid Shakir, who posted a widely read letter online aimed at dissuading the “would-be mujahid,” or warrior.
Gone are the days when Qadhi would dismiss teaming up with clerics of different schools. There were too few Salafis left in America. “I need help,” Qadhi told me one afternoon last month.
He was sitting in the library of his new home, where more than 10,000 books line the cherry-stained shelves. Memphis is a long way from the centers of Islamic thought — places like Egypt and Saudi Arabia. It would be folly, Qadhi said, to think that a young American cleric could solve the theological puzzles that have invited centuries of debate.
But he was certain of one thing: only America’s clerics could lead the way forward for their young flocks. “American Muslims are at the forefront in battling Islamic extremism because they have everything to lose if anything else happens,” Qadhi said. “They’ll lose their American identity, and they’ll lose their prestige, whatever prestige remains of our religion that we would like to have in this land.”
Andrea Elliott (a.elliott-reporter@nytimes.com) is a reporter for The Times. She won the 2007 Pulitzer Prize for feature writing for a series of articles about an imam in Brooklyn.
Editor: Joel Lovell (j.lovell-MagGroup@nytimes.com)

http://www.nytimes.com/2011/03/20/magazine/mag-20Salafis-t.html?_r=1&ref=magazine

MIT Again Reviews Status of Women

March 21, 2011

When the Massachusetts Institute of Technology issued a report in 1999 documenting obstacles faced by female professors (and their small numbers), the university quickly captured worldwide attention. Not only was MIT frank about the issues, but senior officials endorsed the report, and pledged reforms. The MIT study was the model for numerous other examinations of similar issues at colleges and universities.

Today MIT is releasing a new report on the status of women, finding "remarkable progress." The number of women on the faculty in the divisions of science (the subject of the original report) and engineering (the subject of a follow-up report) has nearly doubled in the years since the studies were first issued. There are also far more women in senior positions at MIT, which is today led by Susan Hockfield.

But the report also found significant problems, some of which are variations of issues raised frequently by studies of the status of women in academe. For instance, surveys of female faculty members at MIT (which had an unusually high participation rate of about 90 percent) found many women believe that they face significant "service" burdens that hold back their careers.

Other issues, however, reflect some of the advances made at MIT, which the report notes now pays much more attention to trying to attract female scientific talent. "One concern centers on faculty search procedures, which necessarily attempt to identify and eliminate biases in the search process," the report says. "This procedure can lead to the perception that women faculty are unfairly hired, and later, to the incorrect perception that standards of hiring and promotion are lower for women faculty. These misperceptions can erode the confidence of women faculty."

The report is a mix of demographic statistics about women at MIT and the views obtained in the surveys of and discussions with women at the institute. The report makes clear that gender parity is far from a reality at MIT, where men continue to hold solid majorities in most areas. At the same time, the significant roles for women at the institute (president, two of five academic deans, two of six department heads in the School of Science) led several women to tell the report's authors, "who would have thought it possible in our lifetime?"

The percentage of women in the School of Science grew from 8 percent to 19 percent since the first study was released, and many of those surveyed cited specific shifts in both policies and attitudes that contributed to these gains. In the School of Engineering, the gains brought the share of women on the faculty from 10 to 17 percent.

The report cites "[c]hange in attitudes among some male faculty including, (a) awareness that search committees must consciously look for women and minority applicants since diversity is important and since potentially qualified female and minority applicants can be overlooked; and (b) the fact that younger male faculty find it natural to have women in powerful leadership roles."

On a key work/family issue, the report finds that MIT has seen the "removal of the stigma for women bearing children," and that using family leave policies has become "standard practice for female (and male) faculty throughout MIT, a change that was visibly reinforced by locating a new day-care center on Stata's first floor," referring to a major computer science facility. One woman told the authors of the report, "Today junior women faculty can have a child while taking family leave/extension of the tenure clock and get tenure, which had never happened in [the School of] Science at the time our committee was formed in 1995."

Backlash Issues

Several of the issues identified as problems for women today reflect a sense that MIT is officially in favor of advancing women at the university -- and a perception from some that such a commitment must mean that standards are being compromised at some level.

In one discussion held with women on the faculty as part of the preparation of the report, one faculty member reported that "undergraduate women ask me how they should deal with their male classmates who tell them that they only got into MIT because of affirmative action." That comment, the report says, "prompted some women to note that when they win an award or other recognition it is not uncommon for a colleague on the selection committee to say, 'it was long overdue that the award be given to a woman,' indicating that gender was a significant factor in the selection. These kinds of statements deprive the awardee of the satisfaction of knowing that it was purely because of respect for her accomplishments that she got the award."

With regard to hiring and promotion, the report notes that MIT has made significant efforts to educate search committees about the way bias can affect the way women are evaluated, and that the sources of bias affecting

women at MIT can be scholars elsewhere. For instance, MIT has focused on the issue of letters of recommendation -- which can be extremely influential for highly coveted positions at an institution like MIT -- and the way women may be evaluated more on "temperament" than on their science.

But these various education efforts are having an unintended consequence, the report finds: "the perception that standards for hiring and promotion of women faculty are lower than for male faculty." One woman is quoted in a typical comment as saying: "In discussions I hear others saying 'oh, she'll get tenure ... because we need to have women.' Makes it sound like the standards of excellence are not the same for men and women."

The report finds that these attitudes are "disquieting to women faculty," quoting women as saying, "I am very worried about making too much effort to recruit women, and the perception that women are not as good." And: "I felt I was invited to interview because I was dazzling, but now I wonder...."

All Women Aren't 'Soft and Sweet'

The report notes that one of the continuing problems faced by women is a perception that they are all "soft and sweet" and possess certain stereotypical characteristics, and that they are somehow disappointing when they don't fit into those expectations.

"There is an expectation of niceness, sweetness. It's everywhere. Students, collaborators all make this mistake," one woman told the authors of the report.

The flip side of these expectations is also problematic, the report says. It notes that "assertive behavior may be judged as inappropriately aggressive in a woman, but applauded in a man." One faculty member commented that the "acceptable personality range is narrower for women than men" and that "at a retreat, a male colleague commented on a top woman giving a talk 'she's awfully aggressive, isn't she?'"

Related to these stereotypes, women reported that it is assumed that they -- more than their male colleagues -- will make time to be a mentor, and will be willing to talk about such issues as work/family balance before any audience. In fact, some women reported that they don't have time to be mentors or a desire for public discussion of their work/family issues.

Work and Family and Bias

On the issue of work/family balance, the report notes that there is a specific set of "biological challenges" faced by women that are not the same as those for men. And the report applauds policies on family leave, child care and other related issues that have helped many women (and men).

But the report notes that even though "family friendly" policies are open to and used by men as well as women, many female faculty members feel that these issues are considered theirs alone. One woman was quoted as saying: "Why does 100 percent of the conversation about balancing work and family only involve women? At a departmental visiting committee, I was asked in hushed tones, 'How's daycare?' I wanted to say, 'Why did you ask me, I don't have any kids?'"

And some women interviewed cited stereotyping, "especially among older male faculty, that being a parent and a successful MIT scientist is not possible." One woman told the authors of the report: "An older colleague told me I would not get tenure if I was bouncing a kid on my knee at night."

Generally though, the report notes that women feel much more included at MIT than did those interviewed for the original studies on the status of women at the university. In several instances, women reported that they are treated better at MIT than when they interact as part of the international scientific world.

One woman was quoted as saying: "My field is bad [for women] in Europe. I won't even go there any more. Germany and Switzerland are terrible for women in my field."

Another said: "I am tired of sending notes to organizers of scientific meetings telling them to put women on scientific programs as speakers. It is embarrassing to have to do this. I know many women scientists who do it. There need to be mechanisms that make it unnecessary for professional women scientists to have to do this, such as requiring there be women on the program in order to receive federal funding for a meeting. NIH used to require this. But what can one do about meetings not funded by NIH? Meetings in Europe are often the worst."

— Scott Jaschik

http://www.insidehighered.com/news/2011/03/21/mit_issues_new_report_on_status_of_women

'The Lab'

March 28, 2011
With a Ph.D. in chemical engineering and a faculty position in Harvard University's School of Engineering and Applied Sciences, David Edwards might not immediately strike you as the artsy type. In a way, that's the point.
Edwards, who is Gordon McKay Professor of the Practice of Biomedical Engineering, is also the founding director of two "artscience labs": Le Laboratoire, in Paris, and the Idea Translation Lab at Harvard. Both are predicated on the notion that "the core of creativity" is the "fused process of artscience" -- that is, the natural progression through which we translate new ideas into reality, drawing on both aesthetic and analytical thinking. So Edwards writes in his new book, *The Lab: Creativity and Culture* (Harvard University Press). Roughly speaking, Le Laboratoire is a sort of public scientific laboratory with a focus on art and design, while the Idea Translation Lab adds a higher education emphasis in bringing this model to Harvard students and faculty.
Inside Higher Ed interviewed Edwards via e-mail to learn more about artscience and idea translation, and why they're important in higher education today.

Q: What is artscience? What does it look like, and how does it work?

A: Art, like science, can be meaningfully understood as process or as outcome, the distinction between the experience of discovery and discovery itself. We think of art, in the sense of process, as a kind of aesthetic method, guided by intuition, enveloped by ambiguity, and thriving in uncertainty, while we think of science, as process, as a kind of scientific method, guided by deduction, enveloped in reductive clarity, and thriving in certainty. In reality creators, artists, scientists, however you wish to assign the label, do not really create, or as I speak of it, translate their ideas from conception to realization through one pure method or another, but through a synthetic process of idea development that fuses intuition and deduction, analysis and dream, and this universal creative process is what I mean by artscience. It is in my mind worth a special name in a world where the avalanche of information leads us to divide up knowledge, and finally creative process, into smaller camps, disciplines, institutions, where we alternatively encourage dream or analysis, induction or deduction, and this is fatal to the creative process. It is essential to realize the universality of the creative process, not to kill it in our effort to catalog its myriad results.

Q: How did Le Laboratoire and its offshoots come about? What was the original idea -- and how did it become a reality?

A: Very briefly, Le Laboratoire arose out of my efforts at Harvard University to create an environment where idea development might take place, with educational, cultural, humanitarian, and commercial benefits, and the public might enter into the creative process in a kind of ongoing cultural dialog. It emanated from a book I began to write around 2005 when I left the university to live in Paris. In Paris I made an attempt to build this organization, which in its experimental nature needed in my mind to be independent of any particular institution, and in 2007 opened Le Laboratoire. The network of organizations, or artscience labs, which eventually came into existence from 2005 through 2010, mostly in France and the USA, came to serve, in aggregate, as a kind of idea funnel through which ideas that we developed, often starting with seed ideas tossed around by high school or university students, sometimes emerged as very novel commercial designs, or art exhibitions, or occasionally humanitarian interventions. The original idea is expressed in the last chapter of my book *Artscience*, as a dream of a creative home where I and others could create together and in ways that allowed our ideas to at least have the chance to beneficially change a world that is in many ways changing with breathtakingly little dialog around its design.

Q: Can you give an example or two of exhibitions or products from Le Laboratoire and/or the Idea Translation Lab and explain how they exemplify artscience?

A: A Laboratoire exhibition in 2008 by the Indian artist Shilpa Gupta started with an experiment around the hypothesis, if I can put it that way, that Shilpa might express the connection between political terror and the unconscious mind through her art. This led to a collaboration with the Indian neuroscientist and psychologist

Mahzarin Banaji, who teaches at Harvard, and finally to a stunning work of art, 4000 microphones suspended in the form of a cloud, and from which voices sing, streams rustle, train whistles blow, as a kind of unconscious mind of society, more literally an object that speaks in a way for the voiceless majority that is typically the victim of terror, and as Shilpa experienced it herself in the weeks before the exhibition when Bombay (Mumbai) was the scene of a serious terror incident. Here is a work of art, since having traveled to museums around the world and now part of the permanent collection of the Louisiana Museum in Denmark, which, when Mahzarin saw it for the first time in Paris, made her exclaim: I never thought I would live to see the unconscious mind!

Where in all this is artscience? It is in the creative process itself, of course, but made perhaps more obvious, and even fruitful, by bringing together two great creators, one an artist, the other a scientist, and, led by a shared dream, helping them find a common process, the artscience process.

The idea of breathing chocolate, which came out of a lunch I had with the French chef Thierry Marx, as an experiment of culinary art at the frontier of aerosol science, led to an exhibition, where the first experiences of breathing chocolate took place, and eventually, through a series of unlikely "exhibitions" from the Cannes Film Festival to store sales around the world of an increasingly commercial product, Le Whif, and, later, Le Whaf, which are now part of a startup company, led by a former Harvard student, and the basis of a new approach to healthy eating, none of this being obvious from the start. The idea began as a kind of artistic experiment, was for years an educational and cultural experiment that enjoined students and artists, and finally became commercial. We are now working on humanitarian applications ranging from iodine to iron for the developing world. So in this case the artscience showed up at each critical juncture in a long creative development process, moving from exhibition to exhibition, with multidisciplinary teams from around the world.

Q: You write that the "assumption that Le Laboratoire's founders' intentions would generally be understood ... quickly proved wrong, as many of our early assumptions did." In what ways have Le Laboratoire and the Idea Translation Lab tended to be misunderstood? Has this continued to be a problem?

A: The educational, cultural, commercial and humanitarian partners needed to make an artscience lab of this kind sustainable and fruitful over a long period of time will not enter into the experimental process until they see value produced. The model is new, but even more importantly, this really *is* an experiment, and any lab model needs to have some track record of success before we will invest significantly in what is fundamentally an uncertain process. So this was, and perhaps still is to some degree, the biggest misunderstanding. What were we actually trying to do? Leave aside the complex idea of art and science merging, leave aside the odd experiments we did before the public, we didn't have early on the many students, many traveling exhibitions, many products, we would eventually need to assure partnerships. These partners are now coming, and our products are selling, each year we have more students involved in many countries, and so I am hopeful. I do wish to say also however that the day in which an organization like Le Laboratoire loses its ambiguity, becomes completely transparent and institutionalized in a certain way, it will lose its value.

Q: "Learning in an artscience lab," you write, "... happens best when it is beside the point." What are the pedagogical benefits of the educational artscience lab, and how does "beside the point" learning fit into the university environment?

A: Many of us learn early on by experimenting with our lives and our environments, and innovators continue this experimentation all their lives. But the classical educational process tends to contrast this form of learning with formal teaching by which we learn to memorize, absorb specialized knowledge, perform intellectually in ways that can be quantified and ultimately related to our potential to contribute to society once we finish school in some productive way. This latter kind of learning is probably inevitable, and often valuable, but cannot stand alone in a world where the needs, opportunities, and information cloud that surrounds us are all evolving so incredibly rapidly. We do need to help students recover that "learning through experimenting" philosophy that seems so innate to many children, and particularly to channel it into a "learning by creating" and "creating to matter" environment where in the process of learning is tightly connected to the process of affecting change. That's the purpose of the educational artscience lab. Creators are constantly learning, and

indeed throwing themselves into settings where they are very innocent, and therefore must learn, but they hardly say to themselves "let's learn" -- rather, "let's dream to create in ways that matter." The learning is the careful nourishment that helps them realize dreams.

Q: You write that one of the advantages of the artscience lab is that it encourages people to move beyond the "constraints" of academic or vocational specialization. Do you see the emphasis on specialization in American education as problematic, over all, or as necessary?

A: I cannot deny, nor really do I care to deny, that my specialization in applied math, which I pursued for many years, helped me understand what it means to think deeply, to respect the value of concentration and single-mindedness. There were many years of hitting my head against a wall, so to speak, leading in my case to two textbooks that I wrote with older faculty in my late 20s and early 30s. I remember late one Christmas Eve at MIT walking out into the hallway and literally throwing my manuscript down the hall at my much-older mentor, nearly hitting him on the back, out of anger and frustration at his decision that I should, having written a 600-page manuscript, change all the symbolism, to be just a little clearer. I admit there was value in all that. But I also came to see how lost you can be in your specialization in a world where there is such complexity and diversity and change. So I do not think it is right to dismiss the importance of specialized learning, but I do think it is toxic to students today to be exposed to only this kind of learning. I do think it is urgent, and obviously it is also taking place in many places today, to create, as I call them, "sandboxes" where students can run out of their specialized studies, and play, create, yet with a structure that ties this playing to big dreams of change in culture, society, and beyond. I think it's essential to give students the experience of pursuing a dream on which someone places a bet. And there is way too little of this. Moreover the inertia of the educational system -- and I know best the American and the French -- is enormous and change is slow. Too slow. That's another reason why "labs" are important, catalysts for change, which will never happen at the right rate if we wait for it to trickle through the system.

Q: What are the goals of the book? Would you like to see any sort of broader artscience movement -- or just more attention to what Le Laboratoire and the Idea Translation Lab are already doing?

A: I wished to describe through concrete stories a model of learning through creating, of exhibiting what we create, and of producing what seems valuable of what we exhibit that exists today with all the imperfection that implies. The book is a kind of manifesto, though hardly a knife-edged one. We really are living in a lab, whether you build a coherent model of creative change within it or not. It seems to me hard to deny that every day in a contemporary life amounts to a sort of experiment. Politically, environmentally, technologically, socially -- all seems to be in flux, and it is not realistic to imagine civilization ending in a social and cultural stability like what we knew back even in the 19th century, when everything seemed, even then, to be changing too suddenly. I don't know how you can be a creator today and not wish to participate in this lab. Is this a movement? I use the example of The Beatles to illustrate how I believe sustainable models of innovation propagate. The Lab, while far from a rock band, seems to me a model more than a movement. If the artscience labs described in this book inspire other experimental environments under whatever name, and if by this creators can be less isolated in their creation, the public less detached from the creative process, the book will, I guess, have served its purpose.

— Serena Golden

http://www.insidehighered.com/news/2011/03/28/interview_with_author_of_book_on_artscience_labs

'An Unwanted Consequence'

March 25, 2011
After Ben Barres delivered a lecture at the Massachusetts Institute of Technology, another scientist was overheard making a telling remark.
"Ben Barres gave a great talk today," the scientist reportedly said, as Barres related the story to the journal *Nature* in 2006. "His work is much better than his sister's."
That colleague didn't realize it, but when he compared Barres to his sister, he was actually talking about the same person. Barres, a professor of neurobiology at the Stanford University School of Medicine, had undergone a sex change operation, from female to male, not long before he gave his talk at MIT.
Though Barres's gender has changed, he says that the quality of his work certainly has not. But the underlying assumption the comment reflected -- that women have less innate intellectual prowess or ability to conduct scholarship, both in science and in academe more broadly -- is alive and well even as women are gaining a stronger foothold in academe, according to a recent MIT report on the status of women in science and engineering.
Those attitudes sometimes spill out into the open, as they did in 2005 when Larry Summers, who was then the president of Harvard University, posited that "issues of intrinsic aptitude" may be a more significant factor than discrimination in explaining why women are underrepresented in the top tiers of science and engineering. But these views typically surface in more subtle ways. As recounted in the MIT study, these beliefs find expression, instead, in offhand comments, including remarks suggesting that women were hired or promoted because standards were lowered to accommodate them. And, despite the real gains made in the number of women entering the professoriate, researchers on the subject say that these biases persist and can do damage over time.

Upward Swing

The MIT study celebrated a trend that has been seen across the country's institutions of higher education. The number of female faculty members in science and engineering at the institute has nearly doubled since researchers there produced its first influential report in 1999. Elsewhere, the trajectory also has been on an upward swing: women now account for 43 percent of faculty members nationwide, according to the National Center for Education Statistics.
At MIT and elsewhere, these numbers reflect a concerted effort. The institutions have trained members of search committees about unconscious bias that may lead them to screen out women and members of minority groups. Some have encouraged those on committees to seek applications from women, or take steps to widen the pool of potential applicants.
But if the MIT report lauded these gains, its authors also described "an unwanted consequence" of such efforts -- the perception that hiring and promotion standards are more relaxed for women than they are for men. "In discussions I hear others saying 'oh, she'll get tenure … because we need to have women,' " the report quotes one professor as saying. "Makes it sound like the standards of excellence are not the same for men and women." Some women found themselves questioning whether their own hiring was due to their sex and not their abilities. "I felt I was invited to interview because I was dazzling," one said, "but now I wonder…."
Some faculty members at MIT have rebutted the notion that women enjoy differential treatment. "For all the appointment and promotion cases I know in recent years, I am certain this is not true," Edmund Bertschinger, head of the physics department of MIT, wrote on his blog. "The women to whom we have made faculty offers, promoted and granted tenure all meet the very high standards of MIT, and it has always been so."
Doubters, he said, ought to consult the roster of full professors at MIT's school of science who were members of the National Academy of Sciences last year: 31 percent of men and 40 percent of women, by his count.
If anything, women are held to higher standards, said some who were interviewed. "I always feel that female candidates are not treated the same," one MIT professor related. "People give male candidates the benefit of the doubt. The demands for women candidates are higher, they are more scrutinized."
This mismatch in perception of abilities, and these notions of unfair treatment and double standards, are, to some, the inevitable price of progress. But many scholars who study gender and academe dispute that the efforts to recruit women have sparked a backlash against women. "Backlash is the wrong word," said Joan M.

Herbers, professor of evolution, ecology, and organismal biology at Ohio State University, and president of the Association for Women in Science. “It’s exposing what’s been there all along.”

‘Mountains Are Molehills Piled One On Top Of The Other'

To women like Herbers, who earned her Ph.D. in 1978, tensions over unfair treatment and double standards are not new. A self-described “50-ish scientist,” Herbers said that questions about women being hired for academic jobs because it was fashionable to do so were prevalent when she began her career. Then, as now, these questions prompted self-doubt among the women who benefited from the purportedly fashionable hiring. “I wondered, too,” she said, though her uncertainties faded as she advanced in her field and earned honors, such as being named a fellow of the American Association for the Advancement of Science.

Ultimately, when women confront accusations that they were hired because standards were lowered, they will react in different ways, she said. “Sometimes the message to women is ‘just get over it’ and for others it’s, ‘it’s a real issue here,’ ” said Herbers. “Deciding which is which is a matter of context.”

To Molly Broad, president of the American Council on Education and a female pioneer in the ranks of university administration, lingering doubts about the merits and capacities of women reflect a carryover from an earlier time -- one that will eventually fade away. “It’s part of the process of the natural transformation,” she said, adding that efforts like MIT’s represent one of the best ways to bring such assumptions into the open and talk about them.

Broad, who is the first female president of ACE and also cracked the glass ceiling as president of the University of North Carolina, also counseled women to keep pushing forward -- whether they encounter such slights as being told they had received preferential treatment or, in a classic example, they find themselves at a department meeting, where they make a suggestion that is ignored only to hear a male colleague voice the same idea to rapturous acclaim.

“Keep your focus on the outcomes,” said Broad, who added that, in the latter example, women should have the courage of their convictions to try again. “Keep your eye on what is the best result … and not whose voice galvanized the group to take action.”

While such slights might seem minor compared to policies or attitudes that once kept women out of departments or entire universities, some say they exact a real toll as they accumulate.

“A lot of the things on a daily basis that are happening to men and women are very small things that people are inclined to shrug off and say not to worry about it,” said Virginia Valian, distinguished professor of psychology and co-director of the Gender Equity Project at Hunter College of the City University of New York.

But Valian disputed the notion that, just because such slights seem small, they are inconsequential.

“Mountains are molehills piled one on top of the other,” she said. She noted that, while women may be hired more often than they used to be, they still aren’t progressing to full professorships as fast as or in the same proportion as men, in science or in other fields, such as history. Women also are not paid as much.

In part, seemingly minor episodes, such as whose ideas get recognized in a meeting or who gets invited to speak at a colloquium, start to snowball, Valian argued. “All of those things are adding up over time to give a man more advantage than a woman has,” she said. “You see this growing disparity as careers progress between men and women.”

Implicit Biases And 'Mind Bugs'

The expression of bias or favoritism, as described, is not the only thing that can be subtle or hard to recognize immediately, scholars say. Subtle dynamics are also at play in the hiring and promotions process, where notions of who is most qualified can be shaped by unexamined assumptions and perceptions.

It can be difficult to accurately gauge such subjective qualities as merit -- and job screenings don’t always reveal meaningful differences between candidates, said Wendy M. Williams, professor and director of Cornell University’s Institute for Women in Science. Given the decline in tenure-track positions, there are likely to be many applicants for every slot in a prestigious program. At high levels, many people can boast top grades, scores and letters of recommendation, she said. While differences within an elite group of applicants may reflect actual differences in ability, they also may reflect a range of resources or access to mentors who can help a candidate amass an impressive portfolio.

"In many cases, any person could be randomly selected from the top group and would have just as good a chance of making it in the position offered as would the other members of the top group," Williams said in an e-mail. "There are so many key skills that are simply not assessed at all -- and the ones that are assessed are

imperfect predictors -- meaning that someone who is bypassed [including a man with stellar credentials] may not actually have any more talent for the position."

At the same time, she added that one reason that some men are skeptical of women in academe is that analyses have found that female scholars have, on average, produced fewer peer-reviewed publications and are cited less often than their male counterparts. "A man may potentially have valid reasons to question the records of women being hired around him, and may wonder if their honors and awards stem more from gender than from eminence," she said.

Such skepticism likely won't be dispelled until large numbers of female academics mature in their careers, many argue. Until then, anecdotes about failed female candidates will carry disproportionate weight and reinforce some men's impressions that women scholars are unqualified. Eventually, such questions ought to be resolved by analyzing empirical evidence, said Williams. "We should not assume or take for granted that the women hired are just as good," she said. "We should give them time to flourish and then see what they accomplish, and ultimately evaluate it and them critically."

Another complicating factor, however, is the phenomenon of implicit bias. In 2000, Laurie A. Rudman, a professor of social psychology at Rutgers University, published research in *Personality and Social Psychology Bulletin* with her then-doctoral student (now an instructor), Stephen E. Kilianski, on people's unconscious attitudes toward women and authority. Using a tool called the Implicit Association Test, they brought to the surface people's "mind bugs," a term used by Mahzarin Banaji, the Richard Clarke Cabot Professor of Social Ethics in Harvard University's department of psychology. These bugs reflect implicit or unconscious assessments of one's self or others.

Rudman and Kilianski found that people of both genders automatically favored male authority figures over female ones -- even if they professed to hold the opposite view. Their subjects associated men with high-status traits, such as being competent or competitive, and women with communal ones, such as kinship and nurturing. They also tended to reject or dislike women who vied for authoritative roles. "And, no surprise, people who disliked them tended not to recommend hiring them," she said in an e-mail. "So yes, these deeply ingrained beliefs that people have about who is qualified to lead do play a negative role in their acceptance of female leaders." Women in academe negotiate similarly ingrained biases and assumptions, she said.

What Can Be Done?

By many accounts, the current situation -- in which women are hired in academic jobs but do not advance as quickly or as far as their male counterparts, and in which they chafe at being accused of benefiting from lower expectations -- is both a cultural and a policy problem.

The MIT report counsels hiring committees to point to specific reasons that a candidate is hired, in order to dispel notions that he or she received preferential treatment. "It must be transparent that women hired at MIT are exceptionally accomplished," the authors wrote. Many who advocate either a cultural or a policy remedy also say that strong leadership is crucial to send a signal that sexism won't be tolerated.

But changing culture is not easy, said Valian, of Hunter. Addressing subtle expressions of bias when they happen is one way to do it. And, while some would argue that the sheer numbers of women entering academe will eventually overwhelm outmoded ideas about their competence, Valian struck a far more cautious tone. The reason, she said, is the persistence of "schemas," or overarching, deeply held theories that are often founded on stereotype (for example, that women lack the ability or desire to do scientific research). "They are extremely powerful and long-lasting," she said. "It takes an enormous amount of evidence to overthrow a schema that gets so much support over so many years." The best way to change attitudes, she said, is to couple a preponderance of evidence with a new narrative.

Herbers, of Ohio State, pointed to more direct strategies that can help shape the culture in departments and institutions. Work-life balance needs to be made into a universal issue, not one that touches only women. Sexism also needs to be talked about as a concern that involves both men and women, she said. Herbers suggested enlisting "alpha males" to take up the cause. "That's the key strategy: make it everybody's problem by getting spokespeople who aren't in the affected group," she said.

Another useful strategy is to link, as MIT has done, the notion of gender equity to something that is important to the institution as a whole. For example, said Herbers, an effort to retain women -- by changing the culture and work environment -- can be aligned with the goal of attracting and keeping talent. "The message we're given at Ohio State is that gender equity is an integral strategy to the pursuit of eminence," said Herbers. "That is a message that's hard to argue with."

But Joan C. Williams, distinguished professor of law and founding director of the Center for WorkLife Law at the University of California's Hastings College of the Law, argued that it is not useful to address the issues that women raised in the MIT report as cultural problems. While implicit gender bias needs to be rooted out, she said, structural issues in academe also need to be addressed.

Stopping the tenure clock is one example of how the machinery of higher education has adapted to the larger presence of women, but more needs to be done, she argued. The expectation that junior faculty members should work 50 hours each week is designed, she said, for a man married to a homemaker. “Not too surprisingly, if you design your schedule and expectations around men married to homemakers,” she said, “what you get at the top are men married to homemakers, or women without children.”

One remedy, she said, is to shift the definition of an academic career and to vary the pace at which one can be pursued. Another step, she added, is to ensure that the people in colleges who render decisions about professors’ careers are aware of and in compliance with anti-discrimination laws. This can be accomplished by training department heads and deans, she said, or by reassigning to the human resources office the task of granting leaves, for example.

“Many of the key personnel decisions are made by people who have no training in human resources or basic employment laws. Mainly it’s other professors,” she said. As a result, women and some men encounter what she called open expressions of gender bias that would be much rarer in a corporation, where human resources staff members are trained. “Professors who are department chairs have no training in that,” she said. “The ignorance is breathtaking.”

Ultimately, many experts agreed that MIT was to be commended for asking questions about gender and advancement -- and for disseminating the findings. “I believe that what MIT has done is a truly remarkable work,” said Broad of ACE. “It’s probably the healthiest way I can imagine that organizations like universities can come up with to face up to old views and persuade people to modify them.”

— Dan Berrett

http://www.insidehighered.com/news/2011/03/25/female_college_professors_still_find_bias_despite_gains

Addiction: Pay Attention

Heroin and chocolate cake have a nasty way of crowding out the rest of the universe. The country's chief addiction expert argues that the propensity to drink, overeat and take drugs is a matter of attention gone awry.
By Kathleen McGowan, published on November 01, 2004 - last reviewed on December 08, 2010

Meeting her now, it is hard to believe that the Mexican-Russian great-granddaughter of the revolutionary Leon Trotsky ever felt the need to impress her friends. But the universal teenage urge to look more glamorous drove a young Nora Volkow, then in high school, to smoke her first cigarette. It could have been the first step toward a nasty habit, but something in her neurochemistry rebelled. She hated it.
Volkow, now one of the country's most prominent drug addiction researchers and the director of the National Institute on Drug Abuse (NIDA), doesn't think that her disgust for cigarettes had anything to do with morals or self-control. She says she's just naturally intense; the additional stimulation provided by the nicotine was simply too much for her. "I like coffee, but I cannot even drink it because I get so wired," she says. "I was probably born like that. I'm very protected against drugs. It's my neurobiology, and I'm lucky."

Listening to her explain her theories about addiction and the brain, her self-diagnosis sounds right on target. Even though she's petite, with a jogger's lean physique, she dominates the room. She speaks very fast, with a Spanish accent that rounds her vowels, and ideas tumble out one after the other so quickly that it's almost impossible to keep up.
She's a fast-moving example of one of her most interesting theories: that addiction may be a malfunction of the normal human craving for stimulation. Volkow thinks that drugs and other addictive habits tap into some of the deepest forces within us—our lust for newness, our yearning for vitality and the deep-down thrill of being alive. "We all seek that intensity," she says. "There's something very powerful about that."
This idea is based on a new understanding of dopamine, the brain chemical involved in motivation, pleasure and learning. Because addictive drugs like cocaine and nicotine cause a flood of dopamine in the brain, researchers once thought that the neurochemical was a simple pleasure switch, the body's own "reward" button. Yet something didn't add up. If dopamine delivers the pleasure message, addicts should be in a continual state of bliss—but most of them get very little pleasure from the drug, despite the surge of neurochemicals. "I've seen hundreds of addicted people, and never have I come across one who wanted to be addicted," says Volkow. As she began doing brain-imaging studies with drug addicts, that contradiction haunted her.
In response, Volkow and other researchers are developing a new understanding of addiction. Rather than just telling us to feel good, dopamine tells us what's salient—the unexpected bits of new information we need to pay attention to in order to survive, like alerts about sex, food and pleasure, as well as danger and pain. If you are hungry and you get a whiff of a bacon cheeseburger, Volkow's research team has shown, your dopamine skyrockets. But the chemical will also surge if a lion leaps into your cubicle. Dopamine's role is to shout: "Hey! Pay attention to this!" Only as an afterthought might it whisper "Wow, this feels great." So maybe

addicts aren't just chasing a good time. Perhaps their brains have somehow mistakenly learned that drugs are the most important thing to pay attention to, as crucial to survival as food or sex.
The salience theory of dopamine also provides new explanations for other self-destructive human tendencies, from binge eating to gambling. It may explain why we crave the stimulation of new information. The experiments that Volkow and her team are conducting may also reveal some of the most powerful behavioral machinery in our brains, the equipment that motivates and inspires us. If they are right, dopamine is more than a joyride. It's more like the drug of life. Its mission is more profound and philosophical: to connect us to the world and supply us with the will to stay alive.
Nora Volkow has science in her blood. Her father is a chemist, her grandfather and her great-grandfather were physicists. But her family, which emigrated from Russia to Mexico in the 1930s, has another intellectual legacy. One of her great-grandfathers was the brilliant Bolshevik leader Leon Trotsky, and Volkow grew up in the Mexico City home where he spent the last days of his life—and where he was killed on Stalin's orders in 1940. Parts of the house became a museum of Trotsky's life, and when Volkow was a child, people like the Nobel Prize-winning novelist Gabriel Garcia Marquez would stop by.
Volkow, though, was more interested in psychiatry than in politics. She graduated at the top of her medical school class at the National University of Mexico, then came to the United States to pursue the new science of brain imaging. During the 1980s, at New York University and then at University of Texas, Austin, she used brain imaging techniques to study schizophrenia and cocaine addiction—and established herself as a leader in the field. She then moved to Brookhaven National Laboratory in Upton, New York, where she won a reputation as an intellectual powerhouse, respected for her creativity as well as for her productivity. "Nora has that enthusiasm, that spark," says NYU Medical Center psychiatry chair Robert Cancro, who worked with her early in her career. "She'd get excited about things, talk 160 words a minute—and that was in English
Her colleagues say she is a bold and unconventional thinker. Early on, she demonstrated that cocaine physically damaged the brain. It took years before this controversial finding was accepted, but other research eventually proved her right. She was also an early champion of the idea that drug addiction is a medical problem, rather than a lack of willpower or moral fiber. That formerly radical view is now considered mainstream.
Since she was chosen to direct NIDA, Volkow has brought new visibility to the controversial theory about dopamine that has percolated in the scientific community for approximately the past decade. According to the salience theory of dopamine, the neurochemical is released when something surprisingly important happens, whether that's an unexpected reward or accidentally stepping on a nail. Since dopamine is also involved in learning, memory and motivation, the chemical helps us pay attention to the information we need to survive, act upon it, and remember it for the future. But drugs hijack that machinery, sending 5 to ten times as much dopamine surging through the nucleus accumbens and forcing the brain's motivational and attentional mechanisms to focus purely on the drug. It becomes the most interesting and important thing in the world. "In any addicted person, what's salient is the drug," says Volkow. "There's no competition."

Over time, the addict's brain adapts to the torrent of dopamine by dampening the system down. Imaging experiments show that cocaine addicts' brains don't react to the things that turn on the rest of us, whether that's romantic passion, food or cold, hard cash. Volkow's research has also shown that addicts have fewer dopamine D2 receptors, which are found in parts of the brain involved in motivation and reward behavior. With fewer receptors, the dopamine system is desensitized, and the now-understimulated addict needs more and more of the drug to feel anything at all. Meanwhile, pathways associated with other interesting stimuli are left idle and lose strength. The prefrontal cortex—the part of the brain associated with judgment and inhibitory control—also stops functioning normally. It's a neurological recipe for disaster. "You have enhanced motivation for the drug, and you have impaired prefrontal cortical systems. So you want the drugs pathologically, and you have reduced control of behavior, and what you've got is an addict," says University of Michigan, Ann Arbor psychology professor Terry Robinson, who pioneered this new way of thinking about dopamine with his University of Michigan colleague Kent Berridge.
Some people are apparently born with fewer dopamine receptors, and they are more likely to enjoy the rush of addictive drugs. In one imaging experiment, Volkow gave Ritalin, which gently lifts dopamine levels, to a group of ordinary volunteers. Some loved the feeling of the drug, but others hated it so much that they threatened to drop out of the study. Volkow was puzzled until she imaged their brains. She found that those

who liked the rush from the drug had fewer dopamine D2 receptors than those who hated it. Volkow thinks that some people have a sensitive dopamine circuitry; they can't take the additional stimulation of drugs. Obesity may involve similar malfunctions in the dopamine system. Volkow's longtime Brookhaven collaborator Gene-Jack Wang has discovered that the brains of seriously obese people seem to be tuned toward food. Even when they are lying quietly in the scanning machine, the sensory cortex of their mouth, tongue and lips is more active than it is in normal-weight people, he says: "They are putting out their antennae." Yet he also found that the dopamine circuitry of heavy people is less responsive, with fewer dopamine D2 receptors. Even among the obese, there are dopamine differences. The heaviest people in his study had fewer dopamine receptors than the lightest. Like addicts, overeaters may be compensating for a sluggish dopamine system by turning to the one thing that gets their neurons pumping.

It's a mark of changing times—and more sophisticated science—that the head of the National Institute on Drug Abuse is thinking about doughnuts as well as heroin. Just as blaming drug addiction on moral weakness was a shortsighted and unscientific way of framing a social problem, Volkow believes that focusing solely on metabolism, or blaming fat people for overindulgence and gluttony, are intellectual dead ends. "What motivates us to eat is clearly much more than hunger," she says. "We need to expand the way we think about eating." Wang and Volkow suggest that dopamine may provide a new window into weight loss: Animal studies have shown, for example, that exercise elevates dopamine release and increases dopamine D2 receptors.

Volkow and the other champions of the new view of dopamine don't deny that the chemical helps us register pleasure. But they think that pleasure is just part of a set of interconnected dopamine-related behaviors. Volkow recently found that adults with attention deficit disorder who took dopamine-boosting Ritalin before taking a math test found it easier to concentrate, in part, because the task seemed more interesting, so they felt more motivated to do the problem.

From this angle, it makes sense that the cognitive process of absorbing new information is closely tied to the brain's pleasure mechanisms. You might say that what the brain really "wants" is new information, suggests Gregory Berns, associate professor of psychiatry and behavioral sciences at Emory University in Atlanta. "Neurons really exist to process information. That's what neurons do. If you want to anthropomorphize neurons, you can say that they are happiest when they are processing information."

This urge to connect to the world and learn from it is more important than mere pleasure, says Volkow. It's part of the most basic force in behavior: the will to live. It's not automatic, she points out. Seriously ill or very depressed people can lose the will to survive. "What is the motivation we all have to be alive, to do things?" she asks. "It's not pleasure. Our lives would be so much simpler if we were motivated just for the sake of pleasure."

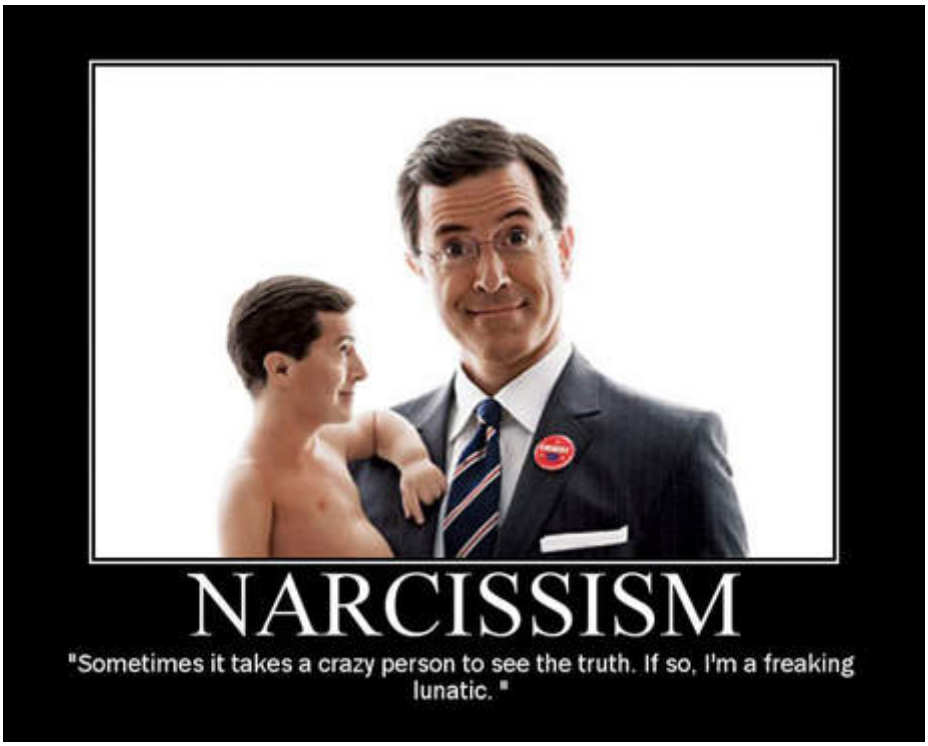
But dopamine sensitivity and addiction aren't genetically determined or inevitable. One experiment with monkeys showed that the dopamine system may be influenced by social interactions: Animals that lost social status also lost D2 receptors. Context is also crucial. Obviously, it's easier to get hooked if drugs are easy to get in your neighborhood, but it's not just a question of supply and demand. People who grow up in stimulating, engaging surroundings are protected against addiction, Volkow believes, even if they don't have a naturally responsive dopamine system. If you connect to the world in a meaningful way, and have more chances to get excited about natural stimuli, you're less likely to need an artificial boost.

"If you don't get excited by everyday things in life, if things look gray, and the drug makes things look extraordinary, that puts you at risk," she says. "But if you get great excitement out of a great multiplicity of things, and intensely enjoy these things—seeing a movie, or climbing a mountain—and then you try a drug, you'll think: What's the big deal?" For those lucky enough to grow up as Volkow did, surrounded by sharp minds and fascinating history, drugs are just nowhere near as interesting as everyday life.

http://www.psychologytoday.com/articles/200411/addiction-pay-attention

Do Narcissists Know They Are Narcissists?

How self-aware are narcissists?
Published on March 25, 2011



Think of your friendly neighborhood narcissist. Status-seeking, grandiose, loud-mouthed, brash, and flamboyant. Have you ever noticed how he (or she) brags all the time, not only about his astronomical I.Q. and bulging pectoral muscles, but also about *the fact that he is narcissistic*? It's as if he is *proud* of it.
Lots of psychologists have theorized that a lack of self-awareness is a hallmark trait of narcissists. My personal experience with narcissists does not seem to support this. It seems to me as though they are not only aware of who they are, but they *embrace* it.
Luckily, I don't have to rely on personal anecdotes. To get to the bottom of this age-old mystery, Erika Carlson and her colleagues at Washington University in St. Louis conducted three very well-done studies to see whether narcissists have insight into their pesonality and their reputation. The results will soon be published in the prestigious *Journal of Personality and Social Psychology*.

The researchers administered a number of different measures of narcissism to college students and looked at how high-scorers are seen by others, how they see themselves, and how they believe they are seen by others. They looked across social contexts, and interviewed new acquaintances as well as friends and family. There results across the three studies are strikingly consistent.

Unsurprisingly, they found that narcissists think they are hot stuff. Those scoring high in narcissism tended to rate themselves as more intelligent, physically attractive, likeable, and funny than others. Interestingly, they also rated themselves as having higher levels of *negative* aspects of narcissism, such as being power-oriented, impulsive, arrogant, and prone to exaggerate their abilities! Therefore, narcissists are aware they are narcissists.
There was also a strong positive correlation between narcissism and having a reputation for narcissism: narcissists were definitely perceived as narcissists! While other people didn't think the narcissists were nearly as hot as the narcissists thought they were, the narcissists were *well aware* of their reputation! When asked

how others perceive them on the positive traits, their results were closer to how they were actually perceived than their own self-perceptions of the very same traits.
These results suggest that narcissists do indeed have self-awareness of themselves and know their reputation. This begs the question: *how can narcissists maintain their inflated self-image even though they know full well how they are perceived by others*? The researchers suggest a few intriguing possibilities.
Perhaps narcissists assume that others are just failing to realize how *bitchin'* they really are. They may think that people are just "too dim to recognize their brilliance". Another possibility is that narcissists may think critics are just "jealous of them". Narcissists may take negative feedback and think to themselves: *those haters are just jealous*!
This may explain why narcissists behave in arrogant ways. Instead of compensating for some deep-seated insecurity, bragging may be their way of *demanding* the recognition they truly believe they deserve. Narcissists score up the kazoo in entitlement. As the researchers note, this idea is consistent with self-verification theory:
"Narcissists believe that they are exceptional people and may behave in arrogant ways because they are attempting to bridge the gap between their self perceptions and their meta-perceptions."

The researchers also suggest it's possible that narcissists maintain their self-image by misconstruing the meaning of narcissism. When told they are arrogant, instead of thinking they are "someone who is confident without merit", they may take it as a compliment, thinking to themselves: *well, duh I'm arrogant, if by that you mean "deservedly confident*"! As the researchers note, "narcissists seem to choose honest arrogance when describing themselves and their reputation."
The results of this study as well as prior studies suggests that narcissists do care more about being perceived as superior on agentic traits (industriousness, assertiveness, dominance) compared to communal traits (e.g., agreeableness and honesty). Narcissists don't seem to care whether they are perceived as good people; they'd rather be admired than liked So perhaps the narcissists in their study construed supposedly negative aspects of narcissism (e.g., arrogance) as desirable.
Of course, it's also possible that narcissists are fully aware of the meaning of narcissism and the negative impact they have on others, but *just don't care* as long as it doesn't get in the way of their goals.
The researchers also found that new acquaintances viewed narcissists more positively than well acquainted others. Those who just met the narcissists did tend to have a favorable impression of the narcissists, whereas those who knew the narcissists much longer tended to have a much more negative impression of the narcissists.
Again, the narcissists in their sample were fully aware of this! The results suggest that narcissists understand that they make positive first impressions that deteriorate over time. These results are consistent with prior research that has shown that narcissists have trouble forming long-term relationships. Narcissists tend to think they are 'too good' for most people and are always seeking 'better' relationship alternatives.
The results are also consistent with research showing that narcissists are masters at first impressions. As researchers have suggested, the narcissist's success at creating initial attraction may make short-term contexts more rewarding for them than longer-term contexts: "*It is possible that narcissists discontinue relationships early on because they cannot bridge the gap between their positive self-perceptions and relatively negative meta-perceptions.*"

Practical Implications

It's well known that narcissists rarely change, mostly because they don't *want* to change. They love their lifestyle. Researchers trying to reform narcissists have noted that a major impediment is their lack of self-awareness. They have speculated that if narcissists received true feedback, they would change. The Carlson and colleagues' study suggests this is not the case. Narcissists are fully aware they are narcissistic and have a narcisstic reputation.
Instead, the researchers suggest that a better intervention would be to "*emphasize the interpersonal and intrapsychic costs of being seen as narcissistic by others*" Narcissists are unlikely to change unless they think changing will benefit the things they desire, such as status and power.

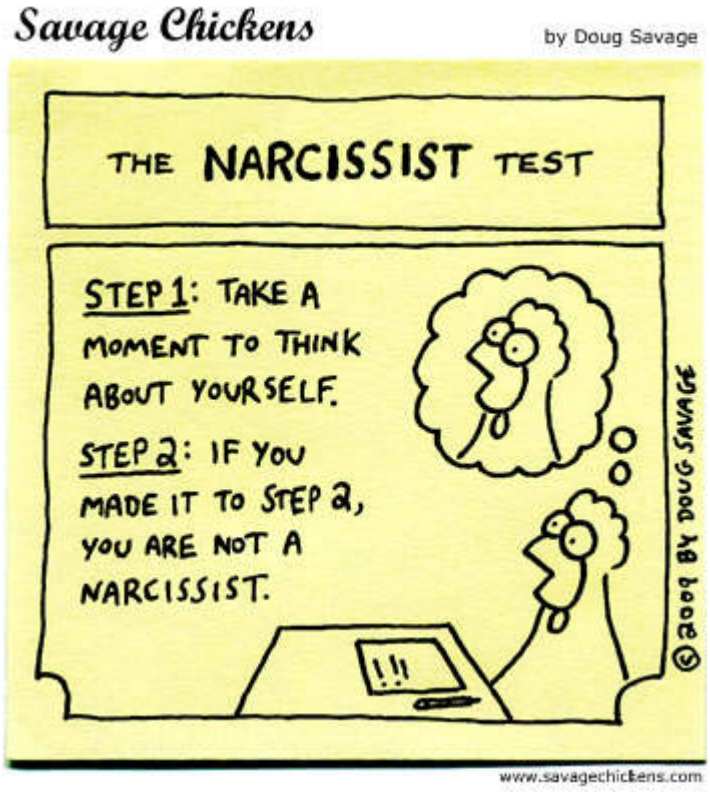
Are You a Narcissist?

Many of you are probably reading this and wondering whether you are a narcissist. An implication of the results I just reviewed is that if you are a narcissist, you probably already know it!

In reality, all of us are at least a little bit narcissistic. In the studies just reviewed, the researchers administered a narcissistic questionnaire to college students. Even though they found that the students scored all across the spectrum, it's not as if there was anyone who was *completely* non-narcissistic. All of us, throughout our day, ebb and flow in and out of the narcissistic mindset.

Still, you might be worrying that you are consistently *extremely* narcissistic. There are plenty of rubbish tests all over the internet that claim to be a good measure of narcissism. Forget them.

The best test I've found by far is this one:



http://www.psychologytoday.com/blog/beautiful-minds/201103/do-narcissists-know-they-are-narcissists

Tylenol and the War on Drugs

Are you better off dead than high?
Published on March 21, 2011

Many years ago after a surgical procedure I was given a prescription for Vicodin, which is the brand name combination of hydrocodone and acetaminophen. Hydrocodone is an opioid analgesic - related to morphine and heroin - and acetaminophen is the generic name for tylenol. There was not (and still is not) a version of hydrocodone all by itself - you can only get the two in combination.
The toxicity of acetaminophen to your liver is well known. Currently some 38% of cases of acute liver failure are due to acetaminophen ingestion. You can get liver failure from taking 15 extra strength tylenol (containing 500 milligrams of acetaminophen) a day or from as few as 4 if you have liver damage from alcohol. This liver failure is insidious. Once it starts, it can quickly progress to the point where you feel fine but will be dead in a matter of days unless you have a liver transplant. By the time you feel desperately ill, it may be too late. If you have overdosed on tylenol and have abdominal pain, you need to get yourself to an emergency room quickly.

I remember being annoyed that in order to get effective pain relief I was being forced to take a liver toxin that added little to the pain relieving efficacy of the opiate. I speculated to my wife that there was probably more injury and death occurring from the acetaminophen than the "dangerous narcotic" in the Vicodin.
Now it looks like the FDA has recognized the same thing that was casually obvious to a radiologist more than 10 years ago. As recreational drug users and addicts seek Vicodin for it's narcotic benefits, and regular folks have acute pain, they are increasingly suffering inadvertent liver toxicity from acetaminophen, contributing to the 40,000 Emergency room visits per year related to acute liver injury.
From this article in the Wall Street Journal January 13, 2011:
Federal health regulators are restricting the amount of acetaminophen in prescription painkillers such as Vicodin and Percocet because of concerns that acetaminophen overdoses are linked to thousands of cases of liver damage in recent years.
The Food and Drug Administration said Thursday it will ask manufacturers to limit acetaminophen used in combination prescription drugs to 325 milligrams. The agency is also asking drug makers to add the strongest warning-a black box-to their labels about the possibility of severe liver damage.
What has all this to do with the war on drugs?
In the early days of the misguided, counterproductive and massively expensive "war on drugs", Richard Nixon signed the Drug Control Act that established "schedules" that doctors and patients must deal with today. The schedules range from IV to I, in order of their "abuse potential".
Just don't get confused and think that this had something to do with safety. Toxic chemotherapy agents, the blood thinner warfarin and many other very dangerous drugs are not on the schedule at all, but pretty much any drug someone might take at a party is.
It was decided that drugs should be made more difficult to obtain based on their potential for "abuse". In keeping with the moralistic and authoritarian origins of all this, "abuse" means "getting high" and has little to

do with how dangerous the given drug is to your health. Some drugs, like cannabis, are schedule I and legally unavailable to anyone in most states. Does anyone really think cannabis is deadlier than Jim Beam?
This is how you end up with an unnecessary liver toxin in your narcotic. The government figures it has a lower potential for abuse because you will be dissuaded from taking enough of it to "get high' by the potential for hepatotoxicity due to the added acetaminophen! The manufacturer quite naturally responds to the perverse incentives of the Drug Control Act by adding the acetaminophen to get a schedule III classification. This makes it less onerous for the prescribing physician, and easier for the patient, resulting in greater sales for the drug company.
Make the potential party drug more toxic so it is less likely to be "abused".
In case you think my reasoning on this is overly cynical, have you ever purchased denatured alcohol at the hardware store? This is ethanol - the same kind found in your gin and tonic - which has been purposefully engineered to kill you if you drink it. "Denatured" implies there has been some chemical alteration of the alcohol, but in fact it is just intentionally contaminated with toxic industrial solvents like methanol or acetone. The manufacturer goes to extra effort and expense to add poison for the sole purpose of escaping burdensome government regulation and taxation. And the government dissuades you from getting high with a legal drug by threatening you with death.
Still doubt that your government might be willing to burn the village in order to save it?
Read an article by Deborah Blum of Slate called The Chemist's War.
Here are some excerpts:
It was Christmas Eve 1926, the streets aglitter with snow and lights, when the man afraid of Santa Claus stumbled into the emergency room at New York City's Bellevue Hospital...
Before hospital staff realized how sick he was-the alcohol-induced hallucination was just a symptom-the man died. So did another holiday partygoer. And another. As dusk fell on Christmas, the hospital staff tallied up more than 60 people made desperately ill by alcohol and eight dead from it. Within the next two days, yet another 23 people died in the city from celebrating the season.....
Frustrated that people continued to consume so much alcohol even after it was banned, federal officials had decided to try a different kind of enforcement. They ordered the poisoning of industrial alcohols manufactured in the United States, products regularly stolen by bootleggers and resold as drinkable spirits. The idea was to scare people into giving up illicit drinking. Instead, by the time Prohibition ended in 1933, the federal poisoning program, by some estimates, had killed at least 10,000 people....
So I am glad the FDA is finally realizing what is going on, but it's too bad they don't address the true source of the problem, which is Prohibition II - the absurd war on drugs, the "schedule" and the perverse incentives such attempts at control always create.
Your government is determined to protect you from too much fun, even if it kills you.

Note: I advise requesting good old morphine when in the hospital, which is cheap, safe and effective, and requesting pure oxycodone or maybe percodan if you really need it after discharge.
I don't advise taking any drugs for recreation.

http://www.psychologytoday.com/blog/p-nu/201103/tylenol-and-the-war-drugs

From Cotton Candy to Rock: New Evidence About Beginnings of the Solar System

A 520g individual of the Allende meteorite shower. Allende is a carbonaceous chondrite (CV3) that fell on 1969 February 8 in Mexico. (Credit: H. Raab / Wikimedia Commons, Creative Commons Attribution-Share Alike license)

ScienceDaily (Mar. 28, 2011) — The earliest rocks in our Solar System were more like cotton candy than the hard rock that we know today, according to research published March 27 in the journal *Nature Geoscience*. The work, by researchers from Imperial College London and other international institutions, provides the first geological evidence to support previous theories, based on computer models and lab experiments, about how the earliest rocks were formed. The study adds weight to the idea that the first solid material in the Solar System was fragile and extremely porous -- much like cotton candy -- and that it was compacted during periods of extreme turbulence into harder rock, forming the building blocks that paved the way for planets like Earth.

Dr Phil Bland, lead author of the study from the Department of Earth Science and Engineering at Imperial College London, says: "Our study makes us even more convinced than before that the early carbonaceous chondrite rocks were shaped by the turbulent nebula through which they travelled billions of years ago, in much the same way that pebbles in a river are altered when subjected to high turbulence in the water. Our research suggests that the turbulence caused these early particles to compact and harden over time to form the first tiny rocks."

The researchers reached their conclusions after carrying out an extremely detailed analysis of an asteroid fragment known as a carbonaceous chondrite meteorite, which came from the asteroid belt between Jupiter and Mars. It was originally formed in the early Solar System when microscopic dust particles collided with one another and stuck together, coalescing around larger grain particles called chondrules, which were around a millimetre in size.

To analyse the carbonaceous chondrite sample, the team used an electron back-scatter diffraction technique, which fires electrons at the sample. Researchers observe the resulting interference pattern using a microscope to study the structures within. This technique enabled the researchers to study the orientation and position of individual micrometre-sized grain particles that had coalesced around the chondrule. They found that the grains coated the chondrule in a uniform pattern, which they deduced could only occur if this tiny rock was subjected to shocks in space, possibly during these periods of turbulence.

The team also defined a new method to quantify the amount of compression that the rock had experienced and deduce the rock's original fragile structure.

Dr Bland adds: "What's exciting about this approach is that it allows us -- for the first time -- to quantitatively reconstruct the accretion and impact history of the most primitive solar system materials in great detail. Our work is another step in the process helping us to see how rocky planets and moons that make up parts of our Solar System came into being."

In the future, the team will focus further studies on how the earliest asteroids were built.

This research was funded by the Science and Technology Facilities Council.

Email or share this story:

| More

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Imperial College London**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Philip A. Bland, Lauren E. Howard, David J. Prior, John Wheeler, Robert M. Hough, Kathryn A. Dyl. **Earliest rock fabric formed in the Solar System preserved in a chondrule rim**. *Nature Geoscience*, 2011; DOI: 10.1038/ngeo1120

http://www.sciencedaily.com/releases/2011/03/110327191159.htm

Smaller Particles Could Make Solar Panels More Efficient

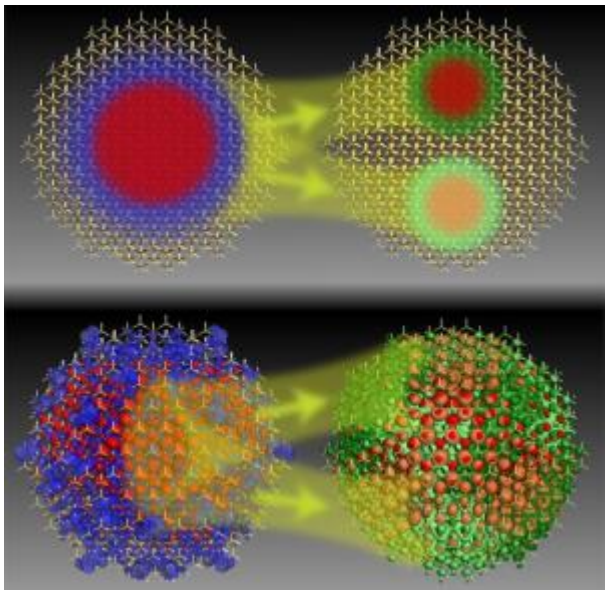


Illustration of multiple-exciton generation (MEG), a theory that suggests it is possible for an electron that has absorbed light energy, called an exciton, to transfer that energy to more than one electron, resulting in more electricity from the same amount of absorbed light. The left side shows an electron promoted to a high energy state (blue) plus the "hole" vacated by the electron (red). The right side shows the original exciton (now dark green/red) and a new exciton (light green/orange) after MEG. The top image shows a conceptualized version of the idea, while the bottom shows an actual exciton and bi-exciton using the same color scheme. (Credit: Mark T. Lusk, Department of Physics, Colorado School of Mines)

ScienceDaily (Mar. 27, 2011) — Studies done by Mark Lusk and colleagues at the Colorado School of Mines could significantly improve the efficiency of solar cells. Their latest work describes how the size of light-absorbing particles--quantum dots--affects the particles' ability to transfer energy to electrons to generate electricity.

The results are published in the April issue of the journal *ACS Nano*.

The advance provides evidence to support a controversial idea, called multiple-exciton generation (MEG), which theorizes that it is possible for an electron that has absorbed light energy, called an exciton, to transfer that energy to more than one electron, resulting in more electricity from the same amount of absorbed light.

Quantum dots are human-made atoms that confine electrons to a small space. They have atomic-like behavior that results in unusual electronic properties on a nanoscale. These unique properties may be particularly valuable in tailoring the way light interacts with matter.

Experimental verification of the link between MEG and quantum dot size is a hot topic due to a large degree of variation in previously published studies. The ability to generate an electrical current following MEG is now receiving a great deal of attention because this will be a necessary component of any commercial realization of MEG.

For this study, Lusk and collaborators used a National Science Foundation (NSF)-supported high performance computer cluster to quantify the relationship between the rate of MEG and quantum dot size.

They found that each dot has a slice of the solar spectrum for which it is best suited to perform MEG and that smaller dots carry out MEG for their slice more efficiently than larger dots. This implies that solar cells made of quantum dots specifically tuned to the solar spectrum would be much more efficient than solar cells made of material that is not fabricated with quantum dots.

According to Lusk, "We can now design nanostructured materials that generate more than one exciton from a single photon of light, putting to good use a large portion of the energy that would otherwise just heat up a solar cell."

The research team, which includes participation from the National Renewable Energy Laboratory, is part of the NSF-funded Renewable Energy Materials Research Science and Engineering Center at the Colorado School of Mines in Golden, Colo. The center focuses on materials and innovations that will significantly impact renewable energy technologies. Harnessing the unique properties of nanostructured materials to enhance the performance of solar panels is an area of particular interest to the center.
"These results are exciting because they go far towards resolving a long-standing debate within the field," said Mary Galvin, a program director for the Division of Materials Research at NSF. "Equally important, they will contribute to establishment of new design techniques that can be used to make more efficient solar cells."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. Zhibin Lin, Alberto Franceschetti, Mark T. Lusk. **Size Dependence of the Multiple Exciton Generation Rate in CdSe Quantum Dots**. *ACS Nano,* 2011; : 110228115312092 DOI: 10.1021/nn200141f

http://www.sciencedaily.com/releases/2011/03/110325164217.htm

Debut of the First Practical 'Artificial Leaf'

Living tree leaves. Scientists have just claimed one of the milestones in the drive for sustainable energy -- development of the first practical artificial leaf. (Credit: iStockphoto)

ScienceDaily (Mar. 28, 2011) — Scientists have claimed one of the milestones in the drive for sustainable energy -- development of the first practical artificial leaf. Speaking in Anaheim, California at the 241st National Meeting of the American Chemical Society, they described an advanced solar cell the size of a poker card that mimics the process, called photosynthesis, that green plants use to convert sunlight and water into energy.

"A practical artificial leaf has been one of the Holy Grails of science for decades," said Daniel Nocera, Ph.D., who led the research team. "We believe we have done it. The artificial leaf shows particular promise as an inexpensive source of electricity for homes of the poor in developing countries. Our goal is to make each home its own power station," he said. "One can envision villages in India and Africa not long from now purchasing an affordable basic power system based on this technology."

The device bears no resemblance to Mother Nature's counterparts on oaks, maples and other green plants, which scientists have used as the model for their efforts to develop this new genre of solar cells. About the shape of a poker card but thinner, the device is fashioned from silicon, electronics and catalysts, substances that accelerate chemical reactions that otherwise would not occur, or would run slowly. Placed in a single gallon of water in a bright sunlight, the device could produce enough electricity to supply a house in a developing country with electricity for a day, Nocera said. It does so by splitting water into its two components, hydrogen and oxygen.

The hydrogen and oxygen gases would be stored in a fuel cell, which uses those two materials to produce electricity, located either on top of the house or beside it.

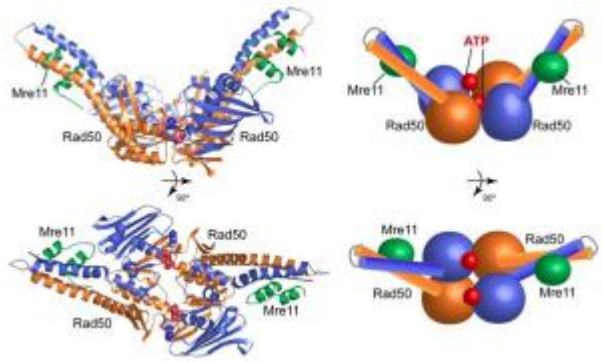
Nocera, who is with the Massachusetts Institute of Technology, points out that the "artificial leaf" is not a new concept. The first artificial leaf was developed more than a decade ago by John Turner of the U.S. National Renewable Energy Laboratory in Boulder, Colorado. Although highly efficient at carrying out photosynthesis, Turner's device was impractical for wider use, as it was composed of rare, expensive metals and was highly unstable -- with a lifespan of barely one day.

Nocera's new leaf overcomes these problems. It is made of inexpensive materials that are widely available, works under simple conditions and is highly stable. In laboratory studies, he showed that an artificial leaf prototype could operate continuously for at least 45 hours without a drop in activity.
The key to this breakthrough is Nocera's recent discovery of several powerful new, inexpensive catalysts, made of nickel and cobalt, that are capable of efficiently splitting water into its two components, hydrogen and oxygen, under simple conditions. Right now, Nocera's leaf is about 10 times more efficient at carrying out photosynthesis than a natural leaf. However, he is optimistic that he can boost the efficiency of the artificial leaf much higher in the future.
"Nature is powered by photosynthesis, and I think that the future world will be powered by photosynthesis as well in the form of this artificial leaf," said Nocera, a chemist at Massachusetts Institute of Technology in Cambridge, Mass.
Nocera acknowledges funding from The National Science Foundation and Chesonis Family Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110327191042.htm

Structure of DNA Repair Complex Reveals Workings of Powerful Cell Motor



The new finding solves the long-standing mystery of how a single protein complex known as MRN (Mre11-Rad50-Nbs1, shown here) can repair DNA in a number of different ways. (Credit: Image courtesy of Scripps Research Institute)

ScienceDaily (Mar. 27, 2011) — Over the last years, two teams of researchers at The Scripps Research Institute have steadily built a model of how a powerful DNA repair complex works. Now, their latest discovery provides revolutionary insights into the way the molecular motor inside the complex functions -- findings they say may have implications for treatment of disorders ranging from cancer to cystic fibrosis.

In a paper published in an Advance Online Edition of *Nature Structural and Molecular Biology* March 27, 2011, the scientists say that the complex's motor molecule, known as Rad50, is a surprisingly flexible protein that can change shape and even rotate depending on the task at hand.

The finding solves the long-standing mystery of how a single protein complex known as MRN (Mre11-Rad50-Nbs1) can repair DNA in a number of different, and tricky, ways that seem impossible for "standard issue" proteins to do, say team leaders Scripps Research Professor John Tainer, Ph.D., and Scripps Research Professor Paul Russell, Ph.D., who also collaborated with members of the Lawrence Berkeley National Laboratory on the study.

They say the finding also provides a critical insight into the ABC-ATPase superfamily of molecular motors, of which Rad50 is a member.

"Rad50 and its brethren proteins in this superfamily are biology's general motors," said Tainer, "and if we know how they work, we might be able to control biological outcomes when we need to."

For example, knowing that Rad50 changes its contour to perform a function suggests it might be possible to therapeutically target unique elements in that specific conformation. "There could be a new generation of drugs that are designed not against an active site, like most drugs now (an approach that can cause side effects, but against the shape the protein needs to be in to work," Tainer said.

Russell added, "Proteins are often viewed as static, but we are showing the moving parts in this complex. They are dynamic. They move about and change shape when engaging with other molecules."

First Responder

The MRN complex is known as a first-responder molecule that rushes in to repair serious double-strand breaks in the DNA helix -- an event that normally occurs about 10 times a day per cell due to ultraviolet light and radiation damage, etc. If these breaks are not fixed, dangerous chromosomal rearrangements can occur that lead to cancer. Paradoxically, the complex also mends DNA breaks promoted by chemotherapy, protecting cells against cancer treatment.

When MRN senses a break, it activates an alarm telling the cell to shut down division until repairs are made. Then, it binds to ATP (an energy source) and repairs DNA in three different ways, depending on whether two ends of strands need to be joined together or if DNA sequences need to be replicated. "The same complex has to decide the extent of damage and be able to do multiple things," Tainer said. "The mystery was how it can do it all."

To find out, Tainer, head of a structural biology group, and Russell, who leads a yeast genetics laboratory, began collaborating five years ago. With the additional help of team members at Lawrence Berkeley National Laboratory and its Advanced Light Source beamline, called SIBYLS, the collaboration has produced a series of high-resolution images of the crystal structure of parts of all three proteins (rad50, Mre11, and Nbs1), taken from fission yeast and archaea. The scientists also used the lab's X-ray scattering tool to determine the proteins' overall architecture in solution, which approximates how a protein appears in a natural state.
The scientists say that the parts of the complex, when imagined together as a whole unit, resemble an octopus: the head consists of the repair machinery (the Rad50 motor and the Mre11 protein, which is an enzyme that can break bonds between nucleic acids) and the octopus arms are made up of Nbs1 which can grab the molecules needed to help the machinery mend the strands.
In this study, Tainer and Russell were able to produce crystal and X-ray scattering images of parts of where Rad50 and Mre11 touched each other, and what happened when ATP bound to this complex and what it looked like when it didn't.
In these four new structures, they showed that ATP binding allows Rad50 to drastically change its shape. When not bound to ATP, Rad50 is flexible and floppy, but bound to ATP, Rad50 snaps into a ring that presumably closes around DNA in order to repair it.
"We saw a lot of big movement on a molecular scale," said Tainer. "Rad50 is like a rope that can pull. It appears to be a dynamic system of communicating with other molecules, and so we can now see how flexibly linked proteins can alter their physical states to control outcomes in biology."
"We thought ATP allowed Rad50 to change shape, but now we have proof of it and how it works," Russell said. "This is a key part of the MRN puzzle."

An Engine for Many Vehicles

Rad50 and ATP provide the motor and gas for a number of biological machines that operate across species. These machines are linked to a number of disorders, such as cystic fibrosis, which is caused by a defect in the cystic fibrosis transmembrane conductance regulator (CFTR) gene, which is a member of the ABC ATPase superfamily.
"Our study suggests that ABC ATPase proteins are used so often in biology because they can flexibly hook up to so many different things and produce a specific biological outcome," Tainer said.
Given this new prototypic understanding of these motors, Tainer and Russell envision a future in which therapies might be designed that target Rad50 when it changes into a shape that promotes a disease. For example, chemotherapy could be coupled with an agent that prevents the MRN complex from repairing DNA damage, promoting death of cancer cells.
"There are some potentially very cool applications to these findings that we are only beginning to think about," Russell said.
The study was funded by the National Cancer Institute, the National Institutes of Health, and the Department of Energy.

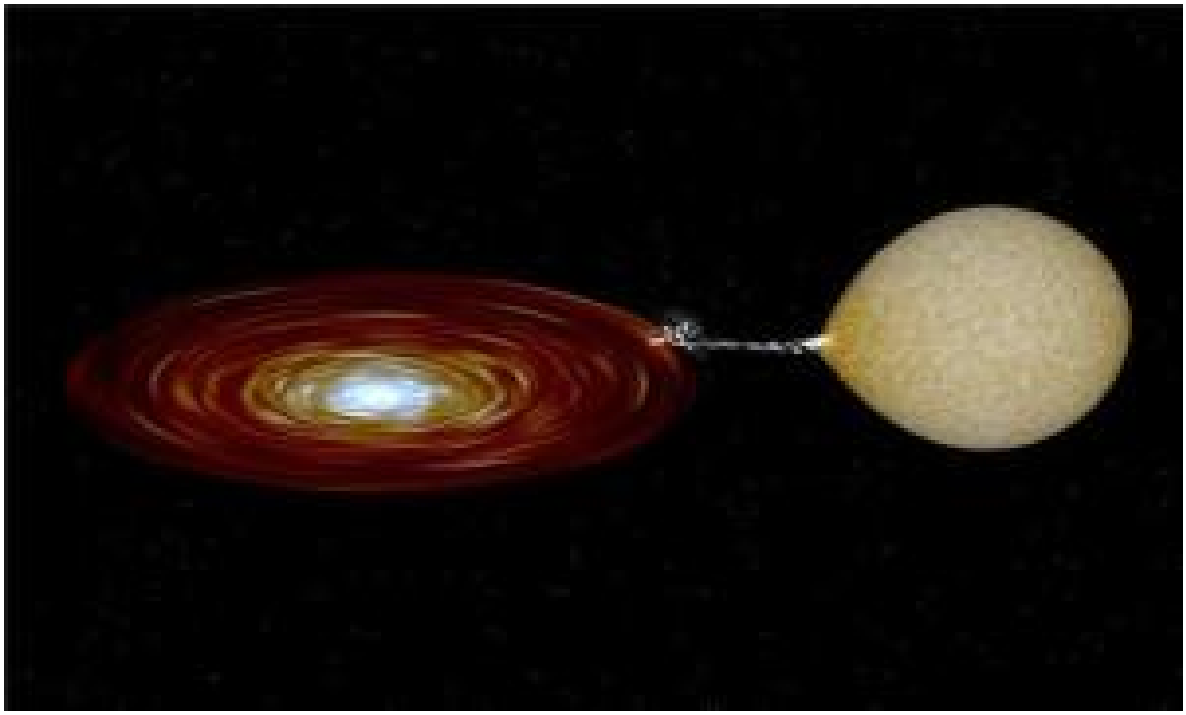
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Scripps Research Institute**.

Journal Reference:

1. Gareth J Williams, R Scott Williams, Jessica S Williams, Gabriel Moncalian, Andrew S Arvai, Oliver Limbo, Grant Guenther, Soumita SilDas, Michal Hammel, Paul Russell, John A Tainer. **ABC ATPase signature helices in Rad50 link nucleotide state to Mre11 interface for DNA repair**. *Nature Structural & Molecular Biology*, 2011; DOI: 10.1038/nsmb.2038

http://www.sciencedaily.com/releases/2011/03/110327191201.htm

Black Hole Found in Binary Star System: More Than Five Times Greater in Mass Than Our Sun



Visual representation of a binary system similar to XTE J1859+226, where there can be observed the star, the stream of matter leading towards the black hole, and the disc that forms around the black hole. (Credit: Jesús Corral Santana (IAC))

ScienceDaily (Mar. 27, 2011) — Researchers from the Instituto de Astrofísica de Canarias (IAC) have discovered the existence of a black hole 5.4 times greater in mass than that of our Sun, located in the X-ray binary system XTE J1859+226. The observations carried out from the Gran Telescopio Canarias (GTC), managing to obtain the first spectroscopic data from this binary system to be published, have been determinant for the discovery.

X-ray binaries are stellar systems composed by a compact object (which may be a neutron star or a black hole) and a 'normal' star. The compact object sucks matter out of the star and adds it slowly to its own mass, through a spiral disc formed around it. This process of absorption is known as acretion. Only 20 binary systems, out of an estimated population of around 5,000 within our Galaxy, are known to contain a black hole.

XTE J1859+226 is, in particular, a transient X-ray binary located in the Vulpecula constellation. It was discovered by satellite RXTE during an eruption registered in 1999.

"Transient X-ray binaries are characterised for spending most of their life in a state of calmness, but occasionally entering eruption stages, during which the rhythm of acretion of matter toward the black hole is triggered," Jesús Corral Santana explains, an astrophysicist from the IAC, who led the work published in the *Monthly Notices of the Royal Astronomical Society (MNRAS).*

Neutron stars as well as black holes are the remains left by a massive star after its death. Most of the known neutron stars have a mass around 1.4 times that of the Sun, though in some cases, values up to over twice the mass of the Sun have been measured. Astronomers believe that when greater than tree times the solar mass, neutron stars are not stable, and end up collapsing and forming a black hole.

For Corral-Santana, "measuring the mass of compact objects is essential to determine what kind of object it may be. If it's greater than three times the solar mass, it can only be a black hole. We found that XTE J1859+226 has a black hole more than 5.4 times greater than the mass of the Sun. It's the definitive confirmation of the existence of a black hole in this object."

"With this result we add a new piece to the study of the mass distribution of black holes. The shape of this distribution has very important implications for our knowledge about the death of massive stars, the formation of black holes, and the evolution of X-ray binary systems," the IAC astrophysicist adds.

Twelve years of observation: measuring the visible and the invisible

The astrophysicists' team at IAC hadn't lost track of the stellar object since it entered an eruption stage in 1999, when they started to set up observation campaigns to follow its evolution. The researchers have combined the photometric measures from the Isaac Newton Telescope (INT) and the William Herschel Telescope (WHT) in year 2000, and those from the Nordic Optical Telescope (NOT) in 2008, with the spectroscopy carried out with the GTC in 2010, the first one ever published about this particular object.

"Due to the low brilliance of the system under observation, we needed 10 meter telescopes in able to obtain spectra. In this sense, having been able to make our observations from the GTC has been determinant," Corral-Santana emphasises.

The measurements at the GTC were carried out with the OSIRIS instrument, which may be used as a camera or as a spectrograph in the visible range. The spectrograph decomposes the light emitted by a star into its different frequencies and allows detecting lines corresponding to the different chemical elements present in its atmosphere. These lines adduce information about the physical properties of the star and its movement.

The photometric measures allowed determining the orbital period of the binary (6.6 hours), while the spectroscopy data also provided information about the speed of the star's orbital movement around the black hole. The combination of both of these parameters proved to be vital to calculate the mass of the back hole.

The Gran Telescopio Canarias (GTC), located at the Roque de los Muchachos Observatory (in La Palma, Canary Islands), is the biggest optical-infrared telescope of the World, with a 10.4 metre diameter mirror.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Instituto de Astrofisica de Canarias**, via AlphaGalileo.

Journal Reference:

1. J. M. Corral-Santana, J. Casares, T. Shahbaz, C. Zurita, I. G. Martínez-Pais, P. Rodríguez-Gil. **Evidence for a black hole in the X-ray transient XTE J1859 226**. *Monthly Notices of the Royal Astronomical Society: Letters*, 2011; DOI: 10.1111/j.1745-3933.2011.01022.x

http://www.sciencedaily.com/releases/2011/03/110325082725.htm

Antarctic Icebergs Play a Previously Unknown Role in Global Carbon Cycle, Climate

An iceberg with exposed shelf in the Scotia Sea -- and, if you look closely, some penguin passengers. This fragment broke off from a larger, tabular iceberg, exposing a smooth section that had been submerged. Penguins and other seabirds are frequently observed standing on exposed portions of icebergs. (Credit: Photo courtesy of Ron Kaufmann, University of San Diego)

ScienceDaily (Mar. 26, 2011) — In a finding that has global implications for climate research, scientists have discovered that when icebergs cool and dilute the seas through which they pass for days, they also raise chlorophyll levels in the water that may in turn increase carbon dioxide absorption in the Southern Ocean. An interdisciplinary research team supported by the National Science Foundation (NSF) highlighted the research this month in the journal *Nature Geoscience.*

The research indicates that "iceberg transport and melting have a role in the distribution of phytoplankton in the Weddell Sea," which was previously unsuspected, said John J. Helly, director of the Laboratory for Environmental and Earth Sciences with the San Diego Supercomputer Center at the University of California, San Diego and Scripps Institution of Oceanography.

Helly was the lead author of the paper, "Cooling, Dilution and Mixing of Ocean Water by Free-drifting Icebergs in the Weddell Sea," which was first published in the journal *Deep-Sea Research Part II.*

The results indicate that icebergs are especially likely to influence phytoplankton dynamics in an area known as "Iceberg Alley," east of the Antarctic Peninsula, the portion of the continent that extends northwards toward Chile.

The latest findings add a new dimension to previous research by the same team that altered the perception of icebergs as large, familiar, but passive, elements of the Antarctic seascape. The team previously showed that icebergs act, in effect, as ocean "oases" of nutrients for aquatic life and sea birds.

The teams's research indicates that ordinary icebergs are likely to become more prevalent in the Southern Ocean, particularly as the Antarctic Peninsula continues a well-documented warming trend and ice shelves disintegrate. Research also shows that these ordinary icebergs are important features of not only marine ecosystems, but even of global carbon cycling.

"These new findings amplify the team's previous discoveries about icebergs and confirm that icebergs contribute yet another, previously unsuspected, dimension of physical and biological complexity to polar ecosystems," said Roberta L. Marinelli, director of the NSF's Antarctic Organisms and Ecosystems Program.

NSF manages the U.S. Antarctic Program, through which it coordinates all U.S. scientific research and related logistics on the southernmost continent and aboard ships in the Southern Ocean.
The latest findings document a persistent change in physical and biological characteristics of surface waters after the transit of an iceberg, which has important effects on phytoplankton populations, clearly demonstrating "that icebergs influence oceanic surface waters and mixing to greater extents than previously realized," said Ronald S. Kaufmann, associate professor of marine science and environmental studies at the University of San Diego and one of the authors of the paper.
The researchers studied the effects by sampling the area around a large iceberg more than 32 kilometers (20 miles) long; the same area was surveyed again ten days later, after the iceberg had drifted away.
After ten days, the scientists observed increased concentrations of *chlorophyll a* and reduced concentrations of carbon dioxide, as compared to nearby areas without icebergs. These results are consistent with the growth of phytoplankton and the removal of carbon dioxide from the ocean.
The new results demonstrate that icebergs provide a connection between the geophysical and biological domains that directly affects the carbon cycle in the Southern Ocean, Marinelli added.
In 2007, the same team published findings in the journal *Science* that icebergs serve as "hotspots" for ocean life with thriving communities of seabirds above and a web of phytoplankton, krill and fish below. At that time, the researchers reported that icebergs hold trapped terrestrial material, which they release far out at sea as they melt, a process that produces a "halo effect" with significantly increased nutrients and krill out to a radius of more than three kilometers (two miles).
The new research was conducted as part of a multi-disciplinary project that also involved scientists from the Monterey Bay Aquarium Research Institute, University of South Carolina, University of Nevada, Reno, University of South Carolina, Brigham Young University, and the Bigelow Laboratory for Ocean Sciences. Scripps Institution of Oceanography research biologist Maria Vernet and graduate student Gordon Stephenson also contributed to the paper.

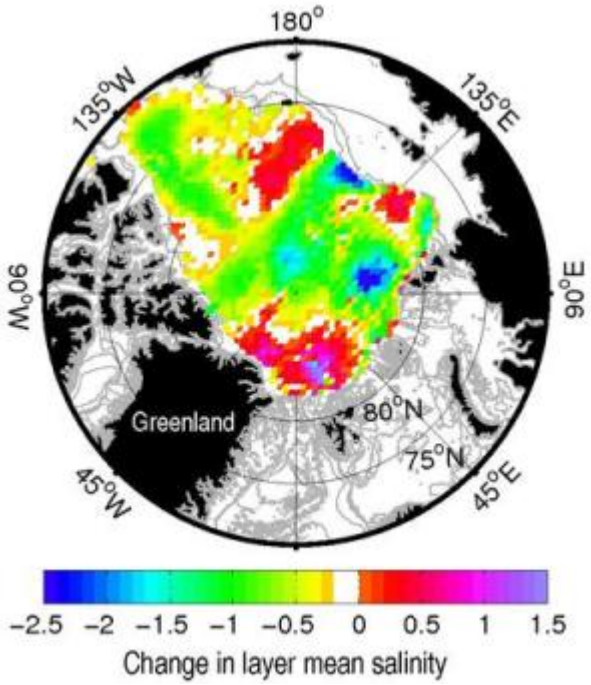
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. John J. Helly, Ronald S. Kaufmann, Gordon R. Stephenson Jr., Maria Vernet. **Cooling, dilution and mixing of ocean water by free-drifting icebergs in the Weddell Sea**. *Deep Sea Research Part II: Topical Studies in Oceanography*, 2011; DOI: 10.1016/j.dsr2.2010.11.010

http://www.sciencedaily.com/releases/2011/03/110325164224.htm

Freshwater Content of Upper Arctic Ocean Increased 20 Percent Since 1990s, Large-Scale Assessment Finds



Freshwater Content of the Arctic Ocean: Differences in the mean salinity of the Arctic Ocean above the 34 isohaline between 2006 to 2008 and 1992 to 1999. Negative values are shown in yellow, green, and blue and stand for an increase of freshwater. (Credit: Benjamin Rabe, Alfred Wegener Institute)

ScienceDaily (Mar. 27, 2011) — The freshwater content of the upper Arctic Ocean has increased by about 20 percent since the 1990s, according to a new large-scale assessment. This corresponds to a rise of approximately 8,400 cubic kilometres and has the same magnitude as the volume of freshwater annually exported on average from this marine region in liquid or frozen form.

The result is published by researchers of the Alfred Wegener Institute in the journal *Deep-Sea Research*. The freshwater content in the layer of the Arctic Ocean near the surface controls whether heat from the ocean is emitted into the atmosphere or to ice. In addition, it has an impact on global ocean circulation.

Around ten percent of the global mainland runoff flows into the Arctic via the enormous Siberian and North American rivers in addition to relatively low-salt water from the Pacific. This freshwater lies as a light layer on top of the deeper salty and warm ocean layers and thus extensively cuts off heat flow to the ice and atmosphere. Changes in this layer are therefore major control parameters for the sensitive heat balance of the Arctic. We can expect that the additional amount of freshwater in the near-surface layer of the Arctic Ocean will flow out into the North Atlantic in the coming years. The amount of freshwater flowing out of the Arctic influences the formation of deep water in the Greenland Sea and Labrador Sea and thus has impacts on global ocean circulation.

Dr. Benjamin Rabe from the Alfred Wegener Institute for Polar and Marine Research in the Helmholtz Association and his colleagues have evaluated a total of over 5,000 measured salt concentration profiles. To measure the depth distribution of the salt concentration, researchers used sensors from ships or mounted sensors on large ice floes so the data were recorded during the ice drift through the Arctic Ocean. Furthermore, measured values from submarines were inputted in the analyses. Major portions of the data stem from expeditions during International Polar Year 2007/2008. "The well coordinated researchprogrammes in the Arctic have substantially improved the database in these difficult to access areas," reports Rabe, who will again sail to the central Arctic on the researchvessel Polarstern in the coming summer. The dense network of observations in recent years made it possible for the first time to come up with a comparative assessment of the freshwater content in the Arctic Ocean.

Rabe and his colleagues have published the increase in the freshwater content between the periods 1992 to 1999 and 2006 to 2008 in the journal Deep-Sea Research. "The considerable changes in the upper water layers primarily comprise a decline in salt concentration," says Rabe. Another, though minor, effect is that the low-salt layers are thicker than before. The freshwater content of the Arctic Ocean may rise due to increased sea ice or glacier melt, precipitation or river inputs. Less export of freshwater from the Arctic -- in the form of sea ice or in liquid form -- also results in a rise in the freshwater content. The authors of the study point to altered export of freshwater and altered inputs from near-coastal areas in Siberia to the central Arctic Ocean as the most probable reasons.
Dr. Michael Karcher from the Alfred Wegener Institute, co-author of the study, simulated the observed processes using the NAOSIM coupled ocean/sea ice model. The model experiments make it possible to study longer periods, i.e. to map times for which no measurement data are available. The model also supplies important insights into the causes of the rising and falling freshwater content and points out the great significance of the local wind field. Measurements and the model additionally show that the changes in the Arctic freshwater content encompass far larger areas than assumed to date.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Helmholtz Association of German Research Centres**.

Journal Reference:

1. Benjamin Rabe, Michael Karcher, Ursula Schauer, John M. Toole, Richard A. Krishfield, Sergey Pisarev, Frank Kauker, Rüdiger Gerdes, Takashi Kikuchi. **An assessment of Arctic Ocean freshwater content changes from the 1990s to the 2006–2008 period**. *Deep Sea Research Part I: Oceanographic Research Papers*, 2011; 58 (2): 173 DOI: 10.1016/j.dsr.2010.12.002

http://www.sciencedaily.com/releases/2011/03/110325111901.htm

Blocking Ship-Borne Bioinvaders Before They Dock

This is a ship emptying ballast water. (Credit: Maritime Environmental Resource Center)

ScienceDaily (Mar. 25, 2011) — The global economy depends on marine transportation. But in addition to cargo, the world's 50,000-plus commercial ships carry tiny stowaways that can cause huge problems for the environment and economy. A new model created by Smithsonian scientists will facilitate accurate screening of vessels for dangerous species before they unload. The team's findings are published March 28 in the journal *Environmental Science & Technology*.

Ballast water taken up by ships in coastal waters teems with plankton and microbes. When discharged at the next port of call, these hitchhikers can wreak havoc on receiving ecosystems. Under current federal regulations, ships exchange their ballast water in the open ocean to flush out unwanted species. However, some survive the process, and not all ships travel across oceans. Environmental regulators have known about this problem for decades. But while regulators check ship records and can sometimes test salinity to verify compliance, unlike many pollutants, there are no federal requirements limiting the number of viable, potentially dangerous organisms.

That is about to change. The U.S. Coast Guard has proposed a new set of rules limiting the number of organisms allowed, in line with current International Maritime Organization standards. For larger zooplankton (length, width or height at least 50 microns, or one-half the thickness of a piece of paper), the number must be fewer than 10 viable organisms per cubic meter (264 gallons). On-board ballast water treatment technologies offer a promising solution, enabling ships to substantially cut the risk of delivering dangerous species. But while a few systems have entered the market, the challenge of testing the ballast water -- and the technology -- remains. A major stumbling block is simply understanding how such testing should occur and how much ballast water must be tested in order to count very sparse numbers of organisms.

To help regulators and engineers develop and test such treatment systems, and ultimately enforce these standards, a team of researchers developed a statistical model to see how to count small, scarce organisms in large volumes of water accurately. Led by Whitman Miller, research ecologist at the Smithsonian Environmental Research Center, the scientists took samples that exceeded the limit and ran them through various tests to see which violations would be spotted. Larger samples gave the best results: sampling only 0.1 cubic meter of water (26.4 gallons) made it difficult to detect concentrations even twice as high as the standard. By contrast, when they raised the volume to 7 cubic meters (1848 gallons), the test regularly picked up violations as low as 13 zooplankton per cubic meter.

Another innovation of the model is that it can pool sample results over time and possibly across ships, making it easier to determine if treatment systems function as advertised and thus whether ships are actually compliant or not. Since analyzing samples larger than 7 cubic meters is difficult for most cargo ships, by

taking multiple 7-cubic-meter samples, regulators could effectively raise the volume without overburdening the ships.

"When trying to decide how to evaluate a treatment system, we need to balance scientific rigor with what is logistically feasible," said Miller. "Science can help inform regulatory efforts. However, in the end, it is necessary for regulators to determine the level of environmental protection that is acceptable in accordance with both scientific evidence and the needs and desires of society."

"The findings of this study will greatly assist the Coast Guard to develop and implement effective and economical procedures for approving treatment equipment and verifying compliance by ships in meeting discharge standards to minimize the risk of introducing potentially harmful organisms to U.S. aquatic ecosystems," said Richard Everett, an environmental scientist with the Coast Guard's Environmental Standards Division.

The Coast Guard proposal would require most ships arriving in U.S. waters to have ballast water-treatment systems that dramatically reduce the number of living organisms in their discharge. Under the proposed regulation, most existing ships would have until 2014 or 2016 to comply, but any ships built after Jan. 1, 2012, would need to comply immediately. The agency estimated in 2009 that the new regulation could cost as much as $168 million a year, largely for ships to install the new technologies necessary to comply. However, in terms of economic and environmental damage avoided, it could save anywhere from $165 to $585 million a year.

The Coast Guard is also considering implementing a second phase of regulations, which would be up to a thousand times more stringent than the International Maritime Organization standards, perhaps beginning in 2016, but subject to an assessment of practicability.

Story Source:

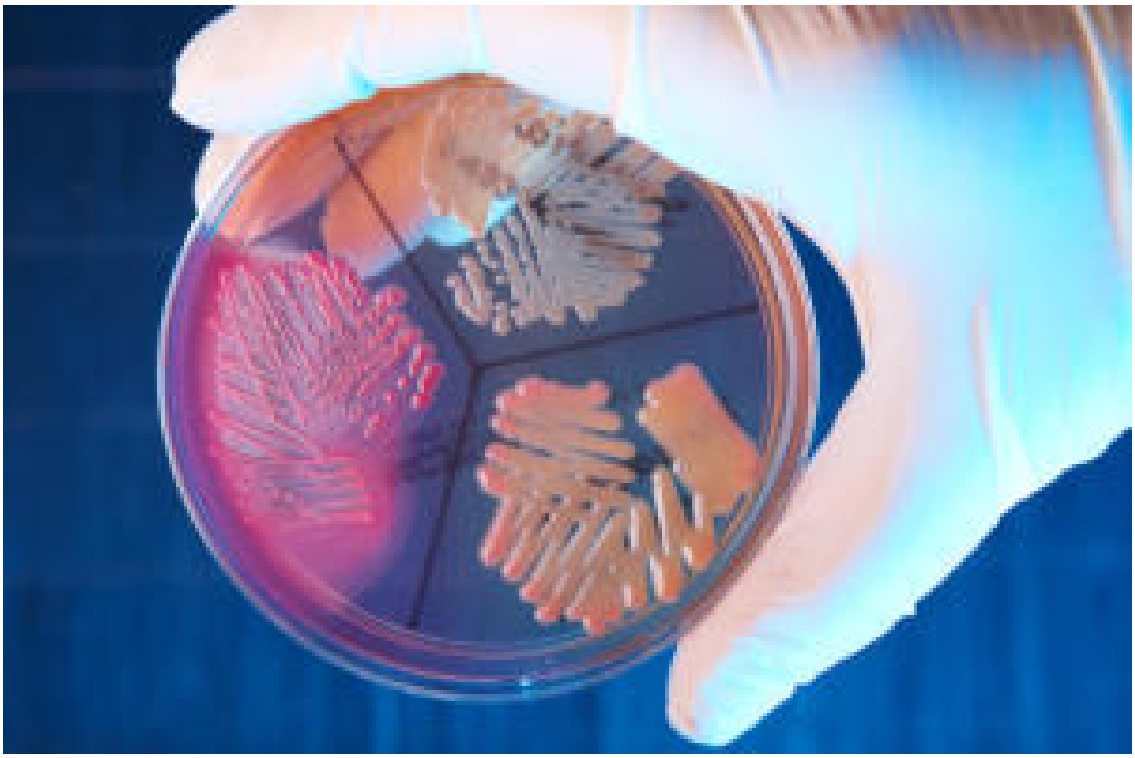
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Smithsonian**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. A. Whitman Miller, Melanie Frazier, George E. Smith, Elgin S. Perry, Gregory M. Ruiz, Mario N. Tamburri. **Enumerating Sparse Organisms in Ships' Ballast Water: Why Counting to 10 Is Not So Easy**. *Environmental Science & Technology*, 2011; : 110324163436083 DOI: 10.1021/es102790d

http://www.sciencedaily.com/releases/2011/03/110328092510.htm

Evolution: Not Only the Fittest Survive



Bacteria growing on a Petri plate. (Credit: iStockphoto/Monika Wisniewska)

ScienceDaily (Mar. 27, 2011) — Darwin's notion that only the fittest survive has been called into question by new research published in the journal *Nature*. A collaboration between the Universities of Exeter and Bath in the UK, with a group from San Diego State University in the US, challenges our current understanding of evolution by showing that biodiversity may evolve where previously thought impossible.

The work represents a new approach to studying evolution that may eventually lead to a better understanding of the diversity of bacteria that cause human diseases.

Conventional wisdom has it that for any given niche there should be a best species, the fittest, that will eventually dominate to exclude all others.

This is the principle of survival of the fittest. Ecologists often call this idea the `competitive exclusion principle' and it predicts that complex environments are needed to support complex, diverse populations.

Professor Robert Beardmore, from the University of Exeter, said: "Microbiologists have tested this principle by constructing very simple environments in the lab to see what happens after hundreds of generations of bacterial evolution, about 3,000 years in human terms. It had been believed that the genome of only the fittest bacteria would be left, but that wasn't their finding. The experiments generated lots of unexpected genetic diversity."

This test tube biodiversity proved controversial when first observed and had been explained away with claims that insufficient time had been allowed to pass for a clear winner to emerge.

The new research shows the experiments were not anomalies.

Professor Laurence Hurst, of the University of Bath, said: "Key to the new understanding is the realization that the amount of energy organisms squeeze out of their food depends on how much food they have. Give them abundant food and they use it inefficiently. When we combine this with the notion that organisms with different food-utilizing strategies are also affected in different ways by genetic mutations, then we discover a new principle, one in which both the fit and the unfit coexist indefinitely."

Dr Ivana Gudelj, also from the University of Exeter, said: "The fit use food well but they aren't resilient to mutations, whereas the less efficient, unfit consumers are maintained by their resilience to mutation. If there's a low mutation rate, survival of the fittest rules, but if not, lots of diversity can be maintained.

"Rather nicely, the numbers needed for the principle to work accord with those enigmatic experiments on bacteria. Their mutation rate seems to be high enough for both fit and unfit to be maintained."
Dr. David Lipson of San Diego State University, concluded: "Earlier work showed that opposing food utilization strategies could coexist in complex environments, but this is the first explanation of how trade-offs, like the one we studied between growth rate and efficiency, can lead to stable diversity in the simplest possible of environments."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Exeter**.

Journal Reference:

1. Robert E. Beardmore, Ivana Gudelj, David A. Lipson, Laurence D. Hurst. **Metabolic trade-offs and the maintenance of the fittest and the flattest**. *Nature*, 2011; DOI: 10.1038/nature09905

http://www.sciencedaily.com/releases/2011/03/110327191044.htm

Even Canadian Rocks Are Different: Sedimentary Differences on Either Side of Border Date Back 120 Million Years

Andrew Leier examined zircons from Lower Cretaceous sandstone near the Sulphur river in the Grande Cache, Alberta area. The prominent sandstone cliff is the Cretaceous sandstone. (Credit: University of Calgary)

ScienceDaily (Mar. 28, 2011) — Canadians have always seen themselves as separate and distinct from their American neighbours to the south, and now they have geological proof.

New research published in April's edition of *Geology* shows that rock formations roughly along the same political boundary as the two North American countries formed as early as 120 million years ago.

Dr. Andrew Leier, of the Department of Geoscience at the University of Calgary, set out to prove what he thought was the obvious: because the mountains are continuous between the U.S. and Canada, the ancient river systems that flowed from these uplands were likely interconnected. In other words, during Cretaceous Period,120 million years ago, rivers should have flowed north and south between the countries, paying no mind to the modern day political border.

"I thought that I could easily show that in my research," says Leier who published a paper in *Geology* with co-author Dr. George Gehrels at the University of Arizona and, Leier adds, a lot of help from Cassandra Frosini, an undergraduate in geoscience at the University of Calgary.

But Leier was wrong. "I was surprised to learn the opposite, in fact, was true," he says.

A tiny piece of sediment found in sandstone called zircon helped the researchers locate where the sediments had originally formed. Knowing its current location, Leier was able to determine just how far the rivers moved it and the direction from which it came.

During the Cretaceous Period, mountains were being created all along western North America, in both Canada and the United States.

"I thought the sediment transported by ancient rivers in Montana and Utah would flow out of the mountain ranges and then north into Alberta. This is similar with how the Ganges River runs parallel to the Himalayas. Our research shows this wasn't the case," says Leier.
Leier and Gehrels used recently developed laser-based techniques to reconstruct the origin of individual sand grains that were deposited during this period in western North America. This technique has applications to the petroleum industry as well, where it can be used to aide in determining drilling locations.
Researchers found slightly different rocks, when eroded, produced slightly different zircons.
"Cretaceous sediment in the United States have a clear American signature; whereas those in the Canadian Rockies have a different and definable Canadian signature," says Leier.
"The demarcation is pretty much coincidental with the modern day border."
Also the implication of the data suggests that the rivers that flowed west to east from the mountains in the United States stayed in the United States, and those in Canada stayed in Canada.
"In other words, there is no evidence that rivers in western North America were crossing what is today the border," says Leier.

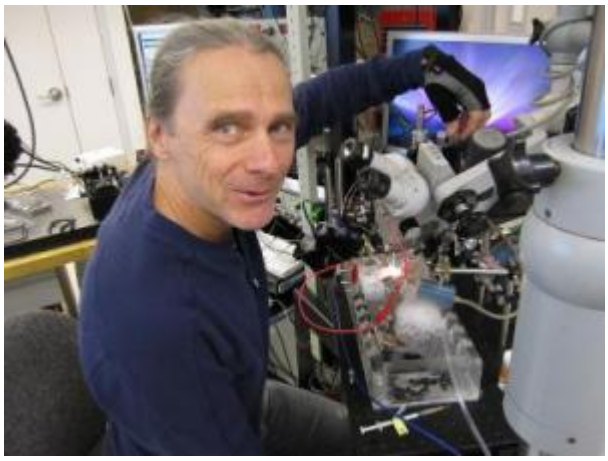
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Calgary**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. A. L. Leier, G. E. Gehrels. **Continental-scale detrital zircon provenance signatures in Lower Cretaceous strata, western North America**. *Geology*, 2011; 39 (4): 399 DOI: 10.1130/G31762.1

http://www.sciencedaily.com/releases/2011/03/110328092425.htm

Will We Hear the Light? Surprising Discovery That Infrared Can Activate Heart and Ear Cells



Using an elaborate apparatus to study the inner-ear cells of the oyster toadfish (in clear plastic container, lower right), University of Utah bioengineering professor Richard Rabbitt found that infrared light similar to those in laser pointers -- but at a longer and invisible wavelength -- can make inner-ear "hair cells" send signals to adjacent nerve cells and then to the brain. The discovery could lead to better cochlear implants that would use infrared light rather than electrical signals to represent sounds, allowing deaf people to hear a much wider ranger of frequencies than in existing electrical implants. (Credit: Lee Siegel, University of Utah)

ScienceDaily (Mar. 27, 2011) — University of Utah scientists used invisible infrared light to make rat heart cells contract and toadfish inner-ear cells send signals to the brain. The discovery someday might improve cochlear implants for deafness and lead to devices to restore vision, maintain balance and treat movement disorders like Parkinson's.

"We're going to talk to the brain with optical infrared pulses instead of electrical pulses," which now are used in cochlear implants to provide deaf people with limited hearing, says Richard Rabbitt, a professor of bioengineering and senior author of the heart-cell and inner-ear-cell studies published this month in The *Journal of Physiology*.

The studies -- funded by the National Institutes of Health -- also raise the possibility of developing cardiac pacemakers that use optical signals rather than electrical signals to stimulate heart cells. But Rabbitt says that because electronic pacemakers work well, "I don't see a market for an optical pacemaker at the present time."

The scientific significance of the studies is the discovery that optical signals -- short pulses of an invisible wavelength of infrared laser light delivered via a thin, glass optical fiber -- can activate heart cells and inner-ear cells related to balance and hearing.

In addition, the research showed infrared activates the heart cells, called cardiomyocytes, by triggering the movement of calcium ions in and out of mitochondria, the organelles or components within cells that convert sugar into usable energy. The same process appears to occur when infrared light stimulates inner-ear cells.

Infrared light can be felt as heat, raising the possibility the heart and ear cells were activated by heat rather than the infrared radiation itself. But Rabbitt and colleagues did "elegant experiments" to show the cells indeed were activated by the infrared radiation, says a commentary in the journal by Ian Curthoys of the University of Sydney, Australia.

Curthoys writes that the research provides "stunningly bright insight" into events within inner-ear cells and "has great potential for future clinical application."

Shedding Infrared Light on Inner-Ear Cells and Heart Cells

The low-power infrared light pulses in the study were generated by a diode -- "the same thing that's in a laser pointer, just a different wavelength," Rabbitt says.

The scientists exposed the cells to infrared light in the laboratory. The heart cells in the study were newborn rat heart muscle cells called cardiomyocytes, which make the heart pump. The inner-ear cells are hair cells, and came from the inner-ear organ that senses motion of the head. The hair cells came from oyster toadfish, which are well-establish models for comparison with human inner ears and the sense of balance.

Inner-ear hair cells "convert the mechanical vibration from sound, gravity or motion into the signal that goes to the brain" via adjacent nerve cells, says Rabbitt.
Using infrared radiation, "we were stimulating the hair cells, and they dumped neurotransmitter onto the neurons that sent signals to the brain," Rabbitt says.
He believes the inner-ear hair cells are activated by infrared radiation because "they are full of mitochondria, which are a primary target of this wavelength."
The infrared radiation affects the flow of calcium ions in and out of mitochondria -- something shown by the companion study in neonatal rat heart cells.
That is important because for "excitable" nerve and muscle cells, "calcium is like the trigger for making these cells contract or release neurotransmitter," says Rabbitt.
The heart cell study found that an infrared pulse lasting a mere one-5,000th of a second made mitochondria rapidly suck up calcium ions within a cell, then slowly release them back into the cell -- a cycle that makes the cell contract.
"Calcium does that normally," says Rabbitt. "But it's normally controlled by the cell, not by us. So the infrared radiation gives us a tool to control the cell. In the case of the [inner-ear] neurons, you are controlling signals going to the brain. In the case of the heart, you are pacing contraction."

New Possibilities for Optical versus Electrical Cochlear Implants

Rabbitt believes the research -- including a related study of the cochlea last year -- could lead to better cochlear implants that would use optical rather than electrical signals.
Existing cochlear implants convert sound into electrical signals, which typically are transmitted to eight electrodes in the cochlea, a part of the inner ear where sound vibrations are converted to nerve signals to the brain. Eight electrodes can deliver only eight frequencies of sound, Rabbitt says.
"A healthy adult can hear more than 3,000 different frequencies. With optical stimulation, there's a possibility of hearing hundreds or thousands of frequencies instead of eight. Perhaps someday an optical cochlear implant will allow deaf people to once again enjoy music and hear all the nuances in sound that a hearing person would enjoy."
Unlike electrical current, which spreads through tissue and cannot be focused to a point, infrared light can be focused, so numerous wavelengths (corresponding to numerous frequencies of sound) could be aimed at different cells in the inner ear.
Nerve cells that send sound signals from the ears to the brain can fire more than 300 times per second, so ideally, a cochlear implant using infrared light would be able to perform as well. In the Utah experiments, the researchers were able to apply laser pulses to hair cells to make adjacent nerve cells fire up to 100 times per second. For a cochlear implant, the nerve cells would be activated within infrared light instead of the hair cells.
Rabbitt cautioned it may be five to 10 years before the development of cochlear implants that run optically. To be practical, they need a smaller power supply and light source, and must be more power efficient to run on small batteries like a hearing aid.

Optical Prosthetics for Movement, Balance and Vision Disorders

Electrical deep-brain stimulation now is used to treat movement disorders such as Parkinson's disease and "essential tremor, which causes rhythmic movement of the limbs so it becomes difficult to walk, function and eat," says Rabbitt.
He is investigating whether optical rather than electrical deep-brain stimulation might increase how long the treatment is effective.
Rabbitt also sees potential for optical implants to treat balance disorders.
"When we get old, we shuffle and walk carefully, not because our muscles don't work but because we have trouble with balance," he says. "This technology has potential for restoring balance by restoring the signals that the healthy ear sends to the brain about how your body is moving in space."
Optical stimulation also might provide artificial vision in people with retinitis pigmentosa or other loss of retinal cells -- the eye cells that detect light and color -- but who still have the next level of cells, known as ganglia, Rabbitt says.
"You would wear glasses with a camera [mounted on the frames] and there would be electronics that would convert signals from the camera into pulses of infrared radiation that would be patterned onto the diseased

retina that normally does not respond to light but would respond to the pulsed infrared radiation" to create images, he says.
Hearing and vision implants that use optical rather than electrical signals do not have to penetrate the brain or other nerve tissue because infrared light can penetrate "quite a bit of tissue," so devices emitting the light "have potential for excellent biocompatibility," Rabbitt says. "You will be able to implant optical devices and leave them there for life."
The heart cell study was led by Rabbitt, with University of Utah bioengineering doctoral student Gregory Dittami as first author. Co-authors were Suhrud Rajguru, a former Utah doctoral student now at Northwestern University in Chicago; Utah doctoral student Richard Lasher; and Robert Hitchcock, an assistant professor of bioengineering at the University of Utah.
Rabbitt's coauthors on the inner-ear study included first author Rajguru; Dittami; Claus-Peter Richter and Agnella Matic of Northwestern University; neuroscientist Gay Holstein of Mount Sinai School of Medicine in New York; and neuroscientist Stephen Highstein of the Marine Biological Laboratory in Woods Hole, Mass.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Utah**.

Journal References:

1. Gregory M. Dittami, Suhrud M. Rajguru, Richard A. Lasher, Robert W. Hitchcock, Richard D. Rabbitt. **Intracellular calcium transients evoked by pulsed infrared radiation in neonatal cardiomyocytes**. *The Journal of Physiology*, 2011; 589 (6): 1295 DOI: 10.1113/jphysiol.2010.198804
2. Suhrud M. Rajguru, Claus-Peter Richter, Agnella I. Matic, Gay R. Holstein, Stephen M. Highstein, Gregory M. Dittami, Richard D. Rabbitt. **Infrared photostimulation of the crista ampullaris**. *The Journal of Physiology*, 2011; 589 (6): 1283 DOI: 10.1113/jphysiol.2010.198333

http://www.sciencedaily.com/releases/2011/03/110328092508.htm

Fossil Is Best Look Yet at an Ancestor of Buttercups

This 125 million-year-old fossil of a eudicot is the earliest, most complete to date. It was named Leefructus mirus by a group of scientists that includes IU Bloomington biologist David Dilcher. (Credit: Zhiduan Chen)

ScienceDaily (Mar. 31, 2011) — Scientists from the United States and China have discovered the first intact fossil of a mature eudicot, a type of flowering plant whose membership includes buttercups, apple trees, maple trees, dandelions and proteas. The 125-million-year-old find, described in the journal *Nature*, reveals a remarkably developed species, leading the scientists to argue for an earlier origin of the eudicots -- and perhaps flowering plants in general.

"This fossil opens up a new way of thinking about the evolution of some of the first flowering plants," said Indiana University Bloomington biologist David Dilcher, the Nature paper's American coauthor. "We are also beginning to understand that the explosive radiation of all flowering plants about 111 million years ago has had a long history that began with the slower diversification of many families of eudicots over 10, perhaps 15 million years earlier."

Dilcher and his Chinese colleagues Ge Sun and Hongshan Wang (Shenyang Normal University) and Zhiduan Chen (Chinese Academy of Sciences) named the fossilized plant Leefructus mirus in honor of Li Shiming, a non-scientist who donated the fossil to Ge Sun's new museum of paleontology in Liaoning Province, China. Ge Sun was the project's principal investigator.

The fossil shows the above-ground portion of a mature plant. A single stem leads to five leaves, and one leads to a fully developed flower. The entire fossil is about 16 cm (6.3 in) tall. Leaves are innervated by branching veins, and the small, cup-shaped flower has five petals.

"I think Leefructus had attractive flowers to advertise for pollinators to visit," said Dilcher, when asked to speculate. "There were no bees at this time, so I think that flies, beetles or extinct types of moths or scorpion flies may have been involved in its pollination. Leefructus was found in the volcanic ash beds of an ancient lake. I think it was living near a lake, perhaps in a wet or marshy area much as buttercups do today."

The scientists' analysis of the plant's form leads them to believe Leefructus should be placed among the Ranunculaceae, an old family of eudicots that includes buttercups and crowroot plants.
"When we look at the branching relationships of the tree for this group, the Ranunculaceae is at the end of several branches going to the other families, such as the poppies," Dilcher said. "As a result, we believe that prior to 122 to 124 million years ago, several families of flowering plants had already begun to diverge. How much older the eudicots are we do not know yet, but this fossil suggests their origin certainly goes further back in the Cretaceous, perhaps even into the Jurassic."
The profusion of flowering plant species in the second half of the Mesozoic Era, the age of dinosaurs, eventually led to flowers' domination of other types of plants in all but Earth's harshest climates. Evolutionary biologists believe the diversification of flowering plants also supported the radiation of a wide range of animal species, particularly pollinators and seed eaters, from beetles and bees to hummingbirds and bats.
Until now, most fossil information about the earliest eudicots has come from fossilized pollen, the plant equivalent of sperm. Despite pollen's small size, pollen grains have provided crucial information to paleontologists. But pollen can only tell scientists so much.
"What we know about the earliest eudicots comes from a few pollen records off the coast of West Africa and the lower Cretaceous sediments in southern England about 127 million years before present," Dilcher said. "We can learn a lot from pollen, but the Leefructus fossil shows us that there is no substitute for a megafossil record if we are to understand the evolution of early flowering plants."
The age of the Leefructus fossil was determined by analyzing the ages of surrounding rock via Argon 40/39 and Uranium-Lead dating methods.
This research was supported by grants from the Chinese Ministry of Education, the "111" Project, China's National Natural Science Foundation, and Shenyang Normal University.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Indiana University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Ge Sun, David L. Dilcher, Hongshan Wang, Zhiduan Chen. **A eudicot from the Early Cretaceous of China**. *Nature*, 2011; 471 (7340): 625 DOI: 10.1038/nature09811

http://www.sciencedaily.com/releases/2011/03/110331142217.htm

Newly Discovered Natural Arch in Afghanistan One of World's Largest

WCS staff found the arch during a wildlife survey of the Bamyan Plateau in central Afghanistan. (Credit: Ayub Alavi)

ScienceDaily (Mar. 30, 2011) — Researchers from the Wildlife Conservation Society have stumbled upon a geological colossus in a remote corner of Afghanistan: a natural stone arch spanning more than 200 feet across its base.

Located at the central highlands of Afghanistan, the recently discovered Hazarchishma Natural Bridge is more than 3,000 meters (nearly 10,000 feet) above sea level, making it one of the highest large natural bridges in the world. It also ranks among the largest such structures known.

"It's one of the most spectacular discoveries ever made in this region," said Joe Walston, Director of the Wildlife Conservation Society's Asia Program. "The arch is emblematic of the natural marvels that still await discovery in Afghanistan."

Wildlife Conservation Society staff Christopher Shank and Ayub Alavi discovered the massive arch in late 2010 in the course of surveying the northern edge of the Bamyan plateau for wildlife (the landscape is home to ibex and urial wild sheep) and visiting local communities.

After making the discovery, they returned to the Hazarchishma Natural Bridge (named after a nearby village) in February 2011 to take accurate measure of the natural wonder. The total span of arch -- the measurement by which natural bridges are ranked -- is 210.6 feet in width, making it the 12th largest natural bridge in the world. This finding pushes Utah's Outlaw Arch in Dinosaur National Monument -- smaller than Hazarchishma by more than four feet -- to number 13 on the list.

The world's largest natural arch -- Fairy Bridge -- is located by Buliu River in Guangxi, China, and spans a staggering 400 feet in width. Several of the top 20 largest natural arches are located in the state of Utah in the U.S.

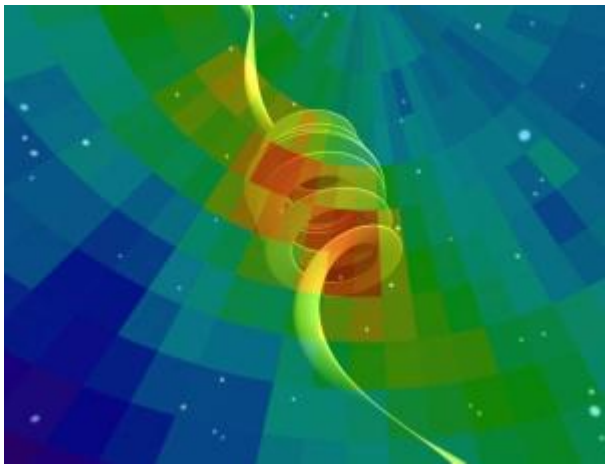
Consisting of rock layers formed between the Jurassic Period (200-145 million years ago) and the more recent Eocene Epoch (55-34 million years ago), the Hazarchishma Natural Bridge was carved over millennia by the once flowing waters of the now dry Jawzari Canyon.

With the assistance of WCS and support from USAID (United States Agency for International Development), the government of Afghanistan has launched several initiatives to safeguard the country's wild places and the wildlife they contain. In 2009, the government gazetted the country's first national park, Band-e-Amir, approximately 100 kilometers south of Hazarchishma Natural Bridge. The park was established with technical assistance from WCS's Afghanistan Program. WCS also worked with Afghanistan's National Environment Protection Agency (NEPA) in producing the country's first-ever list of protected species, an action that now bans the hunting of snow leopards, wolves, brown bears, and other species. In a related effort, WCS now works to limit illegal wildlife trade in the country through educational workshops for soldiers at Bagram Air Base and other military bases across Afghanistan. WCS also works with more than 55 local communities in Afghanistan to better manage their natural resources, helping them conserve wildlife while improving their livelihoods.
"Afghanistan has taken great strides in initiating programs to preserve the country's most beautiful wild places as well as conserve its natural resources," said Peter Zahler, Deputy Director for the WCS Asia Program. "This newfound marvel adds to the country's growing list of natural wonders and economic assets."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wildlife Conservation Society**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110330131350.htm

Mysterious 'Ribbon' of Energy and Particles That Wrap Around Solar System's Heliosphere Isolated



Rendering of ribbon. Scientists have isolated and resolved the mysterious "ribbon" of energy and particles discovered in the heliosphere -- the huge bubble that surrounds our solar system and protects us from galactic cosmic rays. (Credit: IBEX Science Team/Goddard Scientific Visualization Studio/ESA)

ScienceDaily (Mar. 31, 2011) — In a paper to be published in the April 10, 2011, issue of The *Astrophysical Journal*, scientists on NASA's Interstellar Boundary Explorer (IBEX) mission, including lead author Nathan Schwadron and others from the University of New Hampshire, isolate and resolve the mysterious "ribbon" of energy and particles the spacecraft discovered in the heliosphere -- the huge bubble that surrounds our solar system and protects us from galactic cosmic rays.

The finding, which overturns 40 years of theory, provides insight into the fundamental structure of the heliosphere, which in turn helps scientists understand similar structures or "astrospheres" that surround other star systems throughout the cosmos.

The ribbon of energy was captured using ultra-high sensitive cameras that image energetic neutral atoms (instead of photons of light) to create maps of the boundary region between our solar system and the rest of our galaxy.

Notes Schwadron, an associate professor at UNH's Institute for the Study of Earth, Oceans, and Space and department of physics, "Isolating and separating the ribbon from the IBEX maps was like pulling the drapes from our window to discover the landscape at the edge of the solar system."

Of the singular images the IBEX mission has been able to achieve, lead scientist David McComas of the Southwest Research Institute (SwRI) says, "These maps are very rich scientifically and are critical in helping scientists understand how our space environment is controlled by the galactic medium. They provide the first images of our solar system's boundaries, which control the access to potentially harmful galactic cosmic rays as well as all other matter from deep space."

The most energetic galactic cosmic rays penetrate even the powerful magnetic fields closest to Earth and eventually collide and interact with Earth's atmosphere. The direct or indirect effects of these cosmic rays on Earth system, including our biosphere, remain poorly understood and are often highly controversial.

The IBEX team is using the maps to learn how the heliosphere is shaped and what its physical properties are. This detailed information about our solar system's boundaries will allow scientists to better understand how galactic cosmic rays evolve in our space environment, which in turn will provide fundamental information about the radiation environment on Earth and its implications on the evolution of life.

The IBEX scientists analyzed data from the mission's first year of observations and, after developing an effective separation method, were able to isolate and resolve the unanticipated energetic ribbon feature. The ribbon appears to be wrapped like a belt on top of the globally distributed emissions of the broader sky, and by separating it from the background emissions scientists can now see what's underneath the ribbon.

Says Schwadron, "There are many theories about how the ribbon is created, and we don't understand exactly what we're seeing but it seems to be telling us something about how the local galactic magnetic field interacts with the heliosphere."

Additional evidence for that interaction was the discovery of a "tail" of emissions in the underlying boundary landscape, which is apparently deflected in the direction of the galactic magnetic field as the ribbon seems to indicate.

"This galactic magnetic field may be a missing key to understanding how the heliosphere protects the solar system from galactic cosmic rays," says Schwadron.

Also seen in the maps is the expected feature of the "nose" of the heliosphere. The nose represents the direction in which the solar system moves through the local part of the galaxy nearest to our Sun and that Schwadron compares to the "bow wave in front of a ship, which shows us how our motion through the galaxy compresses and deflects the material of the local galactic medium around our heliosphere."

The IBEX maps differ so radically from what was expected prior to the mission that the scientists have been struggling to untangle the vast amount of information the maps contain. The team notes that getting emissions from the nose of the heliosphere has been an important "lamp post" towards understanding how the global heliosphere is controlled by the interaction of the Sun with the local galactic medium.

Says McComas, "Prior to IBEX, most scientists believed that the global boundaries of our solar system were controlled mainly by the motion of our solar system through the galaxy and the solar wind, an extremely fast flow of electrically charged matter that flows out from the Sun. The IBEX maps reveal the galactic magnetic field is also a critical part of the Sun's interaction with the galaxy."

The mission launched October 19, 2008 and carries two ultra-high sensitivity cameras containing important components designed and built at UNH. In addition, the mission's Science Operations Center is headquartered at UNH.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of New Hampshire**.

Journal Reference:

1. N. A. Schwadron, F. Allegrini, M. Bzowski, E. R. Christian, G. B. Crew, M. Dayeh, R. DeMajistre, P. Frisch, H. O. Funsten, S. A. Fuselier, K. Goodrich, M. Gruntman, P. Janzen, H. Kucharek, G. Livadiotis, D. J. McComas, E. Moebius, C. Prested, D. Reisenfeld, M. Reno, E. Roelof, J. Siegel, R. Vanderspek. **Separation of Theinterstellar Boundary Explorerribbon from Globally Distributed Energetic Neutral Atom Flux**. *The Astrophysical Journal*, 2011; 731 (1): 56 DOI: 10.1088/0004-637X/731/1/56

http://www.sciencedaily.com/releases/2011/03/110331114935.htm

Astrophysicist: White Dwarfs Could Be Fertile Ground for Other Earths

This Hubble Space Telescope image shows the "last hurrah" of a star like our sun, the outer layers of gas being cast off and leaving behind the burned out white dwarf, the white dot in the center. (Credit: NASA/European Space Agency)

ScienceDaily (Mar. 31, 2011) — Planet hunters have found hundreds of planets outside the solar system in the last decade, though it is unclear whether even one might be habitable. But it could be that the best place to look for planets that can support life is around dim, dying stars called white dwarfs.

In a new paper published online March 29 in *The Astrophysical Journal Letters*, Eric Agol, a University of Washington associate professor of astronomy, suggests that potentially habitable planets orbiting white dwarfs could be much easier to find -- if they exist -- than other exoplanets located so far.

White dwarfs, cooling stars believed to be in the final stage of life, typically have about 60 percent of the mass of the sun, but by volume they are only about the size of Earth. They are much cooler than the sun and emit just a fraction of its energy, so the habitable zones for their planets are significantly closer than Earth is to the sun.

"If a planet is close enough to the star, it could have a stable temperature long enough to have liquid water at the surface -- if it has water at all -- and that's a big factor for habitability," Agol said.

A planet so close to its star could be observed using an Earth-based telescope as small as 1 meter across, as the planet passes in front of, and dims the light from, the white dwarf, he said.

White dwarfs evolve from stars like the sun. When such a star's core can no longer produce nuclear reactions that convert hydrogen to helium, it starts burning hydrogen outside the core. That begins the transformation to a red giant, with a greatly expanded outer atmosphere that typically envelops -- and destroys -- any planets as close as Earth.

Finally the star sheds its outer atmosphere, leaving the glowing, gradually cooling, core as a white dwarf, with a surface temperature around 5,000 degrees Celsius (about 9,000 degrees Fahrenheit). At that point, the star produces heat and light in the same way as a dying fireplace ember, though the star's ember could last for 3 billion years.

Once the red giant sheds its outer atmosphere, more distant planets that were beyond the reach of that atmosphere could begin to migrate closer to the white dwarf, Agol said. New planets also possibly could form from a ring of debris left behind by the star's transformation.

In either case, a planet would have to move very close to the white dwarf to be habitable, perhaps 500,000 to 2 million miles from the star. That's less than 1 percent of the distance from Earth to the sun (93 million miles) and substantially closer than Mercury is to the sun.

"From the planet, the star would appear slightly larger than our sun, because it is so close, and slightly more orange, but it would look very, very similar to our sun," Agol said.
The planet also would be tidally locked, so the same side would always face the star and the opposite side would always be in darkness. The likely areas for habitation, he said, might be toward the edges of the light zone, nearer the dark side of the planet.
The nearest white dwarf to Earth is Sirius B at a distance of about 8.5 light years (a light year is about 6 trillion miles). It is believed to once have been five times more massive than the sun, but now it has about the same mass as the sun packed into the same volume as Earth.
Agol is proposing a survey of the 20,000 white dwarfs closest to Earth. Using a 1-meter ground telescope, he said, one star could be surveyed in 32 hours of observation. If there is no telltale dimming of light from the star in that time, it means no planet orbiting closely enough to be habitable is passing in front of the star so that it is easily observable from Earth. Ideally, the work could be carried out by a network of telescopes that would make successive observations of a white dwarf as it progresses through the sky.
"This could take a huge amount of time, even with such a network," he said.
The same work could be accomplished by larger specialty telescopes, such as the Large Synoptic Survey Telescope that is planned for operations later this decade in Chile, of which the UW is a founding partner. If it turns out that the number of white dwarfs with potential Earthlike planets is very small -- say one in 1,000 -- that telescope still would be able to track them down efficiently.
Finding an Earthlike planet around a white dwarf could provide a meaningful place to look for life, Agol said. But it also would be a potential lifeboat for humanity if Earth, for some reason, becomes uninhabitable.
"Those are the reasons I find this project interesting," he said. "And there's also the question of, 'Just how special is Earth?'"

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Washington**. The original article was written by Vince Stricherz.

Journal Reference:

1. Eric Agol. **Transit Surveys for Earths in the Habitable Zones of White Dwarfs**. *The Astrophysical Journal*, 2011; 731 (2): L31 DOI: 10.1088/2041-8205/731/2/L31

http://www.sciencedaily.com/releases/2011/03/110330150854.htm

Common Yellow Lab Dye Profoundly Extends Lifespan in Healthy Nematodes

Nematode. (Credit: iStockphoto/Nancy Nehring)

ScienceDaily (Mar. 31, 2011) — Basic Yellow 1, a dye used in neuroscience laboratories around the world to detect damaged protein in Alzheimer's disease, is a wonder drug for nematode worms. In a study appearing in *Nature*, the dye, also known as Thioflavin T (ThT), extended lifespan in healthy nematode worms by more than 50 percent and slowed the disease process in worms bred to mimic aspects of Alzheimer's. The research, conducted at the Buck Institute for Research on Aging, could open new ways to intervene in aging and age-related disease.

The study highlights a process called protein homeostasis -- the ability of an organism to maintain the proper structure and balance of its proteins, which are the building blocks of life. Genetic studies have long indicated that protein homeostasis is a major contributor to longevity in complex animals. Many degenerative diseases have been linked to a breakdown in the process. Buck faculty member Gordon Lithgow, PhD, who led the research, said this study points to the use of compounds to support protein homeostasis, something that ThT, did as the worms aged.

ThT works as a marker of neurodegenerative diseases because it binds amyloid plaques -- the toxic aggregated protein fragments associated with Alzheimer's. In the nematodes ThT's ability to not only bind, but also slow the clumping of toxic protein fragments, may be key to the compound's ability to extend lifespan, according to Lithgow. "We have been looking for compounds that slow aging for more than ten years and ThT is the best we have seen so far," said Lithgow. "But more exciting is the discovery that ThT so dramatically improves nematode models of disease-related pathology as well," said Lithgow, who said the discovery brings together three crucial concepts in the search for compounds that could extend healthspan, the healthy years of life. "ThT allows us to manipulate the aging process, it has the potential to be active in multiple disease states and it enhances the animal's innate ability to deal with changes in its proteins."

The research was the brainchild of Silvestre Alavez, PhD, a staff scientist in the Lithgow lab. Alavez was trained in neuroscience and knew about the use of these compounds to detect disease-related proteins. With the idea that small molecules could impact protein aggregation, he looked at 10 compounds and found five that were effective in increasing lifespan in the worms. Alavez said curcumin, the active ingredient in the popular Indian spice turmeric, also had a significant positive impact on both healthy worms and those bred to express a gene associated with Alzheimer's. "People have been making claims about the health benefits of curcumin for many years. Maybe slowing aging is part of its mechanism of action," said Alavez. Curcumin is currently being tested in several human clinical trials for conditions ranging from colon cancer to rheumatoid arthritis to depression.

Alavez says the study supports the concept that protein homeostasis should be the focus of future research. "We now have an exciting new avenue in the search for compounds that both extend lifespan and slow disease processes," said Alavez. "Any small molecule that maintains protein homeostasis during aging could be active against multiple disease states." Follow up research on ThT is now underway in mice bred to have Alzheimer's.

Other Buck Institute researchers involved in the study include Maithili C. Vantipalli; Ida M. Klang, a graduate student from the Karolinksa Institute in Stockholm, Sweden; and David Zucker, a student from Dominican

University, CA. The work was supported by grants from the Larry L. Hillblom Foundation; the National Institutes of Health supporting the Buck Institute's Interdisciplinary Research Consortium on Geroscience; the National Institute on Aging (through the American Recovery and Reinvestment Act of 2009); and the Longevity Consortium.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Buck Institute for Age Research**.

Journal Reference:

1. Silvestre Alavez, Maithili C. Vantipalli, David J. S. Zucker, Ida M. Klang, Gordon J. Lithgow. **Amyloid-binding compounds maintain protein homeostasis during ageing and extend lifespan**. *Nature*, 2011; DOI: 10.1038/nature09873

http://www.sciencedaily.com/releases/2011/03/110330131258.htm

Sensory Wiring for Smells Varies Among Individuals

A flower may not necessarily smell the same to everyone. Researchers have discovered that mouse olfactory neurons send signals to two key processing regions of the brain in ways that differ significantly from one mouse to another -- a diversity that is likely to be found in humans, too. (Credit: iStockphoto)

ScienceDaily (Mar. 31, 2011) — If, as Shakespeare's Juliet declared, a rose by any other name smells as sweet -- to you and to me and to anyone else who sniffs it -- then one might assume that our odor-sensing nerve cells are all wired in the same way. Alas, they are not, according to a new study from scientists at The Scripps Research Institute.

The researchers developed a new virus-based technique for highlighting individual nerve pathways, then applied it to the olfactory systems of mice. They found that mouse olfactory neurons send signals to two key processing regions of the brain in ways that differ significantly from one mouse to another -- a diversity that is likely to be found in humans, too.

"This shows that we still have a lot to learn about olfactory perception and how the brain is wired in general," said Kristin Baldwin, an assistant professor at Scripps Research and senior author of the study, published online on March 30, 2011, by the journal *Nature*.

The Expected Pattern

For the initial stages of odor perception, the wiring pattern in mammals is already well known. Each primary olfactory neuron has root-like input fibers, embedded in the nasal lining, which express odor-specific receptors. When these receptors detect the appropriate "odorant" chemical, their host neuron becomes activated and sends a signal via its output fiber to an initial processing center, the olfactory bulb. There, the signal terminates in a spherical bundle of fibers known as a glomerulus.

"These odor-specific glomeruli are ordered in a very consistent, stereotyped way in the olfactory bulb so that the spatial pattern of activity that an odor elicits is nearly identical among individuals," said Sulagna Ghosh, a graduate student in Baldwin's lab and the study's first author. "Just by observing which sets of glomeruli are activated in a given mouse, we can predict which smell the animal is perceiving."

But when these olfactory signals go from glomeruli to higher processing centers in the olfactory cortex, does this stereotyped pattern continue? That's the question Ghosh, Baldwin, and their colleagues set out to answer.

"We see stereotyped maps in the cortex for other senses such as vision and touch," said Ghosh. "The same regularity is seen in the olfactory systems of flies, but in mammals, the wiring diagram of the olfactory brain has remained poorly understood."

A New Tracing Technique

Signals from activated glomeruli are relayed to higher processing regions of the olfactory cortex via so-called mitral and tufted (MT) neurons. Until now, researchers haven't had precise-enough tools to trace the

connections in mammals from an individual glomerulus to its dedicated MT neurons and on to their terminals in the olfactory cortex.

However, Ghosh and her colleagues were able to develop a technique by which they could deliver a highly efficient fluorescent-tracer-expressing virus to individual glomeruli. "Using this, we could tag with different fluorescent colors the separate MT neurons serving a single glomerulus, and then trace their output fibers, called axons, into the cortex," said Ghosh.

Surprising Diversity

Ghosh's technique enabled her to trace the branching axons of any MT neuron to two cortical processing centers, the anterior olfactory nucleus pars externa (AON pE) and the piriform cortex. In both regions, the locations where the MT axons terminated no longer showed the clear pattern seen in the olfactory bulb. "They turned out to be much more diverse and widely distributed than we expected," said Ghosh.

To help Ghosh and her colleagues compare these patterns from one mouse to another, a collaborating neuroinformatics expert, graduate student Stephen Larson of the University of California, San Diego, set up a software-based 3D anatomical "reference brain." The Scripps Research team then mapped their nerve tracings from individual mouse studies onto this reference.

"We found that MT projections from the same glomerulus in different mice were no more alike in where they landed than were projections from different glomeruli," said Ghosh. In other words, the wiring from the olfactory bulb to these two higher-processing regions is unique in each mouse -- and because mice are at least a rough model for other mammals, it seems likely this same olfactory wiring is also unique for each human.

This is puzzling for two reasons: First, it leaves unclear how, during fetal development, axons from adjacent and seemingly identical MT neurons find their way to such different destinations in the olfactory cortex. Second, it begs the question of how mammals can experience the same odor in the same way, if each individual's olfactory cortex has such unique wiring.

Ghosh suggests that the regularity of olfactory experiences -- which we infer from our similar descriptions of odors -- may arise from a third set of MT neuron projections, into the amygdala, a brain region best known for its role in processing emotion. "The amygdala was the one region we were unable to look at because its distance is greater than our tracer could reach," she said. "It might be an area where there is a more ordered or stereotyped representation."

"What is clear is that our new virus-based nerve-tracing technique should help in resolving these issues, within the olfactory system and beyond," said Baldwin.

In addition to Baldwin, Ghosh, and Larson, co-authors of the study, "Sensory maps in the olfactory cortex defined by long-range viral tracing of single neurons," were Hooman Hefzi, Zachary Marnoy, and Kartheek Dokka of Scripps Research; and Tyler Cutforth of the University of California, Santa Cruz.

Research in the Baldwin lab is supported by the California Institute of Regenerative Medicine, the Whitehall Foundation, the O'Keefe Foundation, the Shapiro Family Foundation, and the Scripps Research Dorris Neuroscience Center.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Scripps Research Institute**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Sulagna Ghosh, Stephen D. Larson, Hooman Hefzi, Zachary Marnoy, Tyler Cutforth, Kartheek Dokka, Kristin K. Baldwin. **Sensory maps in the olfactory cortex defined by long-range viral tracing of single neurons**. *Nature*, 2011; DOI: 10.1038/nature09945

http://www.sciencedaily.com/releases/2011/03/110330131302.htm

How to Make Skinny Worms Fat and Fat Worms Skinny

The UCSF team identified chemical compounds that reduced the accumulation of fat (highlighted in red) in worms, as seen in the treated worms. (Credit: Kaveh Ashrafi/UCSF)

ScienceDaily (Mar. 23, 2011) — Researchers exploring human metabolism at the University of California, San Francisco (UCSF) have uncovered a handful of chemical compounds that regulate fat storage in worms, offering a new tool for understanding obesity and finding future treatments for diseases associated with obesity.

As described in a paper published this month in the journal *Nature Chemical Biology*, the UCSF team took armies of microscopic worms called *C.elegans* and exposed them to thousands of different chemical compounds. Giving these compounds to the worms, they discovered, basically made them skinnier or fatter without affecting how they eat, grow, or reproduce.

The discovery gives scientists new ways to investigate metabolism and could eventually lead to the development of new drugs to regulate excessive fat accumulation and address the metabolic issues that underlie a number of major human health problems, including, obesity, diabetes and some forms of cancer.

The work also demonstrates the value of "worm screening" as a way of finding new targets for human diseases, according to the UCSF scientists, whose work was spearheaded by postdoctoral fellow George Lemieux, PhD, in the laboratory of Professor Zena Werb, PhD, vice chair of the Department of Anatomy at UCSF.

The work was a collaboration involving Kaveh Ashrafi, PhD, an associate professor in the UCSF Department of Physiology, and Roland Bainton, MD, PhD, an associate professor in residence in the UCSF Department of Anesthesia & Perioperative Care.

Why Worms Are Fat

The UCSF team's interest in how worms deal with fat began with a more fundamental interest in human metabolism. Worms make molecules of fat for the same reasons humans do -- they are useful for storing energy and are a basic building block for body tissues. Many of the genes and mechanisms worms use to regulate fat accumulation have similar systems in humans, and not all of them are completely understood.

Starting with 3,200 different chemical compounds and 3,200 pools of tiny worms, the UCSF team used a red dye that sticks to fat molecules to pinpoint under the microscope which of the chemicals made the worms fatter (more red) or skinnier (less red). They identified a few dozen, and performing additional tests, narrowed in on about 10 compounds they believe regulate fat metabolism. Those compounds not only altered fat storage in the worms but in in insect and human cells grown in test tubes, leading Lemieux to comment that they "may be useful for understanding metabolism in other organisms."

One of these compounds modulates a molecular complex called an AMP-activated kinase, which senses the availability of cellular energy. Versions of kinase complexes exist both in worms and humans, and some already are key targets for drug design by pharmaceutical companies.
"The compound that we get from our worm screen can act on this kinase complex as well if not better than anything else that is out there," said Ashrafi.
The real strength of the work, he added, is that it demonstrates the value of the new worm screen over existing screening tools for identifying the genes, proteins and other molecular players involved in human health.
A large part of drug discovery involves identifying these players and designing ways to treat diseases that emerge when they don't work correctly. But identifying the targets is only the beginning. Designing a drug involves overcoming a long list of other hurdles, Ashrafi said, and the bottom line is that most of the potential drugs that seem to work well in the test tube fail to work in people.
The value of the worm screen, he said, is that it allows scientists to select compounds for further study that already work effectively in a whole organism.
"A lot of the drugs that are in clinical use or development today were discovered basically by chance," Ashrafi said. "If we understood everything about everything, we could probably design the right compounds. But the reality is our understanding of many of the biological principles and chemical principles are still in their infancy."

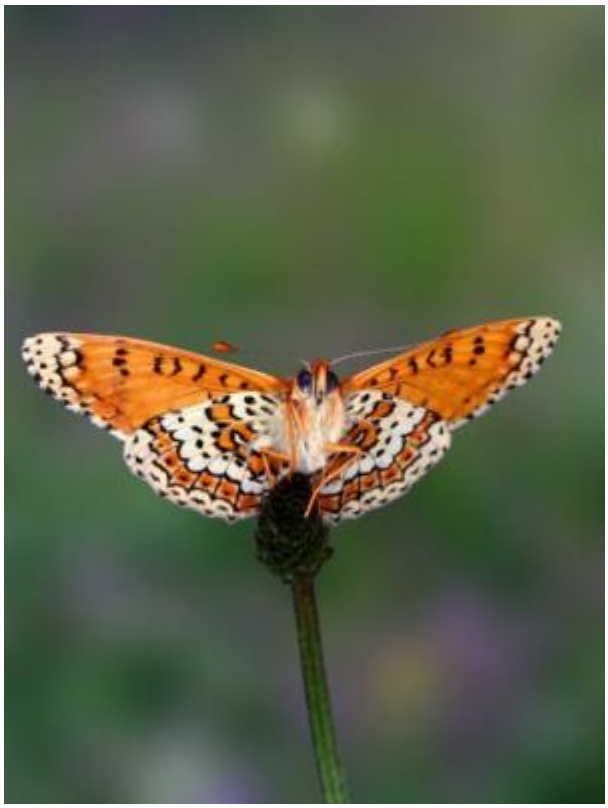
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - San Francisco**.

Journal Reference:

1. George A Lemieux, Jason Liu, Nasima Mayer, Roland J Bainton, Kaveh Ashrafi, Zena Werb. **A whole-organism screen identifies new regulators of fat storage**. *Nature Chemical Biology*, 2011; DOI: 10.1038/nchembio.534

http://www.sciencedaily.com/releases/2011/03/110324104139.htm

Butterflies That Explore and Colonize New Habitats Are Genetically Different from Cautious Cousins



A Glanville fritillary butterfly. Descendants of "exploratory" butterflies that colonized new habitats differ genetically from their more cautious cousins, a research team led by James Marden, a professor of biology at Penn State University has discovered. The research has revealed some of the genetic bases for faster egg maturation, a higher rate of energy metabolism, and superior flight ability -- traits that provide an advantage to butterflies that stray from familiar territory to found new populations in previously unoccupied habitat patches. (Credit: Credit: James Marden, Penn State University.)

ScienceDaily (Mar. 30, 2011) — A team of scientists has discovered that descendants of "exploratory" butterflies that colonized new habitats differ genetically from their more cautious cousins. The team, led by James Marden, a professor of biology at Penn State University, and Christopher Wheat, a post-doctoral scholar working at both Penn State and the University of Helsinki, has revealed some of the genetic bases for faster egg maturation, a higher rate of energy metabolism, and superior flight ability -- traits that provide an advantage to butterflies that stray from familiar territory to found new populations in previously unoccupied habitat patches. The results have potentially broad importance because they show how natural selection may act in species that occupy spatially distinct habitat patches.

This research will be published in the print edition of the journal *Molecular Ecology* in May, and is available in early-online form.

Marden explained that most species are not found everywhere because they tend to require very specific habitats. "Butterflies, like many other species, are specialists. They are picky about where they live. This pickiness gives a species what ecologists call a clumped or patchy distribution," Marden said. "In a patchy environment, individual organisms face a fundamental choice between remaining in their native patch or venturing forth to find a different patch of suitable habitat. Staying put is safer for immediate survival but may expose one's offspring to crowding or parasites, whereas dispersal is dangerous but offers a potentially big payoff if a large, unoccupied patch is located."

Marden and Wheat collaborated with Ilkka Hanski, a professor at the University of Helsinki, to study how a particular species of butterfly successfully establishes new populations. "We wanted to understand better the

genes and physiology involved in determining sedentary, 'stay-at-home' traits versus exploratory, 'venture-forth' traits," Marden said. "Evolutionary biologists are fascinated by cost-benefit questions such as how natural selection produces and maintains both 'stay-at-home' and 'venture-forth' varieties within species."
Marden also explained that the "stay-at-home versus venture-forth" dichotomy is fundamentally important for ecology because habitat changes, disease, and chance events cause local extinction of small populations in individual patches. "Species persistence on a regional scale requires that the rate of establishment of new populations must be at least as high as the rate of local-population extinctions," Marden said. "Dispersal of individual females is what determines the establishment rate, along with the number of patches and distances between them." Much of what is known about the biology of species in patches -- called metapopulations -- comes from Hanski's butterfly research, for which he will be awarded this year's Craaford Prize, generally considered as ecology's version of a Nobel prize.
Together, Marden and Hanski's labs used new gene-sequencing technology to characterize thousands of protein-coding genes in Glanville fritillary butterflies from the Åland Islands of Finland. Then, they measured and compared the variation in gene-expression levels in females from established populations of butterflies -- those originating from old, local populations that had persisted for a minimum of five years -- with new, local populations that had been founded by dispersing butterflies. They found that new-population and old-population butterflies differed most prominently in how they expressed certain genes that control the timing and release of stored proteins for egg production and the maintenance of flight-muscle proteins. They also differed in flight metabolic rate -- a measure of muscle performance and flight ability.
Previous work by members of this team and other collaborators had revealed that an allele -- a variable DNA sequence -- in a gene called phosphoglucose isomerase (Pgi) differed significantly between the old and the new populations. One Pgi allele was associated with two important aspects of metabolism within the butterfly's abdomen and its thorax. First, the new-population, "venture-forth" females were more likely to possess a particular Pgi allele associated with faster egg production. "It's easy to imagine why this kind of ovarian-function trait would provide 'venture-forth' females with an advantage," Marden explained. "Abandoning the secure, known environment can be a perilous endeavor, and life expectancy for such butterflies is probably greatly reduced. Under these conditions, the ability to get a reproductive head start would allow these adventurers to mate earlier, and to fly off to lay their eggs in new habitat patches sooner."
Second, the scientists found that the same Pgi allele predominates in females that are better "sprinters," able to fly better for short distances. Marden explained that for those individuals that fly away to colonize new areas, exceptional muscle function could be a more crucial trait than it would be for "stay-at-home" non-explorers.
In the new study, another gene variant also stood out as an important indicator of butterfly flight ability. New-population females were more often missing a small part of the succinate dehydrogenase gene (Sdhd) and this small deletion was associated with the ability to maintain flight for a greater duration. "The Pgi gene variant seems to be associated with sprinting, and the Sdhd gene variant appears to be associated with endurance," Marden said. "It's easy to see why these traits and their associated genes would be found at higher frequencies in new populations. Better flight ability allows certain butterflies to be able to reach and settle new habitat patches."
Wheat, the paper's lead author, said, "We already knew about Pgi from previous work in other butterflies and what has been done so far in the Glanville fritillary butterfly. Now with Sdhd we have two genes in the same carbohydrate-metabolism pathway containing alleles of major effect for ecologically important traits."
Marden also commented on the differences in gene expression involving protein dynamics. "Butterflies obtain protein only during larval feeding, whereas the adults rely on nectar, from which they obtain only carbohydrate," he said. "The timing and level of expenditure of stored proteins is one way to manipulate life history in a species where no more protein will be available to the adult."
Marden also said that this study system provides a great opportunity to observe evolution in action, in near-real time, and in ways that are coupled tightly with the ecology of the species. "Most evolutionary studies don't have nearly as much ecological detail as this study system, and comparable ecological systems generally don't address the physiology and genetic variants involved," he said. "We've set the stage for a powerful synthesis as this work moves forward."
This research was supported by grants from the National Science Foundation, the Academy of Finland, and the European Research Council.

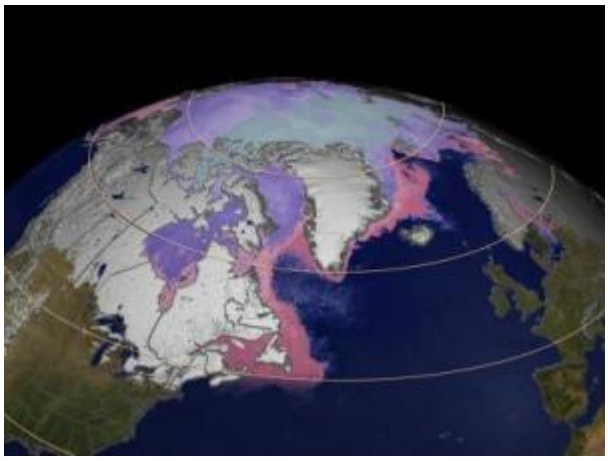
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Penn State**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Christopher W. Wheat, Howard W. Fescemyer, J. Kvist, Eva Tas, J. Cristobal Vera, Mikko J. Frilander, Ilkka Hanski, James H. Marden. **Functional genomics of life history variation in a butterfly metapopulation**. *Molecular Ecology*, 2011; DOI: 10.1111/j.1365-294X.2011.05062.x

http://www.sciencedaily.com/releases/2011/03/110328162026.htm

Warm Water Causes Extra-Cold Winters in Northeastern North America and Northeastern Asia



This image, taken by NASA's Terra satellite in March 2003, shows a much colder North America than Europe??even at equal latitudes. White represents areas with more than 50 percent snow cover. NASA's Aqua satellite also measured water temperatures. Water between 0 and ?15 degrees Celsius is in pink, while water between ?15 and ?28 degrees Celsius is in purple. (Credit: NASA/Goddard Space Flight Center Scientific Visualization Studio; George Riggs (NASA/SSAI).)

ScienceDaily (Mar. 30, 2011) — If you're sitting on a bench in New York City's Central Park in winter, you're probably freezing. After all, the average temperature in January is 32 degrees Fahrenheit. But if you were just across the pond in Porto, Portugal, which shares New York's latitude, you'd be much warmer -- the average temperature is a balmy 48 degrees Fahrenheit.

Throughout northern Europe, average winter temperatures are at least 10 degrees Fahrenheit warmer than similar latitudes on the northeastern coast of the United States and the eastern coast of Canada. The same phenomenon happens over the Pacific, where winters on the northeastern coast of Asia are colder than in the Pacific Northwest.

Researchers at the California Institute of Technology (Caltech) have now found a mechanism that helps explain these chillier winters -- and the culprit is warm water off the eastern coasts of these continents.

"These warm ocean waters off the eastern coast actually make it cold in winter -- it's counterintuitive," says Tapio Schneider, the Frank J. Gilloon Professor of Environmental Science and Engineering.

Schneider and Yohai Kaspi, a postdoctoral fellow at Caltech, describe their work in a paper published in the March 31 issue of the journal *Nature*.

Using computer simulations of the atmosphere, the researchers found that the warm water off an eastern coast will heat the air above it and lead to the formation of atmospheric waves, drawing cold air from the northern polar region. The cold air forms a plume just to the west of the warm water. In the case of the Atlantic Ocean, this means the frigid air ends up right over the northeastern United States and eastern Canada.

For decades, the conventional explanation for the cross-oceanic temperature difference was that the Gulf Stream delivers warm water from the Gulf of Mexico to northern Europe. But in 2002, research showed that ocean currents aren't capable of transporting that much heat, instead contributing only up to 10 percent of the warming.

Kaspi's and Schneider's work reveals a mechanism that helps create a temperature contrast not by warming Europe, but by cooling the eastern United States. Surprisingly, it's the Gulf Stream that causes this cooling.

In the northern hemisphere, the subtropical ocean currents circulate in a clockwise direction, bringing an influx of warm water from low latitudes into the western part of the ocean. These warm waters heat the air above it.

"It's not that the warm Gulf Stream waters substantially heat up Europe," Kaspi says. "But the existence of the Gulf Stream near the U.S. coast is causing the cooling of the northeastern United States."

The researchers' computer model simulates a simplified, ocean-covered Earth with a warm region to mimic the coastal reservoir of warm water in the Gulf Stream. The simulations show that such a warm spot produces so-called Rossby waves.

Generally speaking, Rossby waves are large atmospheric waves -- with wavelengths that stretch for more than 1,000 miles. They form when the path of moving air is deflected due to Earth's rotation, a phenomenon known as the Coriolis effect. In a way similar to how gravity is the force that produces water waves on the surface of a pond, the Coriolis force is responsible for Rossby waves.

In the simulations, the warm water produces stationary Rossby waves, in which the peaks and valleys of the waves don't move, but the waves still transfer energy. In the northern hemisphere, the stationary Rossby waves cause air to circulate in a clockwise direction just to the west of the warm region. To the east of the warm region, the air swirls in the counterclockwise direction. These motions draw in cold air from the north, balancing the heating over the warm ocean waters.

To gain insight into the mechanisms that control the atmospheric dynamics, the researchers speed up Earth's rotation in the simulations. In those cases, the plume of cold air gets bigger -- which is consistent with it being a stationary Rossby-wave plume. Most other atmospheric features would get smaller if the planet were to spin faster.

Although it's long been known that a heat source could produce Rossby waves, which can then form plumes, this is the first time anyone has shown how the mechanism causes cooling that extends west of the heat source. According to the researchers, the cooling effect could account for 30 to 50 percent of the temperature difference across oceans.

This process also explains why the cold region is just as big for both North America and Asia, despite the continents being so different in topography and size. The Rossby-wave induced cooling depends on heating air over warm ocean water. Since the warm currents along western ocean boundaries in both the Pacific and Atlantic are similar, the resulting cold region to their west would be similar as well.

The next step, Schneider says, is to build simulations that more realistically reflect what happens on Earth. Future simulations would incorporate more complex features like continents and cloud feedbacks.

The research described in the *Nature* paper, "Winter cold of eastern continental boundaries induced by warm ocean waters," was funded by the NOAA Climate and Global Change Postdoctoral Fellowship, administrated by the University Corporation for Atmospheric Research; a David and Lucille Packard Fellowship; and the National Science Foundation.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **California Institute of Technology**.

Journal Reference:

1. Yohai Kaspi, Tapio Schneider. **Winter cold of eastern continental boundaries induced by warm ocean waters**. *Nature*, 2011; 471 (7340): 621 DOI: 10.1038/nature09924

http://www.sciencedaily.com/releases/2011/03/110330131306.htm

Gesture-Controlled Microscope Developed by Finnish Researchers

By touching a screen the user can navigate and zoom within a microscope sample in the same way as in a conventional microscope. Using the touch control it is possible to move from the natural size of the sample to a 1000-fold magnification, at which cells and even subcellular details can be seen. (Credit: Photo by Multitouch Ltd.)

ScienceDaily (Mar. 31, 2011) — Researchers at the Institute for Molecular Medicine Finland (FIMM) have in collaboration with the Finnish company Multitouch Ltd created a hand and finger gesture controlled microscope. The method is a combination of two technologies: web-based virtual microscopy and a giant-size multitouch display.

The result is an entirely new way of performing microscopy: by touching a table- or even wall-sized screen the user can navigate and zoom within a microscope sample in the same way as in a conventional microscope. Using the touch control it is possible to move from the natural size of the sample to a 1000-fold magnification, at which cells and even subcellular details can be seen.

"The giant size, minimum 46" screen looks somewhat like an iPad on steroids," says researcher Johan Lundin, one of the creators of the method.

Biological samples are digitized using a microscopy scanner and stored on an image server. Samples displayed on the screen are then continuously read from the server over the internet and the size of a single sample can be up to 200 gigabytes

"The sample viewing experience is like a combination of Google Maps and the user interface from the movie Minority Report," Lundin describes.

The developers think that the method will revolutionize microscopy teaching: a group of students can stand around the display together with the teacher and examine the same sample. The multitouch microscope can recognize the hands of multiple users at the same time.

"The multitouch microscope brings a new dimension into interactive teaching and the learning curve is practically zero as compared to conventional microscopy which can be quite challenging for students," Lundin says.

Web-based virtual microscopy -- the WebMicroscope -- was developed a few years ago by researchers at the universities of Helsinki and Tampere and has been well received among students. The multitouch microscope builds upon this technology and makes it even more useful for teaching.

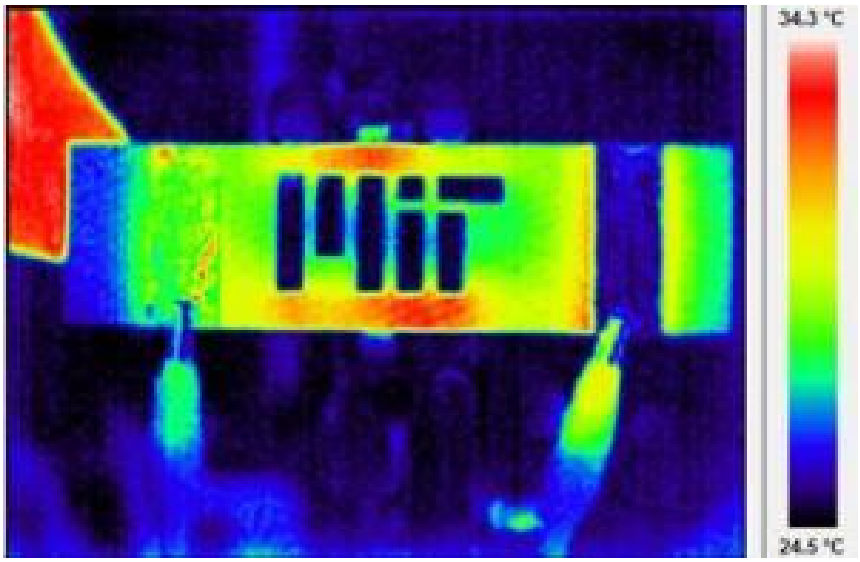
"At scientific meetings this technology is excellent in a situation where a group of users need to simultaneously view a microscopy sample, for example when a consensus needs to be reached concerning a new disease entity or a rare case," Lundin explains.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Helsinki**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110324103145.htm

Seeing Below the Surface: Engineers Devise a New Way to Inspect Advanced Materials Used to Build Airplanes



Infrared themographic image of a nanoengineered composite heated via electrical probes. The scalebar of colors is degrees Celsius. The MIT logo has been machined into the composite, and the hot and cool spots around the logo are caused by the thermal-electrical interactions of the resistive heating and the logo "damage" to the composite. The enhanced thermographic sensing described in the paper works in the same way. (Credit: Roberto Guzmán de Villoria, MIT)

ScienceDaily (Mar. 25, 2011) — In recent years, many airplane manufacturers have started building their planes from advanced composite materials, which consist of high-strength fibers, such as carbon or glass, embedded in a plastic or metal matrix. Such materials are stronger and more lightweight than aluminum, but they are also more difficult to inspect for damage, because their surfaces usually don't reveal underlying problems.

"With aluminum, if you hit it, there's a dent there. With a composite, oftentimes if you hit it, there's no surface damage, even though there may be internal damage," says Brian L. Wardle, associate professor of aeronautics and astronautics.

Wardle and his colleagues have devised a new way to detect that internal damage, using a simple handheld device and heat-sensitive camera. Their approach also requires engineering the composite materials to include carbon nanotubes, which generate the heat necessary for the test.

Their approach, described in the March 22 online edition of the journal *Nanotechnology*, could allow airlines to inspect their planes much more quickly, Wardle says. This project is part of a multiyear, aerospace-industry-funded effort to improve the mechanical properties of existing advanced aerospace-grade composites. The U.S. Air Force and Navy are also interested in the technology, and Wardle is working with them to develop it for use in their aircraft and vessels.

Uncovering damage

Advanced composite materials are commonly found not only in aircraft, but also cars, bridges and wind-turbine blades, Wardle says.

One method that inspectors now use to reveal damage in advanced composite materials is infrared thermography, which detects infrared radiation emitted when the surface is heated. In an advanced composite material, any cracks or delamination (separation of the layers that form the composite material) will redirect the flow of heat. That abnormal flow pattern can be seen with a heat-sensitive (thermographic) camera.

This is effective but cumbersome because it requires large heaters to be placed next to the surface, Wardle says. With his new approach, carbon nanotubes are incorporated into the composite material. When a small

electric current is applied to the surface, the nanotubes heat up, which eliminates the need for any external heat source. The inspector can see the damage with a thermographic camera or goggles.
"It's a very clever way to utilize the properties of carbon nanotubes to deliver that thermal energy, from the inside out," says Douglas Adams, associate professor of mechanical engineering at Purdue University. Adams, who was not involved in the research, notes that two fundamental challenges remain: developing a practical way to manufacture large quantities of the new material, and ensuring that the addition of nanotubes does not detract from the material's primary function of withstanding heavy loads.
The new carbon nanotube hybrid materials that Wardle is developing have so far shown better mechanical properties, such as strength and toughness, than existing advanced composites.

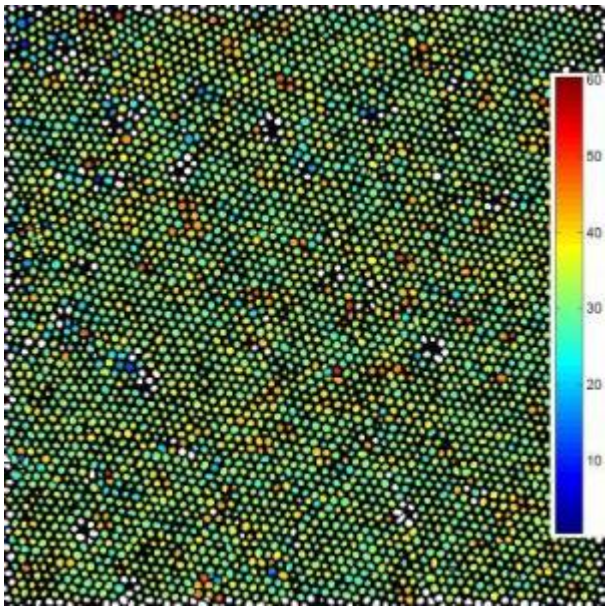
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by Anne Trafton, MIT News Office.

Journal Reference:

1. Roberto Guzmán de Villoria, Namiko Yamamoto, Antonio Miravete, Brian L Wardle. **Multi-physics damage sensing in nano-engineered structural composites**. *Nanotechnology*, 2011; 22 (18): 185502 DOI: 10.1088/0957-4484/22/18/185502

http://www.sciencedaily.com/releases/2011/03/110325111850.htm

'Spincasting' Holds Promise for Creation of Nanoparticle Thin Films



This is an orientation map of a spin-cast array of FePt nanoparticles. Most nanoparticles are enclosed by a hexagon of six neighboring nanoparticles. Each nanoparticle was color coded according to the angle (in degrees) of the hexagon's orientation. Nanoparticles colored white were identified as defects, because they had four, five, seven or eight "nearest neighbors" -- rather than six. (Credit: Dr. Joe Tracy, North Carolina State University)

ScienceDaily (Mar. 31, 2011) — Researchers from North Carolina State University have investigated the viability of a technique called "spincasting" for creating thin films of nanoparticles on an underlying substrate -- an important step in the creation of materials with a variety of uses, from optics to electronics.

Spincasting, which utilizes centrifugal force to distribute a liquid onto a solid substrate, already has a variety of uses. For example, it is used in the electronics industry to deposit organic thin films on silicon wafers to create transistors.

For this study, the researchers first dispersed magnetic nanoparticles coated with ligands into a solution. The ligands, small organic molecules that bond directly to metals, facilitate the even distribution of the nanoparticles in the solution -- and, later, on the substrate itself.

A drop of the solution was then placed on a silicon chip that had been coated with a layer of silicon nitride. The chip was then rotated at high speed, which spread the nanoparticle solution over the surface of the chip. As the solution dried, a thin layer of nanoparticles was left on the surface of the substrate.

Using this technique, the researchers were able to create an ordered layer of nanoparticles on the substrate, over an area covering a few square microns. "The results are promising, and this approach definitely merits further investigation," says Dr. Joe Tracy, an assistant professor of materials science and engineering at NC State and co-author of a paper describing the study.

Tracy explains that one benefit of spincasting is that it is a relatively quick way to deposit a layer of nanoparticles. "It also has commercial potential as a cost-effective way of creating nanoparticle thin films," Tracy says.

However, the approach still faces several hurdles. Tracy notes that modifications to the technique are needed, so that it can be used to coat a larger surface area with nanoparticles. Additional research is also needed to learn how, or whether, the technique can be modified to achieve a more even distribution of nanoparticles over that surface area.

Analysis of the nanoparticle films created using spincasting led to another development as well. The researchers adapted analytical tools to evaluate transmission electron microscopy images of the films they created. One benefit of using these graphical tools is their ability to identify and highlight defects in the

crystalline structure of the layer. "These methods for image analysis allow us to gain a detailed understanding of how the nanoparticle size and shape distributions affect packing into monolayers," Tracy says.

The paper, "Formation and Grain Analysis of Spin Cast Magnetic Nanoparticle Monolayers," was published online March 24 by the journal *Langmuir*. The paper was co-authored by Tracy; NC State Ph.D. student Aaron Johnston-Peck; and former NC State post-doctoral research associate Dr. Junwei Wang. The research was funded by the National Science Foundation, the U.S. Department of Education, and Protochips, Inc.

NC State's Department of Materials Science and Engineering is part of the university's College of Engineering.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **North Carolina State University**.

Journal Reference:

1. Aaron C. Johnston-Peck, Junwei Wang, Joseph B. Tracy. **Formation and Grain Analysis of Spin-Cast Magnetic Nanoparticle Monolayers**. *Langmuir*, 2011; 110324110441093 DOI: 10.1021/la200005q

http://www.sciencedaily.com/releases/2011/03/110330094020.htm

Test After Eye Surgery: New Halometer Tests Alterations in Night Vision

An user trying the software Halo v1.0. (Credit: Image courtesy of University of Granada)

ScienceDaily (Mar. 31, 2011) — Researchers from the Department of Optics of the University of Granada, belonging to the Laboratorio de Ciencias de la Visión y Aplicaciones, have developed a programme for testing alterations in night vision, and the tool required to implement it, which has been named "halometer." This instrument consists on a software named Software Halo v1.0, and a computer where the mouse is used as a response button, and a chin cup with a forehead holder to fix the observer's position.

This software was developed by a group coordinated by Rosario González Anera, receiving technical support of the Granadian company Seven Solutions and of an ophthalmological clinic set in Madrid and named Novovision. The research group was integrated by researchers José Juan Castro, Carolina Ortiz and Aixa Alarcón, and receives funding from the regional government of Economy, Innovation and Science of the Junta de Andalucía.

Low-Light Conditions

Before the test, researchers fix the observer's position with a chin cup and a forehead holder at an adequate distance from the monitor where the test will be displayed. The test is performed under low-light conditions (in a dark room) and, before the test, patients are given some minutes to adapt to darkness.

This test involves showing a bright light stimulus to the subject against a dark background and, progressively showing different peripheral light stimuli -with lower brightness around the central, at random, in different positions and at different distances. The subjects' task is to press the button of a mouse every time they detect a peripheral stimulus. Once the test ends, the software makes an estimation of a parameter named "Visual Disturbance Index" that, together with the results graphic, determines the type and intensity of visual disturbance.

This index scores from 0 to 1, so the higher the index, the stronger is the influence of the halo or any other visual disturbance perceived by the observer. Therefore, the higher the index, the lower is the subject's ability to detect the peripheral stimuli displayed around the main stimulus that causes such disturbances.

One of the advantages of the halometer developed at the University of Granada is that it allows to configure such test parameters as:

- Special parameters: the radius of the central stimulus and the peripheral stimuli can be modified. Furthermore, the number of semi-major axes where the peripheral stimuli will be displayed can be fixed, as well as the maximum radius -maximum distance between these stimuli-, and the number of stimuli per semi-major axe.
- Temporary Parameters: the software allows to set some exposure time for adaptation to darkness and to the brightness of the central stimulus. Furthermore, others parameters as the exposure time to the stimulus and the time elapsed between a stimulus and the next one can also be set.
- The software also allows to set the color and brightness of central and peripheral stimuli, and the weight and number of times each peripheral stimulus is shown.

This test has been tried with different groups consisting of patients shortly after cataract operations or refractory eye surgery, with normal observers and patients with different eye pathologies as AMD (Age-related Macular Degeneration) and unilateral keratitis. The results obtained showed that, in the case of patients with keratitis, the visual disturbance index for the healthy eye was found to be lower than that for the unhealthy eye, and even lower under binocular vision conditions. However, visual disturbance indexes proved to be higher in the case of patients operated on cataracts, showing a higher influence of halos and, therefore, lower detection capacity. Patients operated with LASIK refractory eye surgery also presented high vision disturbance indexes in comparison to normal observers.
The results obtained with this halometer and the new software have been presented in different national and internacional conferences as the IX Reunión Nacional de Óptica, Galice and the Wavefront Confress 2009. furthermore, a research article has been published in the international journal *Applied Optics* describing the results obtained with patients operated with refractory eye surgery. It has also been recently admitted for publication in the scientific journal *Journal of Biomedical Optics*, where the results obtained with patients with different eye pathologies are described.
Software Halo v1.0 was initially presented as freeware available on LabVisGra's website at http://www.ugr.es/local/labvisgr and at the University of Granada's institutional repository. It was also recently released by the Free-Software Bureau of the University of Granada so, it has become a scientific freeware application.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Granada**.

http://www.sciencedaily.com/releases/2011/03/110324104904.htm

New Wind Tunnel Will Evaluate Wind Effects and Thermal Situations to Improve Urban Climate

Working on the wind tunnel operated by Empa and the ETH. (Credit: Image courtesy of Swiss Federal Laboratories for Materials Science and Technology (EMPA))

ScienceDaily (Mar. 31, 2011) — A typical city: row upon row of houses built almost on top of each other, with asphalted roads between them and with very few green areas to be found. Urban areas built on this pattern warm up more strongly than their rural surroundings, creating islands of warmth. The waste heat emitted by vehicles and machinery (such as air conditioning equipment) causes yet more heating, and even during the night the city hardly cools down to any noticeable extent.

Megacities such as Mexico City and urban conurbations such as Athens are more and more frequently covered by a visible dome of pollution because the air cannot properly circulate. This kind of this urban climate can damage the health of the city's inhabitants because the concentration of trapped pollutants may reach dangerous levels.

Built-up areas in cities do not automatically lead to still air conditions. An example of this is Chicago, which is nicknamed "the Windy City" because, being located on the shores of Lake Michigan, it is cooled even during the hottest summers by a pleasant breeze. This only happened, however, when the streets were laid out in a grid pattern as the city was rebuilt after the great fire of 1871, allowing the onshore breeze from the lake to blow freely through the street "canyons" between skyscrapers.

Using models to check architectural measures

The new wind tunnel, which Empa, together with the ETH Zürich, has had constructed is 26 m long and about 4 m high. In it, scientists will be able to test simulations of ideas for improving the "airing" of cities, on a scale ranging from 1 to 50 to 1 to 300. A ventilator with a diameter of 1.8 m powered by a 110kW electric motor will blast air at up to 90 kilometers per hour through the tunnel. The aim of the researchers is not to generate the highest possible wind velocities (such as would be necessary to test building façades). Rather, they plan to investigate how air masses circulate around buildings, what velocities winds can reach, when does turbulence occur and what effects does all this have in terms of energy, comfort and health. They would also like to know such things as whether houses can be cooled by the wind alone in summer (free of charge!), where draughts and windy conditions might cause problems -- for example in street cafes -- and whether pollutants can be transported away from cities by natural means.

Laser technology makes wind speeds visible and measurable

In contrast to computer simulations, in which results are obtained purely by calculation and suffer corresponding levels of uncertainty, the wind tunnel allows scientists to make accurate physical measurements. This enables them to verify simulations and then fine tune them, an important factor for researchers.

The Empa system boasts another advantage over its "contemporaries" -- its sophisticated measuring instrumentation, which includes two high-speed cameras and a special high-performance laser. Whereas in other wind tunnels air mass movements must be inferred from a set of single measurements made at specific individual locations, "… we can make the air currents visible almost in real time, even with all their fluctuations and turbulence," says Victor Dorer, the Empa scientist responsible for the wind tunnel. In order to make the airflow "visible" to the two high-speed cameras, tiny particles are injected into it. A sophisticated dosing system ensures that these particles are evenly distributed in the current and they are then lit up by a special laser which produces a sheet of light. Pictures taken at millisecond intervals make the movements of the particles visible.
The data is then analyzed on the computer. Processing and evaluating the thousand images which are taken every second requires a great deal of computing power. The result looks like a film and enables the user to visualize the air currents. The way the air flow develops, including both large turbulence zones and small eddies, can be seen on the computer screen and velocities are indicated by various colours.
The results are very useful, for example, to architects, urban climate planners, air hygienists, building engineers, and the developers and users of air current calculation programs or software for analyzing the energy usage of buildings. They can also be used to evaluate the effects which wind turbines have on each other.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Swiss Federal Laboratories for Materials Science and Technology (EMPA)**.

http://www.sciencedaily.com/releases/2011/03/110323103926.htm

Economic Importance of Bats in the 'Billions a Year' Range

Little brown bats with white nose syndrome. (Credit: Al Hicks, USGS)

ScienceDaily (Mar. 31, 2011) — Bats in North America are under a two-pronged attack but they are not the only victim -- so is the U.S. economy. Gary McCracken, head of the Department of Ecology and Evolutionary Biology at the University of Tennessee, Knoxville, analyzed the economic impact of the loss of bats in North America in agriculture and found it to be in the $3.7 to $53 billion a year range.

McCracken's findings are published in the April edition of *Science*. McCracken conducted his study with Justin Boyles of the University of Pretoria in South Africa, Paul Cryan of the U.S. Geological Survey and Thomas Kunz of Boston University.

Since 2006, more than a million bats have died due to a fungal disease called White-Nose Syndrome (WNS). At the same time, several migratory tree-dwelling species are being killed in unprecedented numbers by wind turbines. This hurts the economy because bats' diet of pest insects reduces the damage the insects cause to crops and decreases the need for pesticides.

In fact, the researchers estimate the value of bats to the agricultural industry is roughly $22.9 billion a year, with the extremes ranging as low as $3.7 and $53 billion a year.

"These estimates include the reduced costs of pesticide applications that are not needed to suppress the insects consumed by bats. However, they do not include the downstream impacts of pesticides on humans, domestic and wild animals and our environment," said McCracken. "Without bats, crop yields are affected. Pesticide applications go up. Even if our estimates were quartered, they clearly show how bats have enormous potential to influence the economics of agriculture and forestry."

According to the researchers, a single colony of 150 big brown bats in Indiana eat nearly 1.3 million insects a year -- insects that could potentially be damaging to crops.

WNS infects the skin of bats while they hibernate. Some species such as the little brown bat are likely to go extinct in parts of North America. The disease has quickly spread from Canada to Tennessee, Missouri and Oklahoma and actions to slow or stop it have proven unsuccessful.

It is unknown how many bats have died due to wind turbines, but the scientists estimate by 2020, wind turbines will have killed 33,000 to 111,000 annually in the Mid-Atlantic Highlands alone. Why migratory tree-dwelling species are drawn to the turbines remains a mystery.

Due to the economic and ecological importance, the researchers urge policy-makers to avoid a wait-and-see approach to the issue of widespread declines of bat populations.
"Not acting is not an option because the life histories of these flying, nocturnal mammals -- characterized by long generation times and low reproductive rates -- mean that population recovery is unlikely for decades or even centuries, if at all," said McCracken.
According to McCracken, solutions will only be fueled in the next few years by increased awareness of the benefits of insectivorous bats among the public, policymakers and scientists.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Tennessee at Knoxville**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. J. G. Boyles, P. M. Cryan, G. F. McCracken, T. H. Kunz. **Economic Importance of Bats in Agriculture**. *Science*, 2011; 332 (6025): 41 DOI: 10.1126/science.1201366

http://www.sciencedaily.com/releases/2011/03/110331142212.htm

Cat Allergy Vaccine Safe and Effective, Study Suggests

Mark Larché, professor in the Department of Medicine in the Michael G. DeGroote School of Medicine and Canada Research Chair in Allergy & Immune Tolerance. (Credit: Image courtesy of McMaster University)

ScienceDaily (Mar. 31, 2011) — Good-bye itching, watering eyes and sneezing. McMaster University researchers have developed a vaccine which successfully treats people with an allergy to cats.

Traditionally, frequent allergy shots have been considered the most effective way to bring relief -- other than getting rid of the family pet -- for the eight to 10% of the population allergic to cats.

Both options -- one difficult and costly, the other troubling -- may now be tossed aside thanks to the work of immunologist Mark Larché, professor in the Department of Medicine in the Michael G. DeGroote School of Medicine and Canada Research Chair in Allergy & Immune Tolerance.

Building on research he's conducted for the past 10 years in Canada and Britain, Larché and his research team have developed a vaccine which is effective and safe with almost no side effects. The research is published in a recent (January 2011) issue of the *Journal of Allergy & Clinical Immunology*.

The researchers took one protein (molecule) that cats secrete on their fur which causes the majority of allergic problems. Using blood samples from 100 patient volunteers allergic to cats, they deconstructed the molecule and identified short regions within the protein which activate T-cells (helper cells that fight infection) in the immune system.

Using the amino acid code for the whole protein, researchers made synthetic versions of these regions. For the cat allergy vaccine, they found seven peptides (strings of amino acids). "And those synthetic peptides are what we mix together to make the vaccine," said Larché. "We picked the peptides that would work in as much of the population as possible."

Known as "peptide immunotherapy," a low dose of the vaccine is given into the skin. Initially, four to eight doses a year may be required, but the side effects of the traditional allergy shots do not arise, Larché said. The optimal dose will be determined in phase three clinical trials which are getting underway with a much larger group of cat allergy sufferers.

The development of a vaccine to treat people allergic to cats is the first in a line of vaccines developed with Adiga Life Sciences, a company established at McMaster in 2008. It is a joint venture between McMaster University and Circassia Ltd., a UK-based biotech company.

Adiga and McMaster are now collaborating on research into the use of peptide immunotherapy for house dust mite, ragweed, grass, birch tree and moulds.

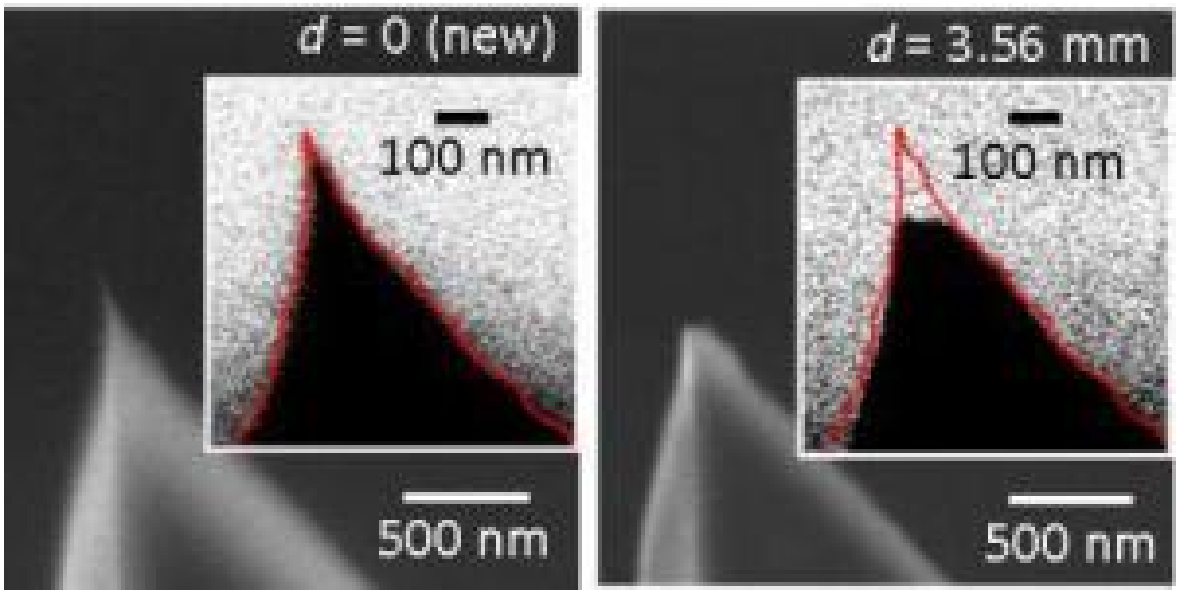
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **McMaster University**. The original article was written by Suzanne Morrison.

Journal Reference:

1. M. Larché, H. Lee, J. Kleine-Tebbe, R.P. Hafner, P. Laidler, D. Healey, C. Buhot, A. Verhoef, B. Maillère, A.B. Kay. **Development and Preliminary Clinical Evaluation of a Peptide Immunotherapy Vaccine for Cat Allergy**. *Journal of Allergy and Clinical Immunology*, 2011; 127 (2): AB219 DOI: 10.1016/j.jaci.2010.12.870

http://www.sciencedaily.com/releases/2011/03/110331163534.htm

Getting the Point: Real-Time Monitoring of Atomic-Microscope Probes Adjusts for Wear



As an atomic force microscope's tip degrades, the change in tip size and shape affects its resonant frequency and that can be used to accurately measure, in real time, the change in the tip's shape, thereby resulting in more accurate measurements and images at nanometer size scales. (Credit: Killgore, NIST)

ScienceDaily (Mar. 31, 2011) — Scientists at the National Institute of Standards and Technology (NIST) have developed a way to measure the wear and degradation of the microscopic probes used to study nanoscale structures in situ and as it's happening. Their technique can both dramatically speed up and improve the accuracy of the most precise and delicate nanoscale measurements done with atomic force microscopy (AFM).

If you're trying to measure the contours of a surface with a ruler that's crumbling away as you work, then you at least need to know how fast and to what extent it is being worn away during the measurement.
This has been the challenge for researchers and manufacturers trying to create images of the surfaces of nanomaterials and nanostructures. Taking a photo is impossible at such small scales, so researchers use atomic force microscopes. Think of a device like a phonograph needle being used, on a nanoscale, to measure the peaks and valleys as it's dragged back and forth across a surface. These devices are used extensively in nanoscale imaging to measure the contours of nanostructures, but the AFM tips are so small that they tend to wear down as they traverse the surface being measured.

Today, most researchers stop the measurement to "take a picture" of the tip with an electron microscope, a time-consuming method prone to inaccuracies.
NIST materials engineer Jason Killgore has developed a method for measuring in real time the extent to which AFM tips wear down. Killgore measures the resonant frequency of the AFM sensor tip, a natural vibration rate like that of a tuning fork, while the instrument is in use. Because changes to the size and shape of the tip affect its resonant frequency, he is able to measure the size of the AFM's tip as it works -- in increments of a tenth of a nanometer, essentially atomic scale resolution. The technique, called contact resonance force microscopy, is described in a paper recently published in the journal *Small.*

The potential impact of this development is considerable. Thousands of AFMs are in use at universities, manufacturing plants and research and development facilities around the world. Improving their ability to measure and image nanosized devices will improve the quality and effectiveness of those devices. Another benefit is that developing new measurement tips -- and studying the properties of new materials used in those tips -- will be much easier and faster, given the immediate feedback about wear rates.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal Reference:

1. Jason P. Killgore, Roy H. Geiss, Donna C. Hurley. **Continuous Measurement of Atomic Force Microscope Tip Wear by Contact Resonance Force Microscopy**. *Small*, 2011; DOI: 10.1002/smll.201002116

http://www.sciencedaily.com/releases/2011/03/110331151357.htm

One-Two Punch to Fight Explosives Terrorism

SRM 2906 includes four ampoules of each of the three explosives and a blank along with a dropper bottle for each. NIST researchers formulated the concentrations of these solutions to be near but above the detection limit of commercial swipe-type detectors, which are commonly based on ion mobility spectrometry. (Credit: NIST)

ScienceDaily (Mar. 31, 2011) — Trace-explosives detectors (TEDs) are an increasingly common sight at airports and on loading docks, and emergency response personnel carry them to evaluate suspicious packages. A new test material developed by the National Institute of Standards and Technology (NIST) in cooperation with ASTM International enables users of these products to evaluate their performance and reliability.

The new testing material, NIST Standard Reference Material (SRM) 2906, Trace Explosives Calibration Solutions, was designed to meet the specifications of ASTM E 2520-07, Standard Practice for Verifying Minimum Acceptable Performance of Trace Explosive Detectors. ASTM is one of the leading industrial organizations for the development of voluntary consensus standards.

The NIST reference material contains calibration solutions of three high explosives: RDX (an ingredient in Composition C-4), PETN, and TNT. Under the test protocol, users sequentially apply a single drop of explosive solution and a solvent blank to swipes, the solvents are allowed to evaporate, and the instrument is tested. A simple 'yes-no' alarm checklist is used to determine TED performance.

SRM 2906 includes four ampoules of each of the three explosives and a blank along with a dropper bottle for each. NIST researchers formulated the concentrations of these solutions to be near, but above, the detection limit of commercial swipe-type detectors, which are commonly based on ion mobility spectrometry. When tested with the solutions, properly functioning TEDs should provide an alarm response.

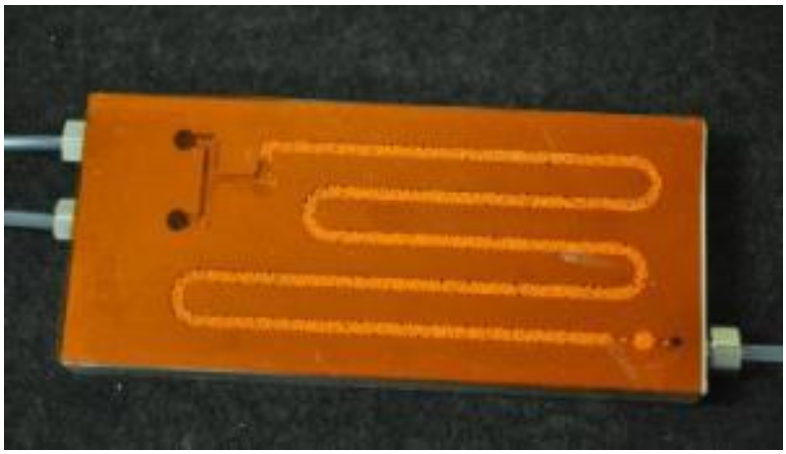
This SRM fully satisfies the need for independent test materials with low uncertainties in concentrations necessary for reliable TED evaluation. Equipment vendors may use the SRM to improve and optimize their

designs and demonstrate to their customers how well their machines function. Buyers may use the SRM to make sound procurement decisions. The combination of a validated standard practice and SRM will provide TED users with a reliable means of verifying initial and continuing field performance of their equipment, contributing to the fight against explosives terrorism.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

http://www.sciencedaily.com/releases/2011/03/110331151355.htm

Microreactors: Small Scale Chemistry Could Lead to Big Improvements for Biodegradable Polymers



Typical NIST microreactor plate for studying enzyme catalyzed polymerization. The aluminum plate, topped with a transparent film, is approximately 40 millimeters by 90 mm. The channel, filled with plastic beads carrying the enzyme catalyst, is 2 mm wide and 1 deep. (Credit: Kundu, NIST)

ScienceDaily (Mar. 31, 2011) — Using a small block of aluminum with a tiny groove carved in it, a team of researchers from the National Institute of Standards and Technology (NIST) and the Polytechnic Institute of New York University is developing an improved "green chemistry" method for making biodegradable polymers. Their recently published work is a prime example of the value of microfluidics, a technology more commonly associated with inkjet printers and medical diagnostics, to process modeling and development for industrial chemistry.

"We basically developed a microreactor that lets us monitor continuous polymerization using enzymes," explains NIST materials scientist Kathryn Beers. "These enzymes are an alternate green technology for making these types of polymers -- we looked at a polyester -- but the processes aren't really industrially competitive yet," she says. Data from the microreactor, a sort of zig-zag channel about a millimeter deep crammed with hundreds of tiny beads, shows how the process could be made much more efficient. The team believes it to be the first example of the observation of polymerization with a solid-supported enzyme in a microreactor.

The group studied the synthesis of PCL,* a biodegradable polyester used in applications ranging from medical devices to disposable tableware. PCL, Beers explains, most commonly is synthesized using an organic tin-based catalyst to stitch the base chemical rings together into the long polymer chains. The catalyst is highly toxic, however, and has to be disposed of.

Modern biochemistry has found a more environmentally friendly substitute in an enzyme produced by the yeast strain Candida antartica, Beers says, but standard batch processes -- in which the raw material is dumped into a vat, along with tiny beads that carry the enzyme, and stirred -- is too inefficient to be commercially competitive. It also has problems with enzyme residue contaminating and degrading the product.

By contrast, Beers explains, the microreactor is a continuous flow process. The feedstock chemical flows through the narrow channel, around the enzyme-coated beads, and, polymerized, out the other end. The arrangement allows precise control of temperature and reaction time, so that detailed data on the chemical kinetics of the process can be recorded to develop an accurate model to scale the process.

"The small-scale flow reactor allows us to monitor polymerization and look at the performance recyclability and recovery of these enzymes," Beers says. "With this process engineering approach, we've shown that continuous flow really benefits these reactors. Not only does it dramatically accelerate the rate of reaction, but it improves your ability to recover the enzyme and reduce contamination of the product." A forthcoming follow-up paper, she says, will present a full kinetic model of the reaction that could serve as the basis for designing an industrial scale process.

While this study focused on a specific type of enzyme-assisted polymer reactions, the authors observe, "it is evident that similar microreactor-based platforms can readily be extended to other systems; for example, high-throughput screening of new enzymes and to processes where continuous flow mode is preferred."
* Polycaprolactone

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal Reference:

1. Santanu Kundu, Atul S. Bhangale, William E. Wallace, Kathleen M. Flynn, Charles M. Guttman, Richard A. Gross, Kathryn L. Beers. **Continuous Flow Enzyme-Catalyzed Polymerization in a Microreactor**. *Journal of the American Chemical Society*, 2011; : 110325123921095 DOI: 10.1021/ja111346c

http://www.sciencedaily.com/releases/2011/03/110331151353.htm

A Measurement First: 'Noise Thermometry' System Measures Boltzmann Constant

NIST physicist Samuel Benz holds the two components that are compared in the first electronic measurement of the Boltzmann constant. The ac reference signal generated by the superconducting chip (left) is compared to the "Johnson noise" of a resistor inside the glass container (right). In the experiment, the water in the container is held at its triple point temperature near 0° C or 32° F. (Credit: Burrus/NIST)

ScienceDaily (Mar. 31, 2011) — Researchers at the National Institute of Standards and Technology (NIST) have for the first time used an apparatus that relies on the "noise" of jiggling electrons to make highly accurate measurements of the Boltzmann constant, an important value for many scientific calculations. The technique is simpler and more compact than other methods for measuring the constant and could advance international efforts to revamp the world's scientific measurement system.

The Boltzmann constant* relates energy to temperature for individual particles such as atoms. The accepted value of this constant is based mainly on a 1988 NIST measurement performed using acoustic gas thermometry, with a relative standard uncertainty of less than 2 parts per million (ppm). The technique is highly accurate but the experiment is complex and difficult to perform. To assure that the Boltzmann constant can be determined accurately around the world, scientists have been trying to develop different methods that can reproduce this value with comparable uncertainty.

The latest NIST experiment used an electronic technique called Johnson noise thermometry (JNT) to measure the Boltzmann constant with an uncertainty of 12 ppm. The results are consistent with the currently recommended value for this constant. NIST researchers aim to make additional JNT measurements with improved uncertainties of 5 ppm or less, a level of precision that would help update crucial underpinnings of science, including the definition of the Kelvin, the international unit of temperature.

The international metrology community is expected to soon fix the value of the Boltzmann constant, which would then redefine the Kelvin as part of a larger effort to link all units to fundamental constants. This

approach would be the most stable and universal way to define measurement units, in contrast to traditional measurement unit standards based on physical objects or substances. The Kelvin is now defined in terms of the triple-point temperature of water (273.16 K, or about 0 degrees C and 32 degrees F), or the temperature and pressure at which water's solid, liquid and vapor forms coexist in balance. This value may vary slightly depending on chemical impurities.

The NIST JNT system measures very small electrical noise in resistors, a common electronic component, when they are cooled to the water triple point temperature. This "Johnson noise" is created by the random motion of electrons, and the signals they generate are directly proportional to temperature. The electronic devices measuring the noise power are calibrated with electrical signals synthesized by a superconducting voltage source based on fundamental principles of quantum mechanics. This unique feature enables the JNT system to match electrical power and thermal-noise power at the triple point of water, and assures that copies of the system will produce identical results. NIST researchers recently improved the apparatus to reduce the statistical uncertainty, systematic errors and electromagnetic interference. Additional improvements in the electronics are expected to further reduce measurement uncertainties.

The new measurements were made in collaboration with guest researchers from the Politecnico di Torino, Italy; the National Institute of Metrology, China; the University of Twente, The Netherlands; the National Metrology Institute of Japan, Tsukuba, Japan; and the Measurement Standards Laboratory, New Zealand.

* The currently accepted value of the Boltzmann Constant is 1.380 6504 x 10-23 joules/kelvin.

Story Source:

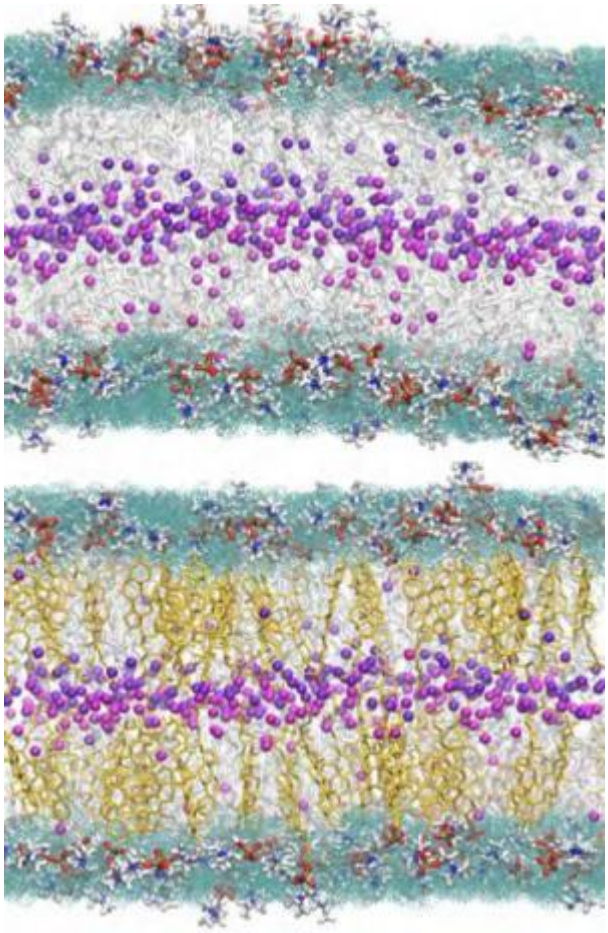
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal Reference:

1. Samuel P Benz, Alessio Pollarolo, Jifeng Qu, Horst Rogalla, Chiharu Urano, Weston L Tew, Paul D Dresselhaus, D Rod White. **An electronic measurement of the Boltzmann constant**. *Metrologia*, 2011; 48 (3): 142 DOI: 10.1088/0026-1394/48/3/008

http://www.sciencedaily.com/releases/2011/03/110331151351.htm

Closer Look at Cell Membrane Shows Cholesterol 'Keeping Order'



The purple "tails" of the lipid molecules that form the cell membrane are far less orderly in the absence of cholesterol (top image) than when cholesterol is present (bottom), a finding made possible by magnifying the membrane with neutron diffraction. (Credit: NIST)

ScienceDaily (Mar. 31, 2011) — Cell membranes form the "skin" of most every cell in your body, but the ability to view them up close and in motion cannot be rendered by many experimental techniques. A team of scientists working at the National Institute of Standards and Technology (NIST) and University of California, Irvine, recently developed a way to magnify them dramatically. Their work has helped illuminate the important role of cholesterol within this boundary between the cell and the outside world.

The multi-institutional team used tools at the NIST Center for Neutron Research (NCNR) to examine the membrane at more than 1,000 times the resolution offered by an optical microscope -- the equivalent of magnifying the point of a needle to the size of a large building. This enabled an unprecedented look at the membrane, which -- because it controls access to our cells -- is a major target for many drugs.

"Drugs that affect pain sensation, heart rhythm, mood, appetite and memory all target proteins lodged in the cell membrane that function like little gates," says Ella Mihailescu of the Institute for Bioscience and Biotechnology Research, a joint institute of NIST and the University of Maryland. "Because membranes and their proteins are important to medicine, we would like a better picture of how the membrane functions -- and not just a better snapshot. We want to see it move, as it does constantly in real life."

Optical microscopes offer limited resolution, while the more powerful electron microscopes require freezing samples before they can be magnified. But by using neutron diffraction, which does not require frozen subjects, the team not only observed the membrane more closely and in motion, but they also gained insight into the long-known phenomenon of the membrane growing thicker and stiffer in the presence of cholesterol.

These lipid chains form a two-layer skin with the "heads" of the lipids facing outward toward the cell's exterior and interior and the "tails" intermingling on the inside of the cellular membrane. Cholesterol is known to be important for managing disorder in membranes. The team saw for the first time that when cholesterol is present, these tails line up in a tight formation, looking like a narrow stripe from which the lipid chains stretch outward -- and producing the order that had been previously anticipated, but never shown directly. But without cholesterol, the tails go a bit wild, flapping around energetically and in some cases even pushing up toward their chains' heads.
Mihailescu says the findings hint that cholesterol may have profound consequences for the membrane's gatekeeper proteins, which are very sensitive to their environment. "The membrane and its proteins interact constantly, so we're curious to learn more," she says. "With this unique magnification technique, we can explore the cell membrane more effectively than ever possible, and we are now establishing a research program with the University of Maryland to do so in greater detail."

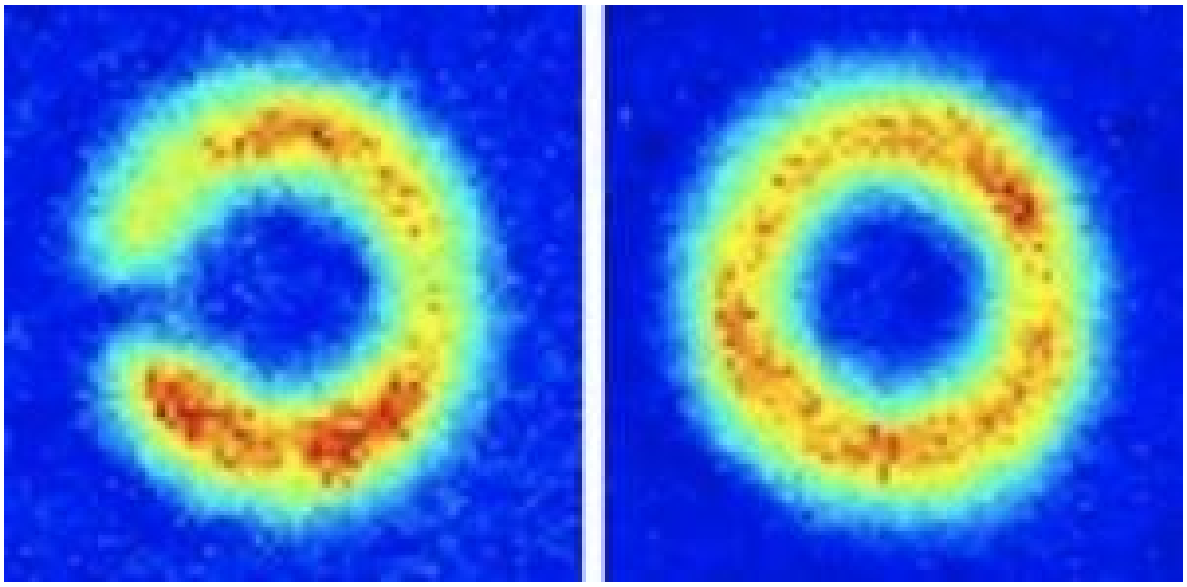
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal Reference:

1. Mihaela Mihailescu, Rishi G. Vaswani, Eduardo Jardón-Valadez, Francisco Castro-Román, J. Alfredo Freites, David L. Worcester, A. Richard Chamberlin, Douglas J. Tobias, Stephen H. White. **Acyl-Chain Methyl Distributions of Liquid-Ordered and -Disordered Membranes**. *Biophysical Journal*, 2011; 100 (6): 1455 DOI: 10.1016/j.bpj.2011.01.035

http://www.sciencedaily.com/releases/2011/03/110331151349.htm

First Non-Trivial Atom Circuit: Progress Toward an Atom SQUID



Atom circuit: False color images of an "atom circuit" made of an ultracold sodium gas. Red denotes a greater density of atoms and traces the path of circulating atoms around the ring. A laser-based barrier can stop the flow of atoms around the circuit (left); without the barrier the atoms circulate around the ring (right). (Credit: JQI/NIST)

ScienceDaily (Mar. 31, 2011) — Researchers from the National Institute of Standards and Technology (NIST) and the University of Maryland (UM) have created the first nontrivial "atom circuit," a donut-shaped loop of ultracold gas atoms circulating in a current analogous to a ring of electrons in a superconducting wire. The circuit is "nontrivial" because it includes a circuit element -- an adjustable barrier that controls the flow of atom current to specific allowed values.

The newly published work was done at the Joint Quantum Institute, a NIST/UM collaboration.

Ultracold gases, such as the Bose-Einstein condensate of sodium atoms in this experiment, are fluids that exhibit the unusual rules of the quantum world. Atomic quantum fluids show promise for constructing ultraprecise versions of sensors and other devices such as gyroscopes (which stabilize objects and aid in navigation). Superfuid helium circuits have already been used to detect rotation. Superconducting quantum interference devices (SQUIDs) use superconducting electrons in a loop to make highly sensitive measurements of magnetic fields. Researchers are striving to create an ultracold-gas version of a SQUID, which could detect rotation. Combined with ultracold atomic-gas analogs of other electronic devices and circuits, or "atomtronics" that have been envisioned, such as diodes and transistors, this work could set the stage for a new generation of ultracold-gas-based precision sensors.

To make their atom circuit, researchers created a long-lived persistent current -- a frictionless flow of particles -- in a Bose-Einstein condensate of sodium atoms held by an arrangement of lasers in a so-called optical trap that confines them to a toroidal, or donut, shape. Persistent flow -- occurring for a record-high 40 seconds in this experiment -- is a hallmark of superfluidity, the fluid analog of superconductivity.

The atom current does not circle the ring at just any velocity, but only at specified values, corresponding in this experiment to just a single quantum of angular momentum. A focused laser beam creates the circuit element -- a barrier across one side of the ring. The barrier constitutes a tunable "weak link" that can turn off the current around the loop.

Superflow stops abruptly when the strength of the barrier is sufficiently high. Like water in a pinched garden hose, the atoms speed up in the vicinity of the barrier. But when the velocity reaches a critical value, the atoms encounter resistance to flow (viscosity) and the circulation stops, as there are no external forces to sustain it.

In atomic Bose-Einstein condensates, researchers have previously created Josephson junctions, a thin barrier separating two superfluid regions, in a single atomic trap. SQUIDs require a Josephson junction in a circuit.

This present work represents the implementation of a complete atom circuit, containing a superfluid ring of current and a tunable weak link barrier. This is an important step toward realizing an atomic SQUID analog.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal Reference:

1. A. Ramanathan, K. Wright, S. Muniz, M. Zelan, W. Hill, C. Lobb, K. Helmerson, W. Phillips, G. Campbell. **Superflow in a Toroidal Bose-Einstein Condensate: An Atom Circuit with a Tunable Weak Link**. *Physical Review Letters*, 2011; 106 (13) DOI: 10.1103/PhysRevLett.106.130401

http://www.sciencedaily.com/releases/2011/03/110331151347.htm

Scat Reveals an Immigrant in Isle Royale Wolves' Gene Pool

The large, lighter colored wolf in the center is the immigrant from Canada dubbed The Old Gray Guy. The wolf to the left is his daughter and mate, who died during 2010. (Credit: John Vucetich)

ScienceDaily (Mar. 31, 2011) — The wolves and moose of Isle Royale have done it again. They've surprised the scientists who have spent more than half a century studying them.

In a journal article published online March 31 in the *Proceedings of the Royal Society* and in their 2010-2011 annual report, Michigan Technological University researchers John A. Vucetich and Rolf O. Peterson tell an unexpected tale of genetic immigration. In 1997, a virile male wolf crossed an ice bridge from Canada to the remote island national park in northern Lake Superior. He was physically larger than most Isle Royale wolves, and soon after his arrival he became the alpha male of Middle Pack, one of the island's three packs. As he aged, his fur turned very light, a trait that had not been seen previously on Isle Royale, but has since become common. Before knowing his genetic history, the researchers called this wolf "The Old Gray Guy."

How did Vucetich and Peterson learn so much about The Old Gray Guy? For the past 12 years, they had been systematically collecting scat (poop or droppings) deposited by the wolves. The immigrant wolf was discovered after Vucetich and Peterson collaborated with geneticists Jennifer Adams and Leah Vucetich from Michigan Tech and Phil Hedrick of Arizona State University, to examine the DNA contained within the scat. The geneticists found a scat that carried several alleles -- alternative forms of a gene -- that had not previously been seen in Isle Royale wolves. Through field observations, Peterson and Vucetich confirmed that this scat belonged to The Old Gray Guy.

The research was funded by the National Science Foundation (NSF) and the US National Park Service.

"Before this discovery, the Isle Royale wolf population had been considered completely isolated since it was founded in the late 1940s," Vucetich says.

According to the researchers, the discovery is also an important opportunity to better understand genetic rescue, a potentially important conservation tool for populations that suffer from inbreeding. Genetic rescue involves introducing one or more unrelated individuals into an inbred population. The effectiveness of genetic rescue is not well understood because the opportunities are limited to closely monitor an isolated population before and after a known immigration event. For this reason, the Isle Royale immigrant represents a special opportunity.

Genetic rescue is supposed to result in increased survival or reproduction. However, evidence for increased birth or longevity rates in the Isle Royale population is equivocal. Coincident with the immigrant□s arrival, though, moose on Isle Royale declined dramatically in response to food shortage, severe winters and tick outbreaks. A clear response to the immigration event may well have been disguised by lack of food for the wolves, the scientists suggest. If so, it may be important to recognize that deteriorating ecological conditions can mask the beneficial effects of infusing new genetic material, they point out.

The Old Gray Guy died in 2006. But he left his mark. He sired 34 offspring and 22 grand-offspring, "and counting," the scientists say. Today, 56 percent of all the genes now found in the Isle Royale wolf population trace back to him. Within a couple of generations of the Old Gray Guy's arrival, inbreeding plummeted, but then rose quickly again. This Isle Royale case shows how the effect of genetic rescue can be substantial and manifest quickly, but also be short-lived.

Wolf Population Declining

The wolf-moose researchers' latest report also brings discouraging news about the wolves of Isle Royale. This year's Winter Study, conducted between Jan. 12 and Feb. 28, 2011, found that the Isle Royale wolf population had been reduced to just 16 wolves. Among these wolves are no more than two adult females. If the few remaining females were to die before raising female pups, the wolf population would almost certainly be committed to extinction. "The situation is kind of precarious," says Vucetich. "But it's always been precarious," Peterson notes.

The wolf population has also been reduced from the four packs seen a couple of years ago to perhaps just a single pack. East Pack and Paduka Pack went extinct in late 2009. In late February 2011, Chippewa Harbor Pack traveled deep into Middle Pack's territory, where they killed Middle Pack's alpha male (a son of the Old Gray Guy). "With his death, the survival of Middle Pack is doubtful," Vucetich and Peterson say. It has been 40 years since the wolf population was composed of just a single pack.

The scientists acknowledge that National Park Service (NPS) policy promotes natural processes, and that, in this instance, local application of NPS policy could mean natural extinction. However, they advocate for an evaluation of the full range of management options, including the introduction of new wolves into the inbred population on Isle Royale.

Moose are Thriving

During the 2011 Winter Study, the scientists estimated a population of 515 moose, approximately the same as it has been for the past three years.

With the number of moose remaining low for so long now, the vegetation on Isle Royale also has become more abundant. Balsam firs, a favorite meal for moose, are growing taller than ever before, and deciduous shrubs have been flourishing. The calves were larger this winter, and the fat content of bone marrow indicates that adult moose are better nourished now. The scientists have spotted three sets of twins in the past two years, the first twins since 2005. Winter ticks, which posed a severe threat to the Isle Royale moose in 2007, have declined significantly since then.

"The moose are poised for increase," says Peterson. The last large increase in the moose population was seen on Isle Royale in the 1990s.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Michigan Technological University**. The original article was written by Jennifer Donovan.

Journal Reference:

1. J. R. Adams, L. M. Vucetich, P. W. Hedrick, R. O. Peterson, J. A. Vucetich. **Genomic sweep and potential genetic rescue during limiting environmental conditions in an isolated wolf population**. *Proceedings of the Royal Society B: Biological Sciences*, 2011; DOI: 10.1098/rspb.2011.0261

http://www.sciencedaily.com/releases/2011/03/110331142219.htm

Novel Technique Reveals How Glaciers Sculpted Their Valleys

Kurt Cuffey overlooking the glacier-carved Bowen River drainage (middle), Mount Tutoko (far right) and Milford Sound (left) in Fiordland National Park of New Zealand. (Credit: Photo by Johnny Sanders)

ScienceDaily (Mar. 31, 2011) — The beautiful and distinctive U-shaped glacial valleys typical of alpine areas from Alaska to New Zealand have fascinated and frustrated geologists for centuries.

While it seems obvious that glaciers scoured the bedrock for millions of years, what the landscape looked like before glaciers appeared, and how the glaciers changed that landscape over time, have remained a mystery. The glaciers erased all the evidence.

Now, University of California, Berkeley, and Berkeley Geochronology Center (BGC) scientists have employed a clever technique to reconstruct the landform history of a 300-square-mile area of Fiordland in New Zealand, from the early Pleistocene some 2.5 million years ago, when the world cooled and glaciers formed, through today's warmer interglacial period.

"The first question we asked was, how much of the current landscape and relief is a result of glacial erosion?" said David Shuster, who developed the novel technique, called helium-4/helium-3 thermochronometry. "The answer is, all of it."

Shuster is an associate adjunct professor of earth and planetary science at UC Berkeley and a geochemist at the Berkeley Geochronology Center.

"Geologists have wondered, what did the landscape look like 200,000 years ago, or 400,000 years ago, or back before the Pleistocene glaciations began?" said glaciologist Kurt Cuffey, professor and chair of geography and a professor of earth and planetary science at UC Berkeley. "Did the valleys start out as V-shaped canyons submerged in ice, and the glacier just widened and deepened them? Or perhaps the relief was sculpted by glaciation, and it didn't matter what the rock landscape looked like before."

"David's work opens up a whole new world of investigation to tell us how the alpine landscape progressed, with implications for how glaciers today act on the landscape," he said.

Shuster, Cuffey, UC Berkeley graduate student Johnny Sanders and BGC researcher Greg Balco report their conclusions in the April 1 issue of the journal *Science*.

Glaciers carved their mouths first, then their heads

The team found that in the Fiordland, a well-known tourist destination in the Southern Alps of New Zealand, the rock currently on the surface was about 1.5 miles (2 kilometers) underground when the glaciers began forming about 2.5 million years ago. Since then, the mountains rose as a result of tectonic activity, while the glaciers flowed downhill, scouring the landscape and gouging U-shaped valleys on their way to the sea.

What surprised the geologists was that most of the valley-making occurred at the downstream mouths of glaciers for the first million years, essentially stopping about 1.5 million years ago. For the next million years, until about 500,000 years ago, erosion took place primarily at the heads of glaciers, which steadily ate into their headwalls, characterized by steep, amphitheater-like cirques. As a result, the deep valleys advanced up their drainage basins toward the range divide, producing razorback ridges in the process.
"Apparently, the heads of glaciers would be directly opposite one another on either side of a high ridge, and faster erosion at the headwalls caused the glaciers to eat their way inward to the spine of the mountain range, farther from the glacier's outlet," Cuffey said.
Major changes to the mountain topography essentially stopped about half a million years ago. The current interglacial period started about 12,000 years ago, after warming temperatures caused the glaciers to melt and recede. The fact that these Fiordland valleys are now ice-free allowed the researchers to collect surface rock samples from 33 sites in four glacial valleys over six days with the assistance of a helicopter. The valleys end in Milford Sound or Lake Te Anau.

Temperature as a proxy for depth

Shuster developed helium-4/helium-3 thermochronometry while a graduate student at Caltech, from which he obtained his Ph.D. in 2005. The technique makes it possible to determine the temperature of a mineral as it cooled over geological time. Because temperature increases with depth, the temperature history of the mineral tells how deeply it was buried over a period of millions of years.
"The technique allows us to collect samples from the present surface and, based on observations, infer how they cooled through 80 degrees Celsius to 20 degrees Celsius (176 to 68 Fahrenheit) over the last few million years, and thus, how deep they were when they cooled," Shuster said.
At the moment, the technique works only with crystals of apatite, a calcium phosphate mineral found mainly in plutonic rocks, such as granite, that solidify from magma deep underground. The apatite crystals contain uranium and thorium, which over millions of years decay radioactively, producing helium-4. The helium gradually leaks out of the crystal into the surrounding rock, but the rate of leakage decreases as the crystal cools.
Using special equipment at the BGC, the geologists were able to date the cooling of the minerals by measuring the amount of uranium and thorium in each crystal as well as the total amount of helium-4. The new technique involves irradiating the crystal with a proton beam to create helium-3, then measuring the outgassing of both helium isotopes to obtain a cross section of the helium-4 concentration in the crystal. They then calculated the crystal's cooling history based on the helium diffusion rate.
The samples, all of them younger than 2.5 million years, showed a large range of temperature, and thus depth, histories. Cuffey and Shuster used a computer model to test various scenarios and concluded that only one fit the data: Glaciers initially scoured the U-shaped valleys on the flanks of the mountain range, and only later began eating away at their headwater regions, including cirques and drainage divides.
"… this morphology resembles modern analogs in Norway and Antarctica, where steep valley ramps descend to level floors," the authors wrote.
The common thread is that the rock erodes faster where the ice sits on a steep slope, they said. Thus, the erosion rate of a glacier is greatest where the flowing river of ice descends steeply downstream.
"This scenario is consistent with a subglacial erosion rate dependent on ice sliding velocity, but not ice discharge," Shuster said.
The research was supported by the National Science Foundation. The work of the BGC was supported by the Ann and Gordon Getty Foundation.

Story Source: The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Berkeley**

http://www.sciencedaily.com/releases/2011/03/110331142210.htm

Researchers Need to Engage Lesbian, Gay, Bisexual, and Transginder Populations in Health Studies, Experts Urge

ScienceDaily (Mar. 31, 2011) — Researchers need to proactively engage lesbian, gay, bisexual, and transgender people in health studies and collect data on these populations to identify and better understand health conditions that affect them, says a new report from the Institute of Medicine. The scarcity of research yields an incomplete picture of LGBT health status and needs, which is further fragmented by the tendency to treat sexual and gender minorities as a single homogeneous group, said the committee that wrote the report. The report provides a thorough compilation of what is known about the health of each of these groups at different stages of life and outlines an agenda for the research and data collection necessary to form a fuller understanding.

"It's easy to assume that because we are all humans, gender, race, or other characteristics of study participants shouldn't matter in health research, but they certainly do," said committee chair Robert Graham, professor of family medicine and public health sciences and Robert and Myfanwy Smith Chair, department of family medicine, University of Cincinnati College of Medicine, Cincinnati. "It was only when researchers made deliberate efforts to engage women and racial and ethnic minorities in studies that we discovered differences in how some diseases occur in and affect specific populations. Routine collection of information on race and ethnicity has expanded our understanding of conditions that are more prevalent among various groups or that affect them differently. We should strive for the same attention to and engagement of sexual and gender minorities in health research."

Because LGBT individuals make up a minority of the population, researchers face challenges in recruiting sufficient numbers of these individuals in general population surveys to yield meaningful data. Stigma experienced by gender and sexual minorities can make them reluctant to disclose their orientation, worsening the problem. Moreover, it is difficult to synthesize data about these groups when studies and surveys use a variety of ways to define them.

Because demographic data provide the foundation for understanding any population's status and needs, federally funded surveys should proactively collect data on sexual orientation and gender identity, just as they routinely gather information on race and ethnicity, the report says. Information on patients' sexual orientation and gender identity also should be collected in electronic health records, provided that privacy concerns can be satisfactorily addressed, the committee said. The National Institutes of Health should support the development of standardized measures of sexual orientation and gender identity for use in federal surveys and other means of data collection.

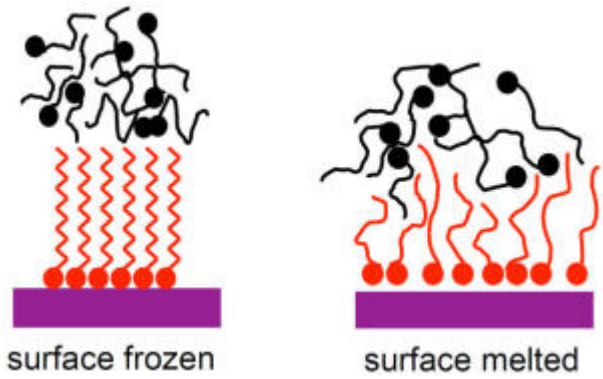
In addition, NIH should provide training opportunities in conducting research with LGBT populations. Training should engage researchers who are not specifically studying LGBT health issues as well as those who are. The agency also should use its policy on the inclusion of women and racial and ethnic minorities in clinical research as a model to encourage grant applicants to address how their proposed studies will include or exclude sexual and gender minorities.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Academy of Sciences**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110331114939.htm

Smooth Single-Molecule Layers of Materials: Expanding the Degrees of Surface Freezing



Schematic representation of the alkanol monolayer when frozen (left) and melted (right). (Credit: Image courtesy of DOE/Brookhaven National Laboratory)

ScienceDaily (Mar. 31, 2011) — As part of the quest to form perfectly smooth single-molecule layers of materials for advanced energy, electronic, and medical devices, researchers at the U.S. Department of Energy's Brookhaven National Laboratory have discovered that the molecules in thin films remain frozen at a temperature where the bulk material is molten. Thin molecular films have a range of applications extending from organic solar cells to biosensors, and understanding the fundamental aspects of these films could lead to improved devices.

The study, which appears in the April 1, 2011, edition of *Physical Review Letters*, is the first to directly observe "surface freezing" at the buried interface between bulk liquids and solid surfaces.

"In most materials, you expect that the surface will start to disorder and eventually melt at a temperature where the bulk remains solid," said Brookhaven physicist Ben Ocko, who collaborated on the research with scientists from the European Synchrotron Radiation Facility (ESRF), in France, and Bar-Ilan University, in Israel. "This is because the molecules on the outside are less confined than those packed in the deeper layers and much more able to move around. But surface freezing contradicts this basic idea. In surface freezing, the interfacial layers freeze before the bulk."

In the early 1990s, two independent teams (one at Brookhaven) made the first observation of surface freezing at the vapor interface of bulk alkanes, organic molecules similar to those in candle wax that contain only carbon and hydrogen atoms. Surface freezing has since been observed in a range of simple chain molecules and at various interfaces between them.

"The mechanics of surface freezing are still a mystery," said Bar Ilan scientist Moshe Deutsch. "It's puzzling why alkanes and their derivatives show this unusual effect, while virtually all other materials exhibit the opposite, surface melting, effect."

In the most recent study, the researchers discovered that surface freezing also occurs at the interface between a liquid and a solid surface. In a temperature-controlled environment at Brookhaven's National Synchrotron Light Source and the ESRF, the group made contact between a piece of highly polished sapphire and a puddle of liquid alkanol -- a long-chain alcohol. The researchers shot a beam of high-intensity x-rays through the interface and by measuring how the x-rays reflected off the sample, the group revealed that the alkanol molecules at the sapphire surface behave very differently from those in the bulk liquid.

According to ESRF scientist Diego Pontoni, "Surprisingly, the alkanol molecules form a perfect frozen monolayer at the sapphire interface at temperatures where the bulk is still liquid." At sufficiently high temperatures, about 30 degrees Celsius above the melting temperature of the bulk alkanol, the monolayer also melts.

The temperature range over which this frozen monolayer exists is about 10 times greater than what's observed at the liquid-vapor interfaces of similar materials. According to Alexei Tkachenko, a theoretical physicist who works at Brookhaven's Center for Functional Nanomaterials, "The temperature range of the surface-frozen layer and its temperature-dependent thickness can be described by a very simple model that we developed. What is remarkable is that the surface layer does not freeze abruptly as in the case of ice, or any other crystal. Rather, a smooth transition occurs over a temperature range of several degrees."

Said Ocko, "These films are better ordered and smoother than all other organic monolayer films created to date."
Moshe Deutsch added, "The results of this study and the theoretical framework which it provides may lead to new ideas on how to make defect-free, single molecule-thick films."
Funding for this work was provided by the U.S. Department of Energy's Office of Science and the U.S.-Israel Binational Science Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Brookhaven National Laboratory**.

Journal Reference:

1. B. Ocko, H. Hlaing, P. Jepsen, S. Kewalramani, A. Tkachenko, D. Pontoni, H. Reichert, M. Deutsch. **Unifying Interfacial Self-Assembly and Surface Freezing**. *Physical Review Letters*, 2011; 106 (13) DOI: 10.1103/PhysRevLett.106.137801

http://www.sciencedaily.com/releases/2011/03/110331114937.htm

Getting Closer to a Better Biocontrol for Garden Pests

ARS entomologist Michael Blackburn is searching the ARS Beltsville Bacterial Collection for a strain of Bacillus thuringiensis (Bt) that will live multiple generations instead of just one, which would provide better biocontrol of insect pests like the strawberry leaf roller. (Credit: Photo by Stephen Ausmus.)

ScienceDaily (Mar. 31, 2011) — U.S. Department of Agriculture (USDA) scientists have found strains of bacteria that could one day be used as environmentally friendly treatments to keep caterpillars and other pests out of gardens and cultivated fields.

Researchers with the USDA's Agricultural Research Service (ARS) surveyed the agency's bacterial collection and discovered that strains sharing the ability to produce a particular enzyme survive being fed to caterpillars longer than those that don't. Such survivability makes them better candidates for controlling crop and garden pests. The results, published in *Biological Control*, support the USDA priorities of agricultural sustainability and promoting international food security.

Bacillus thuringiensis (Bt) is a bacterium now used to control gypsy moths, tent caterpillars, leaf rollers, canker worms and other pests that attack gardens, corn and other crops. But the commonly used strain, Bacillus thuringiensis kurstaki, doesn't survive more than one generation. After an initial round of pests is killed, they die out and the pests return.

Michael Blackburn, an entomologist at the ARS Invasive Insect Biocontrol and Behavior Laboratory in Beltsville, Md., and his colleagues searched among the Beltsville Bacteria Collection's 3,500 Bt strains for those that would not only kill an initial generation of pests, but would kill subsequent generations. The search was part of an overall effort to classify strains in the collection based on compounds they metabolize and produce.

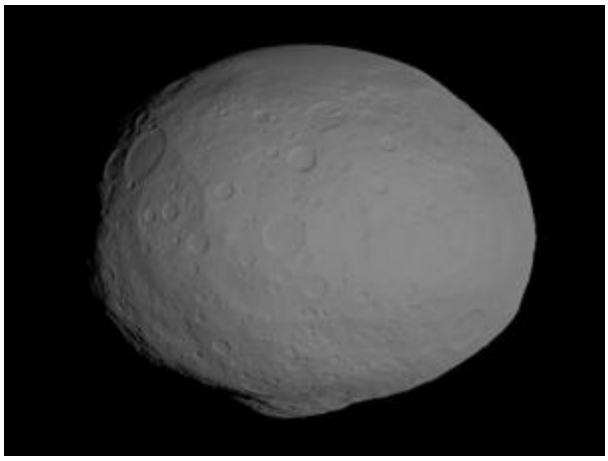
The researchers tested 50 strains of Bt known to be toxic to gypsy moths, including kurstaki, and found they could be divided into two groups: those that produce the enzyme urease and those that don't.

The researchers fed the 50 strains to gypsy moth larvae and when those caterpillars died, they ground them up and applied them to pellets of artificial diet. They then fed the pellets to another cycle of caterpillars. The researchers looked at the survival rates of the bacteria over several generations and found that urease-producing phenotypes survived better when repeatedly fed to gypsy moths.
The results bring scientists a step closer to finding a Bt strain that will be more effective at combating gypsy moths and possibly other insect pests. The efforts could also lead to the discovery of Bt strains that grow on mulch, fight pests on specific crops and thrive in gardens.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Dennis O'Brien.

http://www.sciencedaily.com/releases/2011/03/110331114853.htm

When Is an Asteroid Not an Asteroid?



This image shows a model of the protoplanet Vesta, using scientists' best guess to date of what the surface of the protoplanet might look like. (Credit: NASA/JPL-Caltech/UCLA/PSI)

ScienceDaily (Mar. 30, 2011) — On March 29, 1807, German astronomer Heinrich Wilhelm Olbers spotted Vesta as a pinprick of light in the sky. Two hundred and four years later, as NASA's Dawn spacecraft prepares to begin orbiting this intriguing world, scientists now know how special this world is, even if there has been some debate on how to classify it.

Vesta is most commonly called an asteroid because it lies in the orbiting rubble patch known as the main asteroid belt between Mars and Jupiter. But the vast majority of objects in the main belt are lightweights, 100-kilometers-wide (about 60-miles wide) or smaller, compared with Vesta, which is about 530 kilometers (330 miles) across on average. In fact, numerous bits of Vesta ejected by collisions with other objects have been identified in the main belt.

"I don't think Vesta should be called an asteroid," said Tom McCord, a Dawn co-investigator based at the Bear Fight Institute, Winthrop, Wash. "Not only is Vesta so much larger, but it's an evolved object, unlike most things we call asteroids."

The layered structure of Vesta (core, mantle and crust) is the key trait that makes Vesta more like planets such as Earth, Venus and Mars than the other asteroids, McCord said. Like the planets, Vesta had sufficient radioactive material inside when it coalesced, releasing heat that melted rock and enabled lighter layers to float to the outside. Scientists call this process differentiation.

McCord and colleagues were the first to discover that Vesta was likely differentiated when special detectors on their telescopes in 1972 picked up the signature of basalt. That meant that the body had to have melted at one time.

Officially, Vesta is a "minor planet" -- a body that orbits the sun but is not a proper planet or comet. But there are more than 540,000 minor planets in our solar system, so the label doesn't give Vesta much distinction. Dwarf planets -- which include Dawn's second destination, Ceres -- are another category, but Vesta doesn't qualify as one of those. For one thing, Vesta isn't quite large enough.

Dawn scientists prefer to think of Vesta as a protoplanet because it is a dense, layered body that orbits the sun and began in the same fashion as Mercury, Venus, Earth and Mars, but somehow never fully developed. In the swinging early history of the solar system, objects became planets by merging with other Vesta-sized objects. But Vesta never found a partner during the big dance, and the critical time passed. It may have had to do with the nearby presence of Jupiter, the neighborhood's gravitational superpower, disturbing the orbits of objects and hogging the dance partners.

Other space rocks have collided with Vesta and knocked off bits of it. Those became debris in the asteroid belt known as Vestoids, and even hundreds of meteorites that have ended up on Earth. But Vesta never collided with something of sufficient size to disrupt it, and it remained intact. As a result, Vesta is a time capsule from that earlier era.

"This gritty little protoplanet has survived bombardment in the asteroid belt for over 4.5 billion years, making its surface possibly the oldest planetary surface in the solar system," said Christopher Russell, Dawn's

principal investigator, based at UCLA. "Studying Vesta will enable us to write a much better history of the solar system's turbulent youth."
Dawn's scientists and engineers have designed a master plan to investigate these special features of Vesta. When Dawn arrives at Vesta in July, the south pole will be in full sunlight, giving scientists a clear view of a huge crater at the south pole. That crater may reveal the layer cake of materials inside Vesta that will tell us how the body evolved after formation. The orbit design allows Dawn to map new terrain as the seasons progress over its 12-month visit. The spacecraft will make many measurements, including high-resolution data on surface composition, topography and texture. The spacecraft will also measure the tug of Vesta's gravity to learn more about its internal structure.
"Dawn's ion thrusters are gently carrying us toward Vesta, and the spacecraft is getting ready for its big year of exploration," said Marc Rayman, Dawn's chief engineer at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "We have designed our mission to get the most out of this opportunity to reveal the exciting secrets of this uncharted, exotic world."
The Dawn mission to Vesta and Ceres is managed by the Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, for NASA's Science Mission Directorate, Washington. The Dawn mission is part of the Discovery Program managed by NASA's Marshall Space Flight Center in Huntsville, Ala. UCLA is responsible for overall Dawn mission science. Orbital Sciences Corporation of Dulles, Va., designed and built the Dawn spacecraft. The German Aerospace Center, the Max Planck Society, the Italian Space Agency and the Italian National Astrophysical Institute are part of the mission team.
For more information about Dawn, visit http://www.nasa.gov/dawn and http://dawn.jpl.nasa.gov .

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Jet Propulsion Laboratory**.

http://www.sciencedaily.com/releases/2011/03/110330024614.htm

54 Beneficial Compounds Discovered in Pure Maple Syrup

Bottle of maple syrup. Researchers have discovered 34 new beneficial compounds in pure maple syrup and confirmed that 20 compounds discovered last year in preliminary research play a key role in human health. Five have never been seen in nature before. (Credit: iStockphoto/Daniel Loiselle)

ScienceDaily (Mar. 30, 2011) — University of Rhode Island researcher Navindra Seeram has discovered 34 new beneficial compounds in pure maple syrup and confirmed that 20 compounds discovered last year in preliminary research play a key role in human health.

On March 30 at the 241st American Chemical Society's National Meeting in Anaheim, Calif. the URI assistant pharmacy professor is telling scientists from around the world that his URI team has now isolated and identified 54 beneficial compounds in pure maple syrup from Quebec, five of which have never been seen in nature.

"I continue to say that nature is the best chemist, and that maple syrup is becoming a champion food when it comes to the number and variety of beneficial compounds found in it," Seeram said. "It's important to note that in our laboratory research we found that several of these compounds possess anti-oxidant and anti-inflammatory properties, which have been shown to fight cancer, diabetes and bacterial illnesses."

These discoveries of new molecules from nature can also provide chemists with leads that could prompt synthesis of medications that could be used to fight fatal diseases, Seeram said.

"We know that the compounds are anti-inflammatory agents and that inflammation has been implicated in several chronic diseases, such as heart disease, diabetes, certain types of cancers and neurodegenerative diseases, such as Alzheimer's," Seeram said.

As part of his diabetes research, Seeram has collaborated with Chong Lee, professor of nutrition and food sciences in URI's College of the Environment and Life Sciences. The scientists have found that maple syrup phenolics, the beneficial anti-oxidant compounds, inhibit two carbohydrate hydrolyzing enzymes that are relevant to Type 2 diabetes management.

The irony of finding a potential anti-diabetes compound in a sweetener is not lost on Seeram. "Not all sweeteners are created equal," he said.

Among the five new compounds is Quebecol, a compound created when a farmer boils off the water in maple sap to get maple syrup. It takes 40 liters (10.5 gallons) of sap to make 1 liter (2 pints) of syrup.
"Quebecol has a unique chemical structure or skeleton never before identified in nature," Seeram said. "I believe the process of concentrating the maple sap into maple syrup is what creates Quebecol. There is beneficial and interesting chemistry going on when the boiling process occurs. I believe the heat forms this unique compound."
Seeram said he and his team chose the common name of Quebecol for the new compound to honor the province of Quebec in Canada, which leads the worldwide production of maple syrup. Seeram's research was supported by the
Conseil pour le developpement de l'agriculture du Quebec (CDAQ) and Agriculture and Agri-Food Canada (AAFC) on behalf of the Canadian maple syrup industry.
"Producers, transformers and partners of the Canadian maple industry believe that investing in maple syrup knowledge and innovation will bring the products to another level in a few years," said Serge Beaulieu, president of the Federation of Quebec Maple Syrup Producers and member of the Canadian Maple Industry Advisory Committee.
"Quebec Maple Syrup Producers are especially proud to be leading this long-term innovative strategy on behalf of the Canadian industry and with the talented scientists of the Canadian Maple Innovation Network."
Genevieve Beland, marketing director of the Federation added, "Maple products' composition is unique and we are at the starting point of a new era. Ten years from now consumers will appreciate 100 percent pure maple products because they are delicious, natural and have a number of healthy compounds."
"As we continued our research in the past year, we were astonished when the number of beneficial compounds that we isolated is now more than double the original amount," said Seeram, who is now releasing his findings.
Seeram is the organizer of the daylong symposium on "Bioactives in Natural Sweeteners," and is joined by scientists from Canada, Japan, Mexico and the United States to discuss natural sweeteners. Seeram's collaborations with Angela Slitt, assistant professor of biomedical sciences in URI's College of Pharmacy and Professor Lee, will also be presented during the meeting.
Seeram's findings will be detailed in his article recently accepted for publication in the Journal of Functional Foods. The title of the paper is "Quebecol, a novel phenolic compound isolated from Canadian maple syrup." In addition, Seeram and Lee's work on diabetes and maple syrup will also be published in an upcoming edition of the Journal of Functional Foods.
"I can guarantee you that few, if any, other natural sweeteners have this anti-oxidant cocktail of beneficial compounds; it has some of the beneficial compounds that are found in berries, some that are found in tea and some that are found in flaxseed. People may not realize it, but while we have a wide variety of fruits and vegetables in our food chain, maple syrup is the single largest consumed food product that is entirely obtained from the sap of trees," Seeram said.
Reiterating a statement he made last year, Seeram said no one is suggesting that people consume large quantities of maple syrup, but that if they are going to use a sweetener on their pancakes, they should choose pure maple syrup and not the commercial products with high fructose corn syrup.
"Pure maple syrup is not only delicious, it is so much better for you," Seeram said.
Funding of CDAQ is provided through Agriculture and Agri-Food Canada's Advancing Canadian Agriculture and Agri-Food program. AAFC has been able to provide financial support for maple syrup research through the program 'Growing Canadian Agri-Innovations'.

story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Rhode Island**.

http://www.sciencedaily.com/releases/2011/03/110330131316.htm

Next-Generation Device Developed to Track World's Air Quality

Physics professor Pat Arnott of the University of Nevada, Reno explains the new technology for photoacoustic air particle monitoring recently licensed by the University to Droplet Measurement Technologies. The device is used to measure air quality, including black carbon, in a number of applications. (Credit: Photo by Mike Wolterbeek, University of Nevada, Reno.)

ScienceDaily (Mar. 30, 2011) — A new air-quality measuring instrument invented by Pat Arnott and Ian Arnold of the University of Nevada, Reno that is more economical, more portable and more accurate than older technologies has been licensed for commercial development by Droplet Measurement Technologies of Boulder, Colo.

Arnott, a physics professor in the University's College of Science, had perhaps lugged his heavy pieces of equipment one too many times through airports to faraway places to examine airborne particles. Now, his and Arnold's latest invention has reduced the laser-equipped air-monitoring equipment to suitcase size, while enhancing its measurement capabilities.

This latest, compact version of the photoacoustic particle measuring machine with its lasers, mirrors, flexible tubes, wires and relays is also cheaper and faster and should be an attractive alternative for users.

"This machine will be much more ubiquitous for measuring air quality, or more precisely, black carbon in the air, or a number of other uses," Arnott said. "Key component cost and instrument weight have dropped from $2,000 and 180 pounds to $40 and 20 pounds. This will make it more accessible to researchers, businesses and government agencies; and much easier when traveling around the world to gather data."

Over the past 12 years, Arnott, along with collaborators from the Desert Research Institute, have mapped air pollution on Los Angeles freeways, as well as in Mexico City, the rain forests of Brazil, Vancouver, B.C., and Big Bend National Park, to name a few locations. They have also worked 1,600 feet underground in an active Nevada gold mine to monitor air quality.

Arnott's invention is an improvement on earlier technology he developed with partners. Arnott, John Walker and Hans Moosmüller, all at the time with DRI, commercialized the first version of the instrument with Droplet Measurement Technologies in 2005.

The University of Nevada, Reno's Tech Transfer Office, worked out the deal with DMT to commercialize the technology.

"The new device is a smaller, less expensive photoacoustic instrument for measuring airborne particles related to air quality that makes it affordable for a broader range of uses and it promises to lead to much wider market adoption of photoacoustic technology," said Ryan Heck, director of the University's Tech Transfer Office. "Pat and DMT have worked together for years, and we were pleased to help facilitate a new product based on their collaboration."

Arnott and DMT have already built beta-versions of the device that are in use by researchers at the Lawrence Berkeley Labs and the Bay Area Air Quality District, at the Max Planck Institute for Chemistry in Europe and in locations in Mexico City. Droplet is working to produce many more that will be a fraction of the cost to users.

"We're pleased to have entered into the licensing agreement," John Lovett, CEO of Droplet said. "Pat is a leading scientist in applying photo-acoustic technology to aerosols and has partnered with DMT on developing research-grade scientific instruments for air quality assessment.
"Our new instrument, the Photoacoustic Extinctiometer -- PAX, is a next generation monitoring tool to help scientists and air quality engineers accurately assess the optical properties of aerosols that are relevant for climate change and visibility. By measuring the aerosol in its natural state (photoacoustically), without requiring filter collection, the PAX improves measurement accuracy over older competing technologies." Arnott and Arnold, an undergraduate student in Physics at the University when he assisted Arnott with instrument development, are also working on developing a truly miniature device that may find use as an on-board sensor for real-time black carbon air pollution emission control.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Nevada, Reno**. The original article was written by Mike Wolterbeek.

http://www.sciencedaily.com/releases/2011/03/110329151452.htm

Mothers' Hard Work Pays Off With Big Brains for Their Babies

Brain growth in babies is linked to the amount of time and energy mothers "invest," according to new research. (Credit: iStockphoto/Iakov Filimonov)

ScienceDaily (Mar. 30, 2011) — Brain growth in babies is linked to the amount of time and energy mothers 'invest', according to new research.

The study of 128 mammal species, including humans, shows that brain growth in babies is determined by the duration of pregnancy and how long they suckle. The Durham University research concludes that the longer the pregnancy and breastfeeding period in mammals, the bigger the baby's brain grows.

The researchers say the findings reinforce the suggestion that breast is best for brain development and add further weight to the World Health Organisation's advice of six months' exclusive breastfeeding followed by continuing breastfeeding up to the age of two or beyond supplemented with solid foods.

The study, published in the *Proceedings of the National Academy of Sciences,* helps to explain why humans, who suckle their babies for up to three years in addition to their nine-month pregnancies, have such a long period of dependency as this is necessary to support the growth of our enormous 1300cc brains.

In comparison, species such as fallow deer, which are about the same body weight as humans, are only pregnant for seven months with a suckling period of up to six months, resulting in brains of only 220cc, six times smaller than the human brain.

The anthropologists, from Durham's Evolutionary Anthropology Research Group, analysed statistical evidence on brain and body size, maternal investment, and life history variables in mammals, including species such as gorillas, elephants and whales.

They found that brain size relative to body size was most closely linked to maternal investment -- the amount of time a mother spends carrying her offspring in pregnancy and how long she continues to breastfeed. The study shows that length of the pregnancy determines brain size at birth and the period of lactation decides

brain growth after birth. It also shows that mothers with higher metabolic rates can afford to fuel faster brain growth in the fetus.

Lead investigator, Professor Robert Barton from Durham University's Department of Anthropology, said: "We already know that large-brained species develop slowly, mature later and have longer lifespans but what has not always been clear is why brains and life histories are related.

"One theory is that large brains increase lifespan by making the animal more generally flexible in its behavioural responses to unpredictable challenges, permitting slower life histories. However, our findings suggest that the slow-down in life histories is directly related to the costs rather than the benefits of growing a large brain. The necessary benefits to offset these costs could come in other ways, such as improving specific perceptual and cognitive abilities, rather than through some generalized flexibility.

"Our findings help us to understand what the implications are of evolutionary changes at different stages, before and after birth, but we now need to do more research to pinpoint exactly how changes to the pre- and postnatal growth phases affect the structure of the brain."

The research was funded by the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC)

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Durham University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Robert A. Barton, Isabella Capellini. **Maternal investment, life histories, and the costs of brain growth in mammals**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1019140108

http://www.sciencedaily.com/releases/2011/03/110328151730.htm

River Water and Salty Ocean Water Used to Generate Electricity

The mouth of the Amazon River, where the world's largest drainage basin flows into the Atlantic Ocean. A location such as this, where fresh and sea water mix, is a good spot for generating electricity with Yi Cui's new battery. (Credit: NASA)

ScienceDaily (Mar. 30, 2011) — Stanford researchers have developed a battery that takes advantage of the difference in salinity between freshwater and seawater to produce electricity.

Anywhere freshwater enters the sea, such as river mouths or estuaries, could be potential sites for a power plant using such a battery, said Yi Cui, associate professor of materials science and engineering, who led the research team.

The theoretical limiting factor, he said, is the amount of freshwater available. "We actually have an infinite amount of ocean water; unfortunately we don't have an infinite amount of freshwater," he said.

As an indicator of the battery's potential for producing power, Cui's team calculated that if all the world's rivers were put to use, their batteries could supply about 2 terawatts of electricity annually -- that's roughly 13 percent of the world's current energy consumption.

The battery itself is simple, consisting of two electrodes -- one positive, one negative -- immersed in a liquid containing electrically charged particles, or ions. In water, the ions are sodium and chlorine, the components of ordinary table salt.

Initially, the battery is filled with freshwater and a small electric current is applied to charge it up. The freshwater is then drained and replaced with seawater. Because seawater is salty, containing 60 to 100 times more ions than freshwater, it increases the electrical potential, or voltage, between the two electrodes. That makes it possible to reap far more electricity than the amount used to charge the battery.

"The voltage really depends on the concentration of the sodium and chlorine ions you have," Cui said. "If you charge at low voltage in freshwater, then discharge at high voltage in sea water, that means you gain energy. You get more energy than you put in."

Once the discharge is complete, the seawater is drained and replaced with freshwater and the cycle can begin again. "The key thing here is that you need to exchange the electrolyte, the liquid in the battery," Cui said. He is lead author of a study published in the journal Nano Letters earlier this month.

In their lab experiments, Cui's team used seawater they collected from the Pacific Ocean off the California coast and freshwater from Donner Lake, high in the Sierra Nevada. They achieved 74 percent efficiency in converting the potential energy in the battery to electrical current, but Cui thinks with simple modifications, the battery could be 85 percent efficient.

To enhance efficiency, the positive electrode of the battery is made from nanorods of manganese dioxide. That increases the surface area available for interaction with the sodium ions by roughly 100 times compared with other materials. The nanorods make it possible for the sodium ions to move in and out of the electrode with ease, speeding up the process.

Other researchers have used the salinity contrast between freshwater and seawater to produce electricity, but those processes typically require ions to move through a membrane to generate current. Cui said those

membranes tend to be fragile, which is a drawback. Those methods also typically make use of only one type of ion, while his battery uses both the sodium and chlorine ions to generate power.
Cui's team had the potential environmental impact of their battery in mind when they designed it. They chose manganese dioxide for the positive electrode in part because it is environmentally benign.
The group knows that river mouths and estuaries, while logical sites for their power plants, are environmentally sensitive areas.
"You would want to pick a site some distance away, miles away, from any critical habitat," Cui said. "We don't need to disturb the whole system, we just need to route some of the river water through our system before it reaches the ocean. We are just borrowing and returning it," he said.
The process itself should have little environmental impact. The discharge water would be a mixture of fresh and seawater, released into an area where the two waters are already mixing, at the natural temperature.
One of Cui's concerns is finding a good material for the negative electrode. He used silver for the experiments, but silver is too expensive to be practical.
His group did an estimate for various regions and countries and determined that South America, with the Amazon River draining a large part of the continent, has the most potential. Africa also has an abundance of rivers, as do Canada, the United States and India.
But river water doesn't necessarily have to be the source of the freshwater, Cui said.
"The water for this method does not have to be extremely clean," he said. Storm runoff and gray water could potentially be useable.
A power plant operating with 50 cubic meters of freshwater per second could produce up to 100 megawatts of power, according to the team's calculations. That would be enough to provide electricity for about 100,000 households.
Cui said it is possible that even treated sewage water might work.
"I think we need to study using sewage water," he said. "If we can use sewage water, this will sell really well."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University**. The original article was written by Louis Bergeron.

Journal Reference:

1. Fabio La Mantia, Mauro Pasta, Heather D. Deshazer, Bruce E. Logan, Yi Cui. **Batteries for Efficient Energy Extraction from a Water Salinity Difference**. *Nano Letters*, 2011; 110317090439081 DOI: 10.1021/nl200500s

http://www.sciencedaily.com/releases/2011/03/110329134254.htm

Heavy Metals Open Path to High Temperature Nanomagnets

(Credit: Image courtesy of University of Copenhagen)

ScienceDaily (Mar. 30, 2011) — How would you like to store all the films ever made on a device the size of an I-phone? Magnets made of just a few metallic atoms could make it possible to build radically smaller storage devices and have also recently been proposed as components for spintronics devices. There's just one obstacle. Nano-sized magnets have only been seen to work at temperatures a little above absolute zero.

Now a chemistry student at the University of Copenhagen has demonstrated that molecular magnets using the metals ruthenium and osmium retain their magnetic properties at higher temperatures. Most likely due to the larger spin-orbit coupling and more diffuse electron cloud present in these heavier elements. Some of his findings have recently been published in *Chemistry -- A European Journal.*

Iron not heavy enough

Kasper Steen Pedersen is studying for a Masters degree at the University of Copenhagen. Like many others in his chosen field of molecular magnetism he had been working with magnets based on 3d metal ions from iron. This seems an obvious choice when working with ordinary magnets which usually consist of about a trillion atoms. Single-molecule magnets are isolated molecules behaving like real magnets but they do not exhibit a three-dimensional order characteristic of a magnet.

Frozen magnets useless

Though interesting from a perspective of fundamental research, the need for very low temperatures make the miniscule magnets useless for any practical applications. So Pedersen wanted to see if another tack was possible. "When you take a look at the periodic table of the elements the solution seems obvious. Ruthenium and osmium are in the same group in the periodic table as iron, so it ought to be possible to create magnets out of these substances as well by using our knowledge about molecular magnets based on iron," says Pedersen.

Surprising properties for non-iron metals

As it turned out the chemical synthesis needed to build molecular magnets out of the substances was relatively simple. But the measured properties were surprising. "The chemical properties are the same for these metals as for iron. But the physical properties of the new magnets turned out to be very different from those made of iron. Basically, the magnetism arises from the electron spin but also from the motion of the electron around the nucleus. The latter contribution, which is very large for ruthenium, osmium and other heavy elements, has been largely ignored by the scientific community but we have now shown, experimentally, that is a very pronounced effect. And this is utterly new and exciting," explains Kasper Steen Pedersen.

Not quite a breakthrough

Using the unconventional metals for his magnets enabled Pedersen to raise the critical temperature only by a few Kelvin. However, the intriguing result that electron motion plays a large role for the magnetic properties paves the way for new synthetic approaches to molecular nanomagnets with unprecedented high critical temperatures.

"You'll not get me to call this a breakthrough. But it is a remarkable result for the field," concludes Kasper Steen Pedersen.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Copenhagen**.

Journal Reference:

1. Kasper S. Pedersen, Magnus Schau-Magnussen, Jesper Bendix, Høgni Weihe, Andrei V. Palii, Sophia I. Klokishner, Serghei Ostrovsky, Oleg S. Reu, Hannu Mutka, Philip L. W. Tregenna-Piggott. **Enhancing the Blocking Temperature in Single-Molecule Magnets by Incorporating 3d-5d Exchange Interactions**. *Chemistry - A European Journal*, 2010; 16 (45): 13458 DOI: 10.1002/chem.201001259

http://www.sciencedaily.com/releases/2011/03/110328101324.htm

Measurements of Winter Arctic Sea Ice Shows Continuing Ice Loss, Study Finds

The annual maximum Arctic sea ice extent continues to dwindle, says a new study by CU-Boulder's National Snow and Ice Data Center. (Credit: Image courtesy of University of Colorado)

ScienceDaily (Mar. 30, 2011) — The 2011 Arctic sea ice extent maximum that marks the beginning of the melt season appears to be tied for the lowest ever measured by satellites, say scientists at the University of Colorado Boulder's National Snow and Ice Data Center.

The CU-Boulder research team believes the lowest annual maximum ice extent of 5,650,000 square miles occurred on March 7. The maximum ice extent was 463,000 square miles below the 1979-2000 average, an area slightly larger than the states of Texas and California combined. The 2011 measurements were tied with those from 2006 as the lowest maximum sea ice extents measured since satellite record keeping began in 1979.

Virtually all climate scientists believe shrinking Arctic sea ice is tied to warming temperatures in the region caused by an increase in human-produced greenhouse gases being pumped into Earth's atmosphere. Because of the spiraling downward trend of Arctic sea ice extent in the last decade, some CU scientists are predicting the Arctic Ocean may be ice free in the summers within the next several decades.

The seven lowest maximum Arctic sea ice extents measured by satellites all have occurred in the last seven years, said CU-Boulder Research Scientist Walt Meier of the National Snow and Ice Data Center, who participated the latest study. "I'm not surprised by the new data because we've seen a downward trend in winter sea ice extent for some time now."

Scientists believe Arctic sea ice functions like an air conditioner for the global climate system by naturally cooling air and water masses, playing a key role in ocean circulation and reflecting solar radiation back into space, said Meier. In the Arctic summer months, sunlight is absorbed by the growing amounts of open water, raising surface temperatures and causing more ice to melt.

"I think one of the reasons the Arctic sea ice maximum extent is declining is that the autumn ice growth is delayed by warmer temperatures and the ice extent is not able to 'catch up' through the winter," said Meier. "In addition, the clock runs out on the annual ice growth season as temperatures start to rise along with the sun during the spring months."

Since satellite record keeping began in 1979, the maximum Arctic sea ice extent has occurred as early as Feb. 18 and as late as March 31, with an average date of March 6. Since the CU-Boulder researchers determine the maximum sea ice extent using a five-day running average, there is small chance the data could change.

In early April CU-Boulder's National Snow and Ice Data Center will issue a formal announcement on the 2011 maximum sea ice extent with a full analysis of the winter ice growth season, including graphics comparing 2011 to the long-term record.

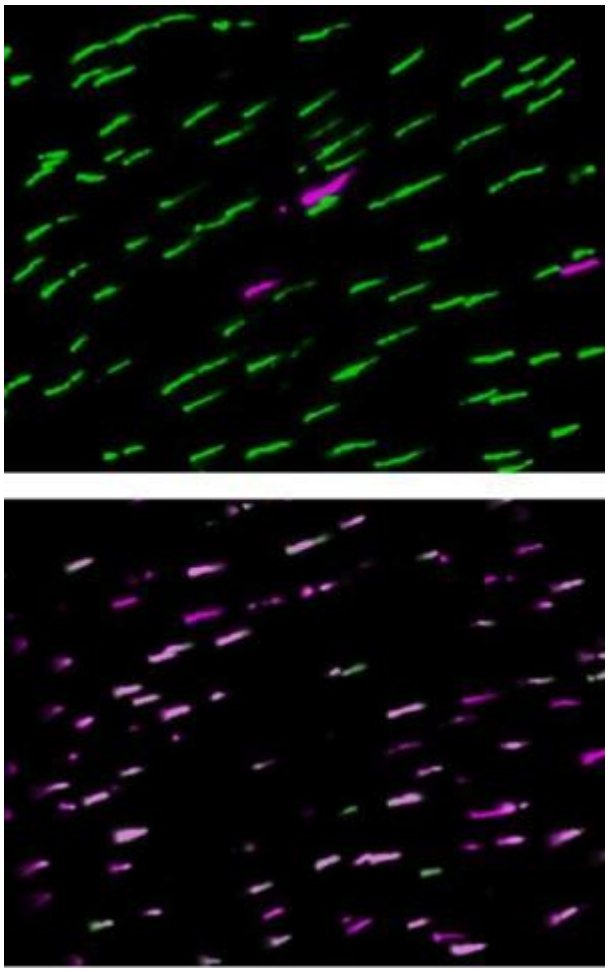
For more information visit http://nsidc.org/arcticseaicenews.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Colorado at Boulder**.

http://www.sciencedaily.com/releases/2011/03/110324104143.htm

Thyroid Hormone Controls the Eye‘s Visual Pigments Throughout Life



Fluorescence micrographs of the cone cells in the retina of an adult healthy rat (top) and of an adult rat with thyroid hormone deficiency (bottom). The cones were labeled with antibodies against their opsins; green opsin is shown in green and UV/blue opsin in magenta. The healthy rat has many green cones and few UV/blue cones. The rat with thyroid hormone deficiency expresses UV/blue opsin in all cones and reduces expression of green opsin. Appearing in lighter magenta in the bottom image are cones that contain some green opsin in addition to the dominant UV/blue opsin. (Credit: Copyright Martin Glösmann)

ScienceDaily (Mar. 30, 2011) — What part does the thyroid gland have in vision? Thyroid hormone is crucially involved in controlling which visual pigment is produced in the cones. Previously, it was assumed that the colour sensitivity of the cones is fixed in the adult retina. Researchers at the Max Planck Institute for Brain Research in Frankfurt/M., together with colleagues at the University of Frankfurt and universities in Vienna, have now been able to show that in mature cones of mice and rats the production of visual pigment is regulated by thyroid hormone. It is assumed that this mechanism exists in all mammals, including humans. If so, the adult-onset of thyroid hormone deficiency would affect colour vision.

Thyroid hormone has a crucial role during development of the body and also of the nervous system. Children born with a thyroid hormone deficiency have serious defects of physiological and mental development, hence newborns are routinely checked for thyroid hormone deficiency, and hormone substitution therapy is given when indicated.

Studies in mice have shown that thyroid hormone also plays an important role in the development of the eye and particularly the cone visual cells. In the retina of the eye, the cones are the visual cells responsible for colour vision. Most mammals have two spectral cone types containing either of two visual pigments (opsins),

one sensitive to shortwave light (UV/blue opsin), the other to middle-to-longwave light (green opsin). Cones express a thyroid hormone receptor. Its activation by the hormone suppresses the synthesis of UV/blue opsin and activates the production of green opsin.
Until now, the control of opsin production by thyroid hormone was considered a developmental phenomenon. Experts assumed that in mature cones the developmentally established 'opsin program' is fixed and needs no further regulation. This perception is now challenged by a study carried out by lead authors Martin Glösmann and Anika Glaschke in Leo Peichl's team at the Max Planck Institute for Brain Research, Frankfurt, and their colleagues at the universities of Frankfurt and Vienna. The study shows that opsin production in mature cones continues to depend on the thyroid hormone level.
The researchers had started with an analysis of thyroid hormone involvement in the early postnatal development of mouse cones. "Then we wanted to know how long the time window for the hormone effect was, at what point the hormone's influence on opsin production stopped," says Anika Glaschke. "To our surprise we did not find such an endpoint, even several weeks after birth there was a hormone effect." So the team analysed the cones in adult mice and rats that had been rendered hypothyroid for several weeks. In these mice all cones switched to the production of UV/blue opsin and reduced green opsin production. After termination of the treatment, hormone levels returned to normal and the cones reverted to the production of their 'regular' opsin -- one cone type to green opsin, the other to UV/blue opsin. The researchers conclude that the spectral cone types, which are defined by the opsin they express, are dynamically and reversibly controlled by thyroid hormone throughout life.
"In addition to their importance for basic retinal research, our findings may also have clinical relevance," says Martin Glösmann, who currently examines the genetic foundations of the process at the University of Veterinary Medicine, Vienna. "If this mechanism also acts in human cones, the adult-onset of thyroid hormone deficiency -- e.g. as a consequence of dietary iodine deficiency or removal of the thyroid -- would also affect the cone opsins and colour vision." There are no such reports in the clinical literature, presumably because the general symptoms of thyroid hormone deficiency are so severe that therapy is initiated before the cone opsin shifts would show up.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Max-Planck-Gesellschaft**.

Journal Reference:

1. Anika Glaschke, Jessica Weiland, Domenico Del Turco, Marianne Steiner, Leo Peichl, Martin Glösmann. **Thyroid hormone controls cone opsin expression in the retina of adult rodents.**. *Journal of Neuroscience*, 31(13): 4844-4851 (March 30, 2011) DOI: 10.1523/JNEUROSCI.6181-10.2011

http://www.sciencedaily.com/releases/2011/03/110329172251.htm

Study Illuminates the 'Pain' of Social Rejection

New research shows that physical pain and intense feelings of social rejection "hurt" in the same way. (Credit: iStockphoto/Photo_Concepts)

ScienceDaily (Mar. 30, 2011) — Physical pain and intense feelings of social rejection "hurt" in the same way, a new study shows.

The study demonstrates that the same regions of the brain that become active in response to painful sensory experiences are activated during intense experiences of social rejection.

"These results give new meaning to the idea that social rejection 'hurts'," said University of Michigan social psychologist Ethan Kross, lead author of the article published in the *Proceedings of the National Academy of Sciences*. "On the surface, spilling a hot cup of coffee on yourself and thinking about how rejected you feel when you look at the picture of a person that you recently experienced an unwanted break-up with may seem to elicit very different types of pain.

"But this research shows that they may be even more similar than initially thought."

Kross, an assistant professor at the U-M Department of Psychology and faculty associate at the U-M Institute for Social Research (ISR), conducted the study with U-M colleague Marc Berman, Columbia University's Walter Mischel and Edward Smith, also affiliated with the New York State Psychiatric Institute, and with Tor Wager of the University of Colorado, Boulder.

While earlier research has shown that the same brain regions support the emotionally distressing feelings that accompany the experience of both physical pain and social rejection, the current study is the first known to establish that there is neural overlap between both of these experiences in brain regions that become active when people experience painful sensations in their body.

These regions are the secondary somatosensory cortex and the dorsal posterior insula.

For the study, the researchers recruited 40 people who experienced an unwanted romantic break-up within the past six months, and who indicated that thinking about their break-up experience led them to feel intensely rejected. Each participant completed two tasks in the study -- one related to their feelings of rejection and the other to sensations of physical pain.

During the rejection task, participants viewed either a photo of their ex-partner and thought about how they felt during their break-up experience or they viewed a photo of a friend and thought about a recent positive experience they had with that person. During the physical pain task, a thermal stimulation device was attached to participants left forearm. On some trials the probe delivered a painful but tolerable stimulation akin to holding a very hot cup of coffee. On other trials it delivered non-painful, warm stimulation.

Participants performed all tasks while undergoing functional magnetic resonance imaging (fMRI) scans. The researchers conducted a series of analyses of the fMRI scans, focusing on the whole brain and on various regions of interest identified in earlier studies of physical pain. They also compared the study's results to a database of more than 500 previous fMRI studies of brain responses to physical pain, emotion, working memory, attention switching, long-term memory and interference resolution.

"We found that powerfully inducing feelings of social rejection activate regions of the brain that are involved in physical pain sensation, which are rarely activated in neuroimaging studies of emotion," Kross said. "These findings are consistent with the idea that the experience of social rejection, or social loss more generally, may represent a distinct emotional experience that is uniquely associated with physical pain."

The team that performed the research hopes that the findings will offer new insight into how the experience of intense social loss may lead to various physical pain symptoms and disorders. And they point out that the findings affirm the wisdom of cultures around the world that use the same language -- words like "hurt" and "pain" -- to describe the experience of both physical pain and social rejection.

The study was funded by the National Institute of Mental Health and by the National Institute on Drug Abuse and performed at Columbia University.

Story Source:

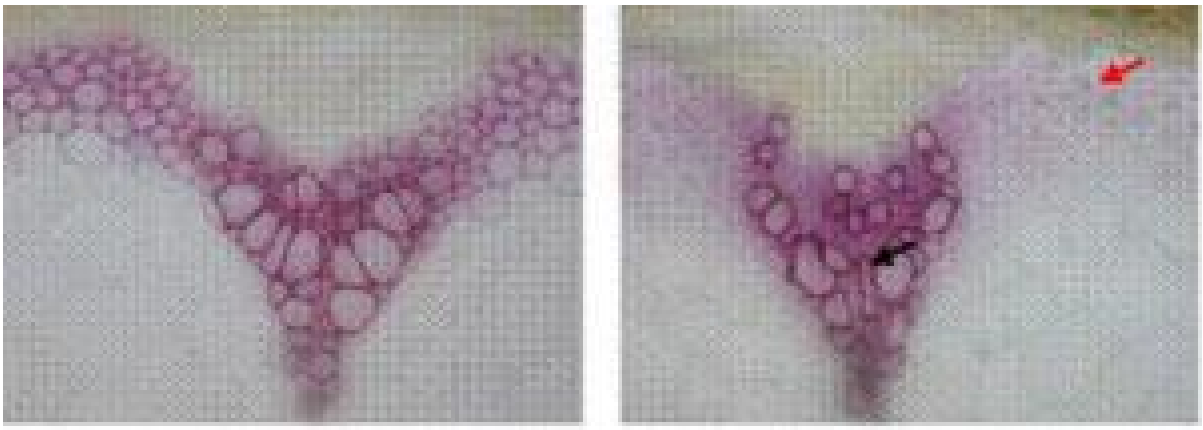
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Michigan**.

Journal Reference:

1. Ethan Kross, Marc G. Berman, Walter Mischel, Edward E. Smith, Tor D. Wager. **Social rejection shares somatosensory representations with physical pain**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1102693108

http://www.sciencedaily.com/releases/2011/03/110328151726.htm

Insight Into Lignin Biosynthesis



The amount of lignin (stained pink) in the stems of mutants that lack both LACCASE4 and 17 (right) is much lower than in normal plants (left). Fiber hypolignified (no staining) while vascular cells (arrow) have an irregular shape or are collapsed. (Credit: Image courtesy of American Society of Plant Biologists)

ScienceDaily (Mar. 30, 2011) — A new study furthers our understanding of lignin formation in the model plant *Arabidopsis*. Two laccase genes are shown to play a major role in lignin deposition.

Lignin is the durable biopolymer that gives carrots their fiber and crunch and meat grilled over a campfire its characteristic smoky flavor. Acting as the glue that holds the plant cell wall together, lignin imparts tremendous mechanical strength to the plant. Present in all land plants except mosses, lignin performs three important functions: it allows plants to grow upright as they compete for sunlight, it facilitates the upward movement of water and minerals through the plant's vascular tissue, and it protects plants from pathogens and foraging animals.

Lignin also sequesters atmospheric carbon in its tissues and thereby plays an important role in the carbon cycle. Approximately 30% of non-fossil organic carbon is stored in lignin, and, after cellulose, lignin is the most abundant biological polymer on Earth.

Lignin consists of three phenylpropanoid subunits, G (guaiacyl), S (syringyl), and H (p-hydroxyphenyl). The precursors of these subunits are generated inside the cell and transported to the cell wall, where they are oxidized by enzymes and then join together to form lignin's highly complex and heterogeneous three-dimensional structure. Biologists have long since wondered how this process of lignification is regulated. Two families of enzymes, the peroxidases and laccases, occur in plant cell walls and have been proposed to catalyze the oxidation of lignin precursors. Whereas the involvement of peroxidases in lignification has been confirmed, that of laccases had not.

Now, a team of researchers at the Institut Jean Pierre Bourgin INRA, France, provide compelling evidence that laccases do indeed contribute to lignification in the model plant Arabidopsis (a member of the mustard and cabbage family). Seventeen laccase genes are present in Arabidopsis. Since genes involved in lignification would most likely be expressed in the stem, the researchers examined the expression of all 17 laccase genes. Two of these genes, *LACCASE4* and *LACCASE17*, were found to be strongly expressed in stems and were selected for further analysis.

The researchers then identified mutant Arabidopsis plants in which *LACCASE4* and *17* were silenced. They crossed these mutants to generate double mutants that lacked both LACCASE4 and 17 enzymes. Whereas both the single and double mutants grew normally in the greenhouse, the lignin content was slightly reduced in the single mutants and reduced by up to 40% in the double mutants. Interestingly, the reduction of lignin in the double mutant appeared to have a positive effect on saccharification, the process whereby sugars are liberated from plant biomass. Given that resistant cell walls represent a major obstacle in the production of biofuels, this finding may have useful applications in the biofuel industry.

The scientists went on to demonstrate that disruption of *LACCASE17* specifically reduced the incorporation of G subunits into the lignin of fiber cells and that introducing an intact version of the *LACCASE17* gene into lines that contained a mutated version of this gene corrected this mistake. Thus, LACCASE17 appears to

contribute to the fiber-specific deposition of G subunits into lignin. Disruption of *LACCASE4* did not affect the ratio of phenylpropanoid subunits in the stem, suggesting that this gene catalyzes the deposition of all lignin subunits equally.
This work provides strong evidence that laccases play a central role in lignification. According to Catherine Lapierre, "The genetic engineering of lignin-specific laccases is a potentially innovative and promising tool for increasing the saccharification of plant cell walls when used for the production of biofuels."
This research was supported by the INRA BV and CEPIA Departments (PhD grant to Serge Berthet) and was partly funded by the French Genoplante MAIZEWALL and the UE RENEWALL programs.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Society of Plant Biologists**.

Journal Reference:

1. S. Berthet, N. Demont-Caulet, B. Pollet, P. Bidzinski, L. Cezard, P. Le Bris, N. Borrega, J. Herve, E. Blondet, S. Balzergue, C. Lapierre, L. Jouanin. **Disruption of LACCASE4 and 17 Results in Tissue-Specific Alterations to Lignification of Arabidopsis thaliana Stems**. *The Plant Cell Online*, 2011; DOI: 10.1105/tpc.110.082792

http://www.sciencedaily.com/releases/2011/03/110331094630.htm

Rare Discovery of Plant Genus

Yasunia. The Missouri Botanical Garden (MBG) has played a significant role in identifying a new genus, Yasunia, with two confirmed species from Ecuador and Peru, Y. quadrata and Y. sessiliflora. (Credit: Image courtesy of Missouri Botanical Garden)

ScienceDaily (Mar. 30, 2011) — The Missouri Botanical Garden (MBG) has played a significant role in identifying a new genus, Yasunia, with two confirmed species from Ecuador and Peru, *Y. quadrata* and *Y. sessiliflora*.

New species are often found among the samples that are gifted to the Missouri Botanical Garden for identification. While hundreds of new plant species are identified each year, new genera are extremely uncommon, and being coupled with the two new species makes Yasunia very distinctive.

Henk van der Werff is the Head of Monographic Studies Department at the Missouri Botanical Garden. He explains, "There are many new species found mostly in the tropics each year. Typically, new species differ in minor characteristics from their close relatives. New genera differ in major characteristics from their relatives and such a find is truly a matter of luck and perseverance."

In 1993, MBG staff member David Neill collected the first sample in the Amazon lowlands of Ecuador, yet it remained an undetermined specimen due to the lack of detail, particularly of the flower which is needed for identification. Local staff conducting floristic inventory in the Yasuni National Park collected additional specimens from a tagged tree, ensuring that the information necessary for identification would become available. From these samples, it was determined that the characteristics present in the new specimens did not fit into any of the recognized Neotropical genera of Lauraceae.

In 2003 the collection of the second species was located in the upper Rio Utiquinia in Ucayali (Peru) near the border of Brazil. In minor details, it is very different from the Ecuadorian species.

DNA of the two Yasunia species and their related analysis may ultimately result in changes of the classification of the plant family.

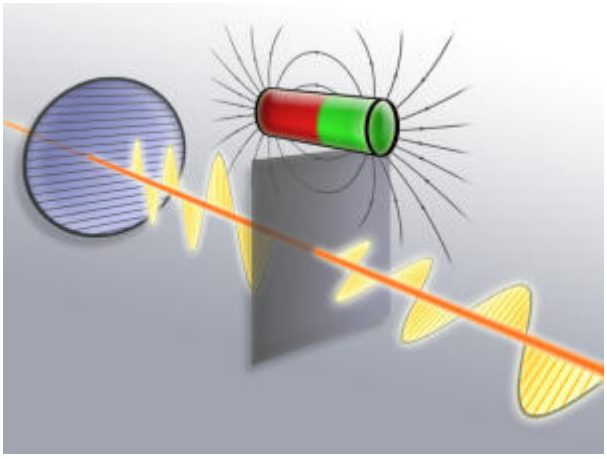
"This is an extremely rare and exciting scenario. The two new species that were collected did not belong in a known genus, so what we suddenly had were both two new species and new genus. Usually, when a new genus is discovered, it is associated with only one species. It is very unusual to find two new species belonging to the same new genus. Yasunia with two new species is one of those very rare cases," said Van der Werff.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Missouri Botanical Garden**.

http://www.sciencedaily.com/releases/2011/03/110330192548.htm

Physicists Rotate Beams of Light



The magnetic field in the thin layer rotates the light waves. (Credit: Image courtesy of Vienna University of Technology)

ScienceDaily (Mar. 30, 2011) — Controlling the rotation of light – this amazing feat was accomplished by means of a ultra thin semiconductor. This can be used to create a transistor that works with light instead of electrical current.

Light waves can oscillate in different directions -- much like a string that can vibrate up and down or left and right -- depending on the direction in which it is picked. This is called the polarization of light. Physicists at the Vienna University of Technology have now, together with researchers at Würzburg University, developed a method to control and manipulate the polarization of light using ultra thin layers of semiconductor material. For future research on light and its polarization this is an important step forward -- and this breakthrough could even open up possibilities for completely new computer technology. The experiment can be viewed as the optical version of an electronic transistor. The results of the experiment have now been published in the journal *Physical Review Letters.*

Controlling light with magnetic fields

The polarization of light can change, when it passes through a material in a strong magnetic field. This phenomenon is known as the "Faraday effect." "So far, however, this effect had only been observed in materials in which it was very weak," professor Andrei Pimenov explains. He carried out the experiments at the Institute for Solid State Physics of the TU Vienna, together with his assistant Alexey Shuvaev. Using light of the right wavelength and extremely clean semiconductors, scientists in Vienna and Würzburg could achieve a Faraday effect which is orders of magnitude stronger than ever measured before.

Now light waves can be rotated into arbitrary directions -- the direction of the polarization can be tuned with an external magnetic field. Surprisingly, an ultra-thin layer of less than a thousandth of a millimeter is enough to achieve this. "Such thin layers made of other materials could only change the direction of polarization by a fraction of one degree," says professor Pimenov. If the beam of light is then sent through a polarization filter, which only allows light of a particular direction of polarization to pass, the scientists can, rotating the direction appropriately, decide whether the beam should pass or not.

The key to this astonishing effect lies in the behavior of the electrons in the semiconductor. The beam of light oscillates the electrons, and the magnetic field deflects their vibrating motion. This complicated motion of the electrons in turn affects the beam of light and changes its direction of polarization.

An optical transistor

In the experiment, a layer of the semiconductor mercury telluride was irradiated with light in the infrared spectral range. "The light has a frequency in the terahertz domain -- those are the frequencies, future generations of computers may operate with," professor Pimenov believes. "For years, the clock rates of computers have not really increased, because a domain has been reached, in which material properties just don't play along anymore." A possible solution is to complement electronic circuits with optical elements. In a transistor, the basic element of electronics, an electric current is controlled by an external signal. In the

experiment at TU Vienna, a beam of light is controlled by an external magnetic field. The two systems are very much alike. "We could call our system a light-transistor," Pimenov suggests.
Before optical circuits for computers can be considered, the newly discovered effect will prove useful as a tool for further research. In optics labs, it will play an important role in research on new materials and the physics of light.
Email or share this story:
| More

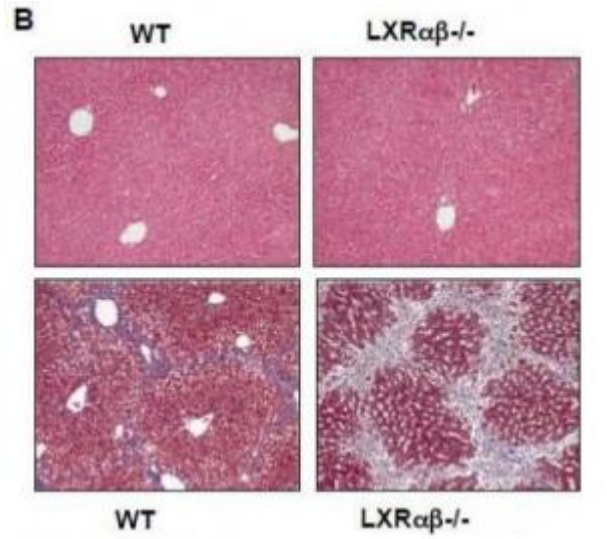
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Vienna University of Technology**.

Journal Reference:

1. A. Shuvaev, G. Astakhov, A. Pimenov, C. Brüne, H. Buhmann, L. Molenkamp. **Giant Magneto-Optical Faraday Effect in HgTe Thin Films in the Terahertz Spectral Range**. *Physical Review Letters*, 2011; 106 (10) DOI: 10.1103/PhysRevLett.106.107404

http://www.sciencedaily.com/releases/2011/03/110330094149.htm

Cholesterol Regulator Plays Key Role in Development of Liver Scarring, Cirrhosis



Treated with a control substance, livers from normal and LXR-deficient mice appear identical and undamaged (top left and right). The bottom images show the greater degree of fibrosis (blue bands) in the livers of mice lacking LXRs (right) compared to normal mice (left) after liver injury. (Credit: UCLA)

ScienceDaily (Mar. 30, 2011) — UCLA researchers have demonstrated that a key regulator of cholesterol and fat metabolism in the liver also plays an important role in the development of liver fibrosis -- the build-up of collagen scar tissue that can develop into cirrhosis. Cirrhosis, in turn, is a major cause of premature death and is incurable without a liver transplant.

Published in the March issue of the journal *Gastroenterology*, the study shows that liver X receptors (LXRs), master regulators of cholesterol, fat and inflammatory gene expression, also control the fibrosis-making cells of the liver, known as hepatic stellate cells.

In the face of chronic liver injury -- due to excess fat, chronic viral hepatitis or alcohol abuse, for example -- stellate cells become activated and launch an inflammatory and fibrotic cascade that eventually results in the build-up of collagen scar tissue in the liver.

LXRs, when stimulated, "turn on" several hundred genes that hold instructions to create proteins for carrying out bodily processes in cells, from transporting and excreting cholesterol to synthesizing fat in the liver. They have also been shown to suppress inflammatory processes in several contexts.

"Our work sets the stage for looking at new ways to modulate cholesterol and/or fat metabolism in order to have therapeutic potential for the treatment of fibrosing liver diseases," said lead author Dr. Simon Beaven, an assistant professor of digestive diseases at the David Geffen School of Medicine at UCLA.

The research was done in the laboratory of senior author Dr. Peter Tontonoz, a professor of pathology and laboratory medicine at the Geffen School of Medicine and a Howard Hughes Medical Institute investigator.

Beaven noted that the recent rise in obesity has resulted in a surge in the prevalence of a condition known as fatty liver, which can be a precursor to fibrosis and chronic liver disease. Simple fatty liver, also known as non-alcoholic fatty liver disease, or NAFLD, is one of the most common reasons patients consult a liver doctor in the United States. Cirrhosis due to fatty liver is skyrocketing and within a decade may become the most common indication for liver transplantation.

Beaven said the need to find better treatments for liver disease is crucial.

"A 'holy grail' for liver researchers is to develop anti-fibrotic treatments that target activated stellate cells in order to slow or prevent the development of cirrhosis," Beaven said. "Our study offers the first detailed look at how LXRs specifically impact the activation of hepatic stellate cells and the subsequent development of liver fibrosis in animal models."

UCLA researchers have found that LXRs normally play a role in helping to reduce the collagen-producing actions of stellate cells when the cells are "activated" by liver damage. For the study, UCLA scientists first

tested how activated stellate cells taken from mice would react when a chemical that induces LXR activity was added to the cell culture.
In stellate cells from normal mice, LXRs suppressed the inflammatory and fibrosis-promoting program. But in those taken from mice genetically lacking LXRs, that same program of genes significantly increased because the inhibitory effect of LXRs was no longer present.
"We showed that LXRs dampen stellate cell activation by repressing inflammatory and collagen-producing genes," Beaven said.
To further gauge the strength of the response, scientists took the medium from the cultures of LXR-deficient cells and added it to stellate cells from normal mice. These cells then showed a markedly exaggerated inflammatory and collagen-producing response, suggesting that LXR-deficient stellate cells are secreting signals to promote fibrosis.
The researchers noted that these experiments demonstrate that LXRs control a fibrotic response in stellate cells that can have a wide influence on neighboring cells.
The scientists also found that after replicating chronic liver injury, mice without LXRs had dramatically more liver fibrosis than normal mice.
"The genetic loss of LXRs rendered the mice susceptible to developing fibrotic liver disease," Beaven said.
But LXRs are also known to have important functions in the immune system. The researchers then wanted to know whether the effects they were seeing in animals were due to changes in stellate cell activity specifically or whether immune cells -- derived from bone marrow -- accounted for most of the effect. After extensive testing, the researchers found no differences
in the level of liver fibrosis among normal mice and animals lacking LXRs, suggesting that the contribution from the immune system was negligible.
"This finding, along with the cell culture studies, suggests that LXRs' influence on fibrosis most likely resides in altering stellate cell function in the liver," Beaven said. "This is a critical finding and opens an entire new field of study for stellate cell biologists."
Additional studies will further identify which genes in stellate cells are activated by LXRs and help researchers better understand the role of cholesterol metabolism in the fibrotic response.
This study was funded primarily by grants from the National Institutes of Health and the Howard Hughes Medical Institute. Collaborators from the University of Southern California were funded by core grants from the NIH and the Southern California Research Center for ALPD and Cirrhosis.
Other study authors included senior investigator Dr. Peter Tontonoz of the Howard Hughes Medical Institute; Kevin Wroblewski and Cynthia Hong from Tontonoz's lab; Jiaohong Wang and Hide Tsukamoto of the Southern California Research Center for ALPD and Cirrhosis, USC's Keck School of Medicine and the Department of Veterans Affairs Greater Los Angeles Healthcare System; and Steven Bensinger of the department of pathology at the David Geffen School of Medicine at UCLA.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Los Angeles**.

Journal Reference:

1. Simon W. Beaven, Kevin Wroblewski, Jiaohong Wang, Cynthia Hong, Steven Bensinger, Hide Tsukamoto, Peter Tontonoz. **Liver X Receptor Signaling Is a Determinant of Stellate Cell Activation and Susceptibility to Fibrotic Liver Disease**. *Gastroenterology*, 2011; 140 (3): 1052 DOI: 10.1053/j.gastro.2010.11.053

http://www.sciencedaily.com/releases/2011/03/110330192546.htm

Declining Rainfall Is a Major Influence for Migrating Birds

This is a male American redstart. (Credit: Dan Pancamo)

ScienceDaily (Mar. 30, 2011) — Instinct and the annual increase of daylight hours have long been thought to be the triggers for birds to begin their spring migration. Scientists at the Smithsonian Conservation Biology Institute, however, have found that that may not be the case. Researchers have focused on how warming trends in temperate breeding areas disrupt the sensitive ecology of migratory birds. This new research shows that changes in rainfall on the tropical wintering grounds could be equally disruptive.

The team's findings are published in scientific journal *Proceedings of the Royal Society B on* March 30.

Many of the bird species that breed in the temperate forests, marshes and backyards of North America spend the winter months in the tropics of the Caribbean, and Central and South America. Insects are the primary food for many birds during the winter, and rainfall largely determines the amount of insects available. Climactic warming, however, is causing declining and more variable rainfall cycles in many areas, affecting the availability of insects and delaying when birds leave for their northern breeding grounds. To examine this, the Smithsonian scientists focused on American redstarts (*Setophaga ruticilla*), a member of the warbler family, at a non-breeding site in Jamaica where they conduct long-term studies.

"American redstarts were a perfect species for this study since they defend exclusive territories throughout the non-breeding period until they depart for spring migration and most return back to the same territory the following year," said Pete Marra, research ecologist at the Smithsonian Conservation Biology Institute's Migratory Bird Center. "These behaviors made it relatively easy to keep track of individual birds over multiple years and document changing spring departures. Each individual was fitted with a unique combination of colored leg bands."

Precipitation in Jamaica is highly seasonal, with consistent rainfall from September to November and a pronounced dry season from January to March. The scientists observed the redstarts in their non-breeding territories for five years during the dry season. They paid special attention to the annual variation in dry season rainfall. The correlation between the amount of insects in a bird's territory and the timing of its departure suggested to the team that annual variation in food availability was an important determining factor in the timing of spring migration. Had the redstarts relied on internal cues alone to schedule their spring departure, they would have all left their winter territories at the same time each year.

"Our results support the idea that environmental conditions on tropical non-breeding areas can influence the departure time for spring migration," said Colin Studds, a postdoctoral fellow at the Smithsonian Conservation Biology Institute's Migratory Bird Center and lead author of the study. "We found that the same birds changed their spring departure from one year to the next in relation to the amount of rainfall and food in March."

During the past 16 years, the dry season in Jamaica has become both increasingly severe and unpredictable, leading to an 11 percent drop in total rainfall during the three-month annual drought. Making the future even more dire, climate models predict not only increased warming on temperate breeding areas but also continued drying in the Caribbean.

A critical question for the scientists is whether this variation in the onset of spring migration carries consequences for the birds. Delaying departure could be beneficial if food resources are low and the

individual has not yet stored enough energy to migrate. However, delaying departure could affect arrival time to its breeding territory and result in less time to successfully reproduce. "Because American redstarts return to the same site to breed each year, arriving later may make it harder for them remain to remain in synch with their breeding cycle," Studds said.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Smithsonian**.

Journal Reference:

1. C. E. Studds, P. P. Marra. **Rainfall-induced changes in food availability modify the spring departure programme of a migratory bird**. *Proceedings of the Royal Society B: Biological Sciences*, 2011; DOI: 10.1098/rspb.2011.0332

http://www.sciencedaily.com/releases/2011/03/110330192544.htm

Diet-Exercise Combo Best for Obese Seniors

Senior exercisers speak with Dennis T. Villareal, MD, while participating in a study to find effective ways to boost physical function and reduce frailty in the elderly. Both were obese when the study began but lost weight through a combination of diet and exercise. (Credit: Joe Angeles)

ScienceDaily (Mar. 30, 2011) — For obese seniors, dieting and exercise together are more effective at improving physical performance and reducing frailty than either alone.

The research, by a team at Washington University School of Medicine in St. Louis, is reported March 31 in *The New England Journal of Medicine*.

Older adults who are obese face severe health risks, including high blood pressure, heart disease and diabetes, which can be compounded by a lack of mobility.

"We wanted to tease apart the effects of dieting and exercise in older people who are obese," says principal investigator Dennis T. Villareal, MD, adjunct associate professor of medicine at Washington University School of Medicine in St. Louis. "In older adults, obesity exacerbates declines in physical performance and leads to frailty, impaired quality of life and increases in nursing home admissions. Given the increasing prevalence of obesity even among older people, it is important to find ways to combat the problem and help seniors remain healthier and more independent."

In this study, Villareal and his colleagues evaluated the effects of dieting and exercise in more than 100 obese seniors over a one-year period. Although weight loss alone and exercise alone improved physical function by about 12 percent and 15 percent, respectively, neither was as effective as diet and exercise together, which improved physical performance by 21 percent.

The investigators used the Physical Performance Test, a test that evaluates an individual's ability to perform tasks, such as walking 50 feet, putting on and removing a coat, standing up from a chair, picking up a penny, climbing a flight of stairs and lifting a book.

In addition, the researchers evaluated peak oxygen consumption during exertion with treadmill walking. On that test, obese elderly people who both dieted and exercised improved 17 percent from their baseline. The diet-only group showed a 10 percent gain, and the exercise-only group improved about 8 percent.

All subjects in the study were over 65, with some as old as 85 when the study began. Their average age was about 70. Volunteers were randomly assigned to one of four groups. One set of seniors was placed on a low-calorie diet to help them lose weight. Members of a second group attended exercise sessions three times a week, doing balance work, resistance training and aerobic exercise. A third group combined both the low-calorie diet and the exercise. The last group made no changes in diet or exercise habits.

All subjects had medically significant obesity, defined as having a body mass index (BMI) of 30 or more. BMI measures the relationship between a person's height and weight.

At the study's outset, participants had evidence of frailty and impaired physical function based on their Physical Performance Test and on measures of their peak aerobic capacity using an exercise stress test and a questionnaire about their physical function.

Villareal and his team also surveyed study subjects about their quality of life, and again, those in the combined diet-exercise group had the biggest improvements. Their scores improved by 15 percent, compared to 14 percent in the diet-only group and 10 percent in the exercise-only group. By every measure, strength, balance and gait all showed the most consistent improvement in the diet-exercise group.

"In older, obese people, it may be more important to improve physical function and quality of life, rather than to reverse or treat risk factors for cardiovascular disease," says Villareal, now chief of geriatrics at the New Mexico Veterans Affairs Health Care System and professor of medicine at the University of New Mexico School of Medicine, both in Albuquerque. "Combining exercise and weight loss isn't designed so much to extend their life expectancy as it is to improve their quality of life during their remaining years and to help seniors avoid being admitted to a nursing home."

There is some debate, however, about whether it's good for elderly people to lose weight, even if they are obese. Some studies have found an association between weight loss in seniors and mortality risk, but Villareal says many of those studies did not distinguish between voluntary weight loss and involuntary weight loss that may be related to illness.

But even if voluntary weight loss carries no significant risk of shortening life, another potential drawback is that when older people lose fat, they also tend to lose muscle and bone.

In this study, the researchers did find slight reductions in lean body mass and bone mineral density among those who lost weight, but the decreases were smaller in the combined diet-exercise group than in those who dieted or exercised alone. The diet-exercise group participants lost 3 percent of their lean body mass, with a 1 percent bone mineral loss in the key area of the hip. Those who only dieted lost 5 percent of their lean body mass and 3 percent in bone mineral density at the hip.

Just as in younger people, the prevalence of obesity has increased in the elderly. About 20 percent of people 65 and older are obese, and that is expected to continue rising as more baby boomers become senior citizens. Elevated weight is known to be associated with impairments in daily living, limitations in mobility and an increased risk for physical decline and frailty.

"Although losing weight is beneficial and exercise also is good, when seniors do both, they get a greater improvement," he says.

Story Source:

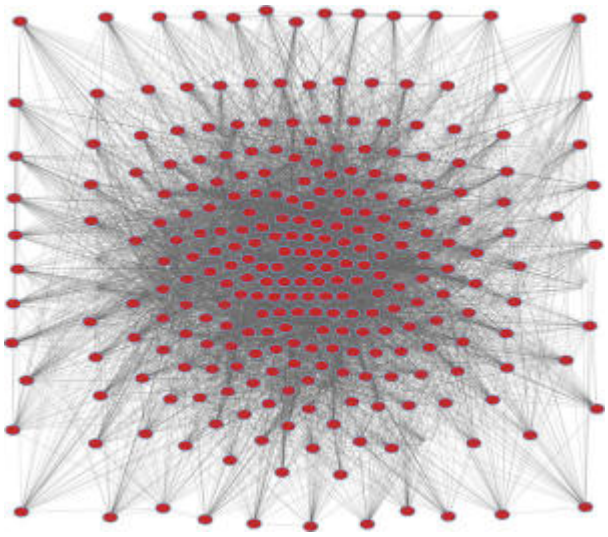
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**.

Journal Reference:

1. Dennis T. Villareal, Suresh Chode, Nehu Parimi, David R. Sinacore, Tiffany Hilton, Reina Armamento-Villareal, Nicola Napoli, Clifford Qualls, Krupa Shah. **Weight Loss, Exercise, or Both and Physical Function in Obese Older Adults**. *New England Journal of Medicine*, 2011; 364 (13): 1218 DOI: 10.1056/NEJMoa1008234

http://www.sciencedaily.com/releases/2011/03/110330192212.htm

Deciphering Hidden Code Reveals Brain Activity



University of Pennsylvania scientists have shown that the mathematics used to find an efficient route through a complicated, connected network can be used to decode how the brain represents information. (Credit: Image courtesy of University of Pennsylvania School of Medicine)

ScienceDaily (Mar. 29, 2011) — By combining sophisticated mathematical techniques more commonly used by spies instead of scientists with the power and versatility of functional magnetic resonance imaging (fMRI), a Penn neurologist has developed a new approach for studying the inner workings of the brain. A hidden pattern is encoded in the seemingly random order of things presented to a human subject, which the brain reveals when observed with fMRI. The research is published in the journal *NeuroImage*.

Geoffrey K. Aguirre, MD, Assistant Professor of Neurology at the University of Pennsylvania School of Medicine, says "the same math that could break into your car can be used to crack the brain's codes." It's called a de Bruijn sequence, which is a set or "alphabet" of things (letters, pictures, sounds) in a cyclic order such that every possible "word" or combination of things occurs only once. De Bruijn sequences are what mathematicians call "pseudo-random" because they appear to be a confused jumble but actually contain an underlying structure. To break into a car protected by an electronic lock with a five-digit numerical keycode, for example, a thief could try every possible combination. However, such a brute-force technique is time-consuming because it involves a great deal of repetition. But a de Bruijn sequence uses "every possible combination squeezed together," explains Aguirre. The overlapping combinations encode a pattern scientists can observe in brain activity using fMRI, revealing how nerve cells work to represent the world.

Breaking Codes in Brain Studies

This approach measures how the order of things changes brain responses. Do you see a photo of your brother differently when it follows a picture of your sister? Aguirre says, "Many neuroscience experiments use the context and order of sights, sounds, words, and feelings to reveal how the nervous system is organized" Previous experiments have presented information to study participants in more or less completely random order. This can be inefficient and inaccurate, making it difficult to discern important patterns and correlations between stimuli and neural responses. "We use the de Bruijn sequence to design the experiment," Aguirre says. "It tells us how to present things to the subject. By presenting a series of faces in different combinations and orders, as dictated by the de Bruijn sequence, it's possible to measure the brain response to each face individually."

Beating the Blood Flow Problem

Aguirre's new algorithm for creating de Bruijn sequences also helps correct an important limitation of fMRI, which works by measuring changes in brain blood flow. "It takes a little while for the blood flow changes to catch up with the brain response," Aguirre says. "By creating these sequences in a special way that accounts for the slower blood flow response, experiments are many times more powerful than before."

"The amazing thing is the person in the experiment just sees random pictures," Aguirre notes. "But in fact, we're hiding in this seemingly random sequence a signal that's invisible to the person but can be decoded by the MRI scanner. We can measure the nerve cells' response to that hidden pattern and then use that to understand how the brain is representing information."
Aguirre's unique marriage of advanced mathematics with the latest neuroimaging techniques promises to both open up new areas of research and improve current experimental designs in the study of the brain. The next step is to apply the new algorithm to actual fMRI studies in one of Aguirre's special research areas, visual perception and representation in the brain.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Pennsylvania School of Medicine**.

Journal Reference:

1. Aguirre, G.K., et al. **de Bruijn cycles for neural decoding**. *NeuroImage*, 2011; DOI: 10.1016/j.neuro- image.2011.02.005

http://www.sciencedaily.com/releases/2011/03/110328131302.htm

Killer Whales in Antarctic Waters Prefer Weddell Seals Over Other Prey

A killer whale "spy-hops" to identify a Weddell seal resting on an ice floe off the western Antarctic Peninsula. The whale will notify other killer whales in the area so they can coordinate a wave to wash the seal off the floe. (Credit: Robert Pitman/NOAA)

ScienceDaily (Mar. 30, 2011) — NOAA's Fisheries Service scientists studying the cooperative hunting behavior of killer whales in Antarctic waters observed the animals favoring one type of seal over all other available food sources, according to a study published in the journal *Marine Mammal Science*.

Researchers Robert Pitman and John Durban from NOAA's Southwest Fisheries Science Center in La Jolla, Calif., observed killer whales hunting in ice floes, off the western Antarctic Peninsula during January of 2009. While documenting the whales' behavior of deliberately creating waves to wash seals off ice floes, the researchers noticed Weddell seals as their primary target, despite the availability of other prey species, particularly the more abundant crabeater seals.

"These killer whales would identify and then attack Weddell seals almost exclusively, even though they made up only about 15 percent of the available seal population," said Pitman.

Killer whales creating waves to wash seals off ice floes in Antarctica had previously been observed only a handful of times. The whales, sometimes as many as seven abreast, charge the ice floe creating a wave that either washes the seal off the ice or breaks the ice into smaller pieces and more vulnerable to another attack. A previous study involving the authors suggested that this very distinctive killer whale population, which they refer to as "pack ice killer whales," is a separate species.

Once the seal was washed off the ice, the killer whales worked as a group to keep it away from hauling onto the safety of another ice floe. The whales seemed to try and confuse the seal by causing turbulence in the water with their flukes and blowing bubbles under the water through their blowholes.

Away from the ice, the whales attempt to tire and eventually drown the animal by pulling it under water by its hind flippers. Eventually the seal succumbs to exhaustion and is usually divided up among the pod members underwater. In most cases, little of the seal's remains float to the surface, but in one instance the carcass rose to the surface and appeared to have been methodically skinned and dismembered before being eaten.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NOAA National Marine Fisheries Service**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/03/110330150852.htm

Hidden Elm Population May Hold Genes to Combat Dutch Elm Disease

Scientists have found American elm trees that may be the source of genes for resistance to Dutch elm disease. (Credit: Image courtesy of USDA/Agricultural Research Service)

ScienceDaily (Mar. 30, 2011) — Two U.S. Department of Agriculture (USDA) scientists may have discovered "the map to El Dorado" for the American elm -- a previously hidden population of elms that carry genes for resistance to Dutch elm disease. The disease kills individual branches and eventually the entire tree within one to several years.

It has been accepted for 80 years that American elms (*Ulmus americana*) are tetraploids, trees with four copies of each chromosome. But there have also been persistent but dismissed rumors of trees that had fewer copies -- triploids, which have three copies of chromosomes, or diploids, which have two copies.

Now botanist Alan T. Whittemore and geneticist Richard T. Olsen with USDA's Agricultural Research Service (ARS) have proven beyond question that diploid American elms exist as a subset of elms in the wild. Their findings will be published in the April edition of the *American Journal of Botany*. Whittemore and Olsen work at the U.S. National Arboretum operated by ARS in Washington, D.C.

American elms once lined the country's streets and dominated eastern forests until they succumbed by the millions after Dutch elm disease arrived in the United States in 1931. Yet elms are still one of the most important tree crops for the $4.7 billion-a-year nursery industry, especially since the introduction of a very few new trees with some tolerance to the disease. American elms remain popular because of their stately beauty, their rapid leaf litter decay and their ability to stand up to city air pollution.

It was one of the disease-tolerant elm trees -- Jefferson, released jointly by ARS and the National Park Service in 2005 -- that put Whittemore and Olsen on the trail of the diploid.

"Jefferson is a triploid. To get a triploid elm, we thought there had to be a diploid parent out there somewhere in the wild that had crossed with a tetraploid," said Whittemore.

To settle the question, the two scientists tested elm trees from across the species' eastern and central U.S. range. About 21 percent of the wild elms sampled were diploid; some grew in stands with tetraploids, while others were larger groupings of diploids.
The small amount of genetic data now available suggests that at least some tetraploid and diploid elm populations have diverged significantly from one another, which strengthens the possibility of the diploid trees having genes for disease resistance that the tetraploids don't have, Whittemore said.
"We can't say yet whether this is a distinct race of *U. americana* or if we are really talking about a separate species," he said. "That's a job we will tackle this summer."

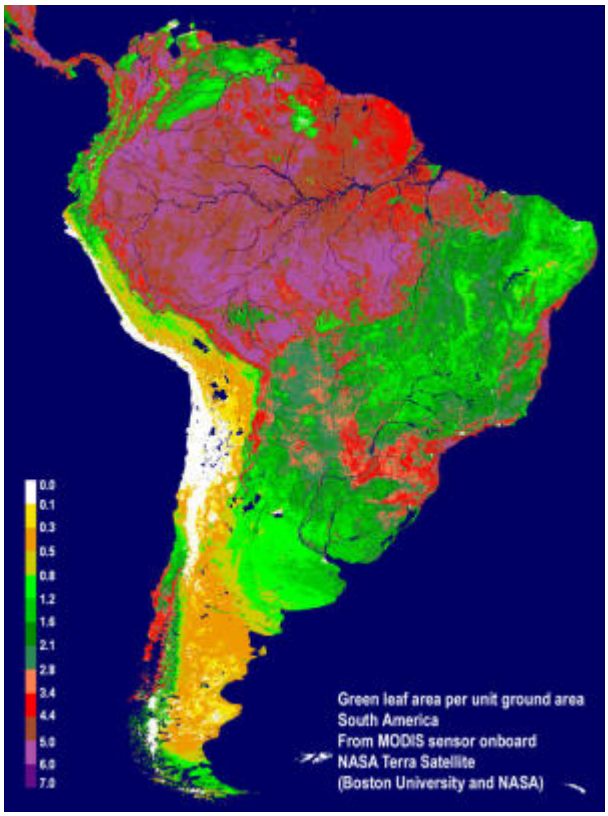
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Kim Kaplan.

Journal Reference:

1. Alan T. Whittemore and Richard T. Olsen. **Ulmus americana (Ulmaceae) is a polyploid complex**. *American Journal of Botany*, April 2011

http://www.sciencedaily.com/releases/2011/03/110330142340.htm

Satellites Detect Extensive Drought Impact on Amazon Forests



NASA satellite sensors, such as MODIS, showed an average pattern of greenness of vegetation on South America: Amazon forests which have very high leaf area are shown in red and purple colors, the adjacent cerrado (savannas) which have lower leaf area are shown in shades of green, and the coastal deserts are shown in yellow colors. (Credit: Boston University/NASA)

ScienceDaily (Mar. 29, 2011) — A new NASA-funded study has revealed widespread reductions in the greenness of the forests in the vast Amazon basin in South America caused by the record-breaking drought of 2010.

"The greenness levels of Amazonian vegetation -- a measure of its health -- decreased dramatically over an area more than three and one-half times the size of Texas and did not recover to normal levels, even after the drought ended in late October 2010," said Liang Xu, the study's lead author from Boston University.

The drought sensitivity of Amazon rainforests is a subject of intense study. Scientists are concerned because computer models predict that in a changing climate with warmer temperatures and altered rainfall patterns the ensuing moisture stress could cause some of the rainforests to be replaced by grasslands or woody savannas. This would cause the carbon stored in the rotting wood to be released into the atmosphere, which could accelerate global warming. The United Nations' Intergovernmental Panel on Climate Change (IPCC) has warned that similar droughts could be more frequent in the Amazon region in the future.

The comprehensive study was prepared by an international team of scientists using more than a decade's worth of satellite data from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) and Tropical Rainfall Measuring Mission (TRMM).

Analysis of these data produced detailed maps showing vegetation greenness declines from the 2010 drought. The study has been accepted for publication in Geophysical Research Letters, a journal of the American Geophysical Union.

The authors first developed maps of drought-affected areas using thresholds of below-average rainfall as a guide. Next they identified affected vegetation using two different greenness indices as surrogates for green leaf area and physiological functioning. The maps show the 2010 drought reduced the greenness of

approximately 965,000 square miles of vegetation in the Amazon -- more than four times the area affected by the last severe drought in 2005.

"The MODIS vegetation greenness data suggest a more widespread, severe and long-lasting impact to Amazonian vegetation than what can be inferred based solely on rainfall data," said Arindam Samanta, a co-lead author from Atmospheric and Environmental Research Inc. in Lexington, Mass.

The severity of the 2010 drought was also seen in records of water levels in rivers across the Amazon basin. Water levels started to fall in August 2010, reaching record low levels in late October. Water levels only began to rise with the arrival of rains later that winter.

"Last year was the driest year on record based on 109 years of Rio Negro water level data at the Manaus harbor. For comparison, the lowest level during the so-called once-in-a-century drought in 2005, was only eighth lowest," said Marcos Costa, coauthor from the Federal University in Vicosa, Brazil.

As anecdotal reports of a severe drought began to appear in the news media during the summer of 2010, the authors started near real-time processing of massive amounts of satellite data. They used a new capability, the NASA Earth Exchange (NEX), built for the NASA Advanced Supercomputer facility at the agency's Ames Research Center in Moffett Field, Calif. NEX is a collaborative supercomputing environment that brings together data, models and computing resources.

With NEX, the study's authors quickly obtained a large-scale view of the impact of the drought on the Amazon forests and were able to complete the analysis by January 2011. Similar reports about the impact of the 2005 drought were published about two years after the fact.

"Timely monitoring of our planet's vegetation with satellites is critical, and with NEX it can be done efficiently to deliver near-real time information, as this study demonstrates," said study coauthor Ramakrishna Nemani, a research scientist at Ames. An article about the NEX project appears in this week's issue of Eos, the weekly newspaper of the American Geophysical Union.

For more information about this study and the NEX project, visit https://c3.ndc.nasa.gov/nex/projects/1209/

For more information about the MODIS sensor and data products, visit: http://modis.gsfc.nasa.gov

For information about the Tropical Rainfall Measuring Mission, visit: http://trmm.gsfc.nasa.gov

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA**.

Journal References:

1. Liang Xu, Ranga B. Myneni, Arindam Samanta, Marcos H. Costa, Sangram Ganguly, Ramakrishna R. Nemani. **Widespread Decline in Greenness of Amazonian Vegetation Due to the 2010 Drought**. *Geophysical Research Letters*, 2011; (in press)
2. R. Nemani, P. Votava, A. Michaelis, F. Melton, C. Milesi. **Collaborative Supercomputing for Global Change Science**. *Eos*, 2011; (in press)

http://www.sciencedaily.com/releases/2011/03/110329150453.htm

Researchers Close in on Technology for Making Renewable Petroleum

Researchers have taken a crucial step toward making renewable petroleum by figuring out how to use a protein to transform fatty acids produced by the bacteria into ketones, which can be cracked to make hydrocarbon fuels. (Credit: iStockphoto/David Freund)

ScienceDaily (Mar. 29, 2011) — University of Minnesota researchers are a key step closer to making renewable petroleum fuels using bacteria, sunlight and carbon dioxide.

Graduate student Janice Frias, who earned her doctorate in January, made the critical step by figuring out how to use a protein to transform fatty acids produced by the bacteria into ketones, which can be cracked to make hydrocarbon fuels. The university is filing patents on the process.

The research is published in the April 1 issue of the *Journal of Biological Chemistry*. Frias, whose advisor was Larry Wackett, Distinguished McKnight Professor of Biochemistry, is lead author. Other team members include organic chemist Jack Richman, a researcher in the College of Biological Sciences' Department of Biochemistry, Molecular Biology and Biophysics, and undergraduate Jasmine Erickson, a junior in the College of Biological Sciences. Wackett, who is senior author, is a faculty member in the College of Biological Sciences and the university's BioTechnology Institute.

Aditya Bhan and Lanny Schmidt, chemical engineering professors in the College of Science and Engineering, are turning the ketones into diesel fuel using catalytic technology they have developed. The ability to produce ketones opens the door to making petroleum-like hydrocarbon fuels using only bacteria, sunlight and carbon dioxide.

"There is enormous interest in using carbon dioxide to make hydrocarbon fuels," Wackett says. "CO_2 is the major greenhouse gas mediating global climate change, so removing it from the atmosphere is good for the environment. It's also free. And we can use the same infrastructure to process and transport this new hydrocarbon fuel that we use for fossil fuels."

The research is funded by a $2.2 million grant from the U.S. Department of Energy's Advanced Research Projects Agency-energy (ARPA-e) program, created to stimulate American leadership in renewable energy technology.
Wackett is principal investigator for the ARPA-e grant. His team of co-investigators includes Jeffrey Gralnick, assistant professor of microbiology and Marc von Keitz, chief technical officer of BioCee, as well as Bhan and Schmidt. They are the only group using a photosynthetic bacterium and a hydrocarbon-producing bacterium together to make hydrocarbons from carbon dioxide.
The U of M team is using *Synechococcus*, a bacterium that fixes carbon dioxide in sunlight and converts CO_2 to sugars. Next, they feed the sugars to *Shewanella*, a bacterium that produces hydrocarbons. This turns CO_2, a greenhouse gas produced by combustion of fossil fuel petroleum, into hydrocarbons.
Hydrocarbons (made from carbon and hydrogen) are the main component of fossil fuels. It took hundreds of millions of years of heat and compression to produce fossil fuels, which experts expect to be largely depleted within 50 years.

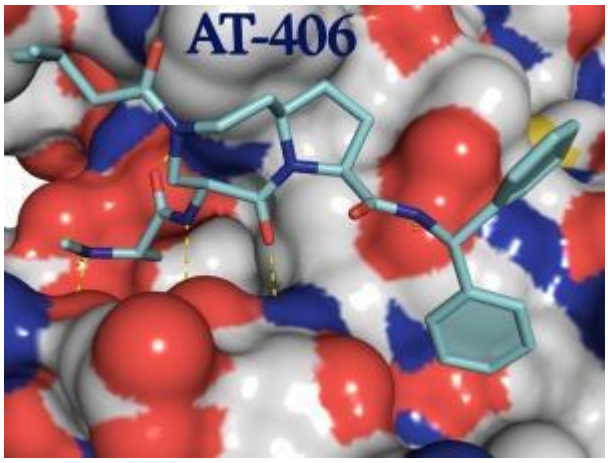
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Minnesota**.

Journal Reference:

1. J. A. Frias, J. E. Richman, J. S. Erickson, L. P. Wackett. **Purification and Characterization of OleA from Xanthomonas campestris and Demonstration of a Non-decarboxylative Claisen Condensation Reaction**. *Journal of Biological Chemistry*, 2011; 286 (13): 10930 DOI: 10.1074/jbc.M110.216127

http://www.sciencedaily.com/releases/2011/03/110323135635.htm

New Cancer Drug Heads to Clinical Trials



AT-406 binds directly to the proteins that block cell death. (Credit: Image courtesy of University of Michigan Health System)

ScienceDaily (Mar. 29, 2011) — Researchers at the University of Michigan Comprehensive Cancer Center have developed a new drug called AT-406 with potential to treat multiple types of cancer.

A study, published this week in the *Journal of Medicinal Chemistry*, showed that AT-406 effectively targets proteins that block normal cell death from occurring. Blocking these proteins caused tumor cells to die, while not harming normal cells. The researchers believe the drug could potentially be used alone or in combination with other treatments.

The normal cell death process, called apoptosis, is what keeps normal cells in check. When apoptosis is disrupted, cells reproduce uncontrollably, which is a hallmark of human cancer.

"Removing key apoptosis blockades in tumor cells is a completely new cancer therapeutic approach and could have benefit for the treatment of many types of human tumors," says study author Shaomeng Wang, Ph.D., Warner-Lambert/Parke-Davis Professor in Medicine and director of the Cancer Drug Discovery Program at the U-M Comprehensive Cancer Center.

Wang's laboratory has been pursuing new cancer treatments aimed at this cell death pathway since 2003. His team designed and made AT-406 and tested it in the laboratory in 2006. The small-molecule drug hones in directly on the proteins -- called inhibitor of apoptosis proteins or IAPs -- that block cell death. The researchers found that AT-406 destroyed these proteins in cancer cells. Meanwhile, the drug had little to no effect on normal cells.

In animal models, the drug shrank tumors but caused few side effects. The drug is designed to be taken by mouth, which researchers say will make it easier than traditional intravenous chemotherapies to administer.

Patent applications covering the drug are exclusively licensed to Ascenta Therapeutics, a privately-held, clinical stage biopharmaceutical company co-founded by Wang. After extensive testing, Ascenta began the first clinical trial in 2010 testing AT-406 for cancer treatment. This trial, which is being tested in all solid tumors, is offered at the U-M Comprehensive Cancer Center, Duke University and the Mayo Clinic. Ascenta has also recently opened a second trial of AT-406 in high-risk acute myeloid leukemia at the U-M Comprehensive Cancer Center. Several more clinical trials are planned.

"Our research goal and our passion is to translate our science and discovery into new and effective medicines for patients," Wang says. "I am delighted to see the drug we have designed, made and tested in our laboratory now being given to patients right here in the same building."

Note to patients: AT-406 is still in early stages of testing. To learn more about clinical trials opportunities at the U-M Comprehensive Cancer Center, visit UMClinicalStudies.org or call the Cancer AnswerLine at 800-865-1125.

Additional authors: Qian Cai, Haiying Sun, Yuefeng Peng, Jianfeng Lu, Zaneta Nikolovska-Coleska, Donna McEachern, Liu Liu, Su Qiu, ChaoYie Yang, Rebecca Miller, Han Yi, Tao Zhang and Duxin Sun, all from U-M; Sanmao Kang, Ming Guo, Lance Leopold and Dajun Yang, all from Ascenta Therapeutics

Funding: Breast Cancer Research Foundation, National Cancer Institute, Ascenta Therapeutics and the University of Michigan Comprehensive Cancer Center

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Michigan Health System**.

Journal Reference:

1. Qian Cai, Haiying Sun, Yuefeng Peng, Jianfeng Lu, Zaneta Nikolovska-Coleska, Donna McEachern, Liu Liu, Su Qiu, Chao-Yie Yang, Rebecca Miller, Han Yi, Tao Zhang, Duxin Sun, Sanmao Kang, Ming Guo, Lance Leopold, Dajun Yang, Shaomeng Wang. **A Potent and Orally Active Antagonist (SM-406/AT-406) of Multiple Inhibitor of Apoptosis Proteins (IAPs) in Clinical Development for Cancer Treatment**. *Journal of Medicinal Chemistry*, 2011; : 110328133059049 DOI: 10.1021/jm101505d

http://www.sciencedaily.com/releases/2011/03/110329134302.htm

Communicating Uncertain Climate Risks

The authors of a recent Perspectives piece in the journal Nature Climate Science say it is not enough to intuit the success of climate communications. They contend the evaluation of climate communication should be met with the same rigor as climate science itself. Here, someone uses the 220 megapixel HiPerWall display at the University of California, San Diego to discuss 10 time varying Intergovernmental Panel on Climate Change simulation runs. (Credit: Falko Kuester, California Institute for Telecommunications and Information Technology (Calit2), University of California, San Diego)

ScienceDaily (Mar. 29, 2011) — Despite much research that demonstrates potential dangers from climate change, public concern has not been increasing. One theory is that this is because the public is not intimately familiar with the nature of the climate uncertainties being discussed.

"A major challenge facing climate scientists is explaining to non-specialists the risks and uncertainties surrounding potential [climate change]," says a new Perspectives piece published March 29 in the science journal *Nature Climate Change.*

The article attempts to identify communications strategies needed to improve layman understanding of climate science.

"Few citizens or political leaders understand the underlying science well enough to evaluate climate-related proposals and controversies," the authors write, at first appearing to support the idea of specialized knowledge--that only climate scientists can understand climate research.

But, author Baruch Fischhoff quickly dispels the notion. "The goal of science communication should be to help people understand the state of the science," he says, "relevant to the decisions that they face in their private and public lives."

Fischhoff, a social and decision scientist at Carnegie Mellon University in Pittsburgh and Nick Pidgeon, an environmental psychologist at Cardiff University in the United Kingdom wrote the article together, titled, "The role of social and decision sciences in communicating uncertain climate risks."

Fischhoff and Pidgeon argue that science communication should give the public tools that will allow them to understand the uncertainties and disagreements that often underlie scientific discussion. He says that understanding is more likely to happen when people know something about the process that produces the conflicts they hear about in the press.

"Communications about climate science, or any other science, should embrace the same scientific standards as the science that they are communicating," says Fischhoff. He says this is crucial to maintaining people's trust in scientific expertise.

"When people lack expertise, they turn to trusted sources to interpret the evidence for them," Fischhoff says. "When those trusted sources are wrong, then people are misled."

Fischhoff and Pidgeon propose a communications strategy that applies "the best available communications science to convey the best available climate science." The strategy focuses on identifying, disclosing and when necessary reframing climate risks and uncertainties so the lay public can understand them easily.

"All of our climate-related options have uncertainties, regarding health, economics, ecosystems, and international stability, among other things," says Fischhoff. "It's important to know what gambles we're taking if, for example, we ignore climate issues altogether or create strong incentives for making our lives less energy intensive."

Key to effective communications is what the authors call "strategic organization" and "strategic listening." Strategic organization involves working in cross-disciplinary teams that include, at a minimum, climate scientists, decision scientists, social and communications specialists and other experts.

Strategic listening encourages climate scientists, who often have little direct contact with the public, to overcome flawed intuitions of how well they communicate. Strategic listening asks scientists to go beyond intuitive feeling and consider how well they communicate by using systematic feedback and empirical evaluation.

"I think that it is good for scientists to be in contact with the public, so that they can learn about its concerns and see how well, or poorly, they are communicating their knowledge," says Fischhoff. "That way they can do a better job of producing and conveying the science that people need."

Fischhoff's research on science communication is funded by the National Science Foundation's Decision Risk and Management Sciences program.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. Nick Pidgeon, Baruch Fischhoff. **The role of social and decision sciences in communicating uncertain climate risks**. *Nature Climate Change*, 2011; 1 (1): 35 DOI: 10.1038/nclimate1080

http://www.sciencedaily.com/releases/2011/03/110329163128.htm

Treadmill Tests for Poison Frogs Show Toxic Species Are More Physically Fit

Dendrobates leucomelas, a poisonous frog from Venezuelan Guiana, has higher aerobic capacity than its nontoxic relatives. (Credit: iStockphoto/Mariya Bibikova)

ScienceDaily (Mar. 29, 2011) — The most toxic, brightly colored members of the poison frog family may also be the best athletes, says a new study.

So-named because some native peoples use their skin secretions to poison their darts, the poison dart frogs of the Amazon jungle are well known for their bitter taste and beautiful colors. The spectacular hues of these forest frogs serve to broadcast their built-in chemical weapons: skin secretions containing nasty toxins called alkaloids. Like the red, yellow and black bands on a coral snake or the yellow stripes on a wasp, their contrasting color patterns warn would-be predators to stay away, said lead author Juan Santos of the National Evolutionary Synthesis Center in Durham, NC.

As it turns out, the most boldly-colored and bad-tasting species are also the most physically fit, the authors report this week in the journal *Proceedings of the National Academy of Sciences*.

In forests in Colombia, Ecuador, Venezuela, and Panamá, Santos subjected nearly 500 poison frogs -- representing more than 50 species -- to a frog fitness test. He measured their oxygen uptake during exercise using a rotating plastic tube, turning the tube like a hamster wheel to make the frogs walk.

Santos estimated the frogs' metabolic rates while at rest, and again after four minutes of exercise. The result? The most dazzling and deadly species had higher aerobic capacity than their drab, nontoxic cousins.

"They're better able to extract oxygen from each breath and transport it to their muscles, just like well-trained athletes," Santos said.

Poisonous species owe their athletic prowess to their unusual foraging habits, explained co-author David Cannatella of the University of Texas at Austin. Unlike snakes and other poisonous animals which make their own venom, poison frogs get their toxins from their food.

"They acquire their alkaloid chemicals by eating ants and mites," Cannatella said.

Because of their picky diet, poisonous frogs have to forage far and wide for food. "Nontoxic species basically stay in one place and don't move very much and eat any insect that comes close to them," Santos said. "But the bright, poisonous frogs are very picky about what they eat."

"It's not like a buffet where they can get everything they need to eat in one place," Cannatella added. "Ants and mites are patchy, so the frogs have to move around more to find enough food."
This combination of toxic skin and bold colors -- a syndrome known as aposematism -- evolved in tandem with specialized diet and physical fitness multiple times across the poison frog family tree, the authors explained. In some cases the frogs' physical fitness may have evolved before their unusual diet, making it possible to forage for harder-to-find food. But the specific sequence of events was likely different for different branches of the tree, Santos said.
The findings appear in the March 28 issue of *Proceedings of the National Academy of Sciences*.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Evolutionary Synthesis Center (NESCent)**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. J. C. Santos, D. C. Cannatella. **Phenotypic integration emerges from aposematism and scale in poison frogs**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1010952108

http://www.sciencedaily.com/releases/2011/03/110329134250.htm

Key Plant Traits Yield More Sugar for Biofuels

Scientists are testing core samples from poplar trees to identify key characteristics that influence how the plants can be more effectively processed into biofuels. (Credit: Image courtesy of Oak Ridge National Laboratory)

ScienceDaily (Mar. 29, 2011) — New clues about plant structure are helping researchers from the Department of Energy's BioEnergy Science Center narrow down a large collection of poplar tree candidates and identify winners for future use in biofuel production.

Led by Charles Wyman of the Bourns College of Engineering's Center for Environmental Research and Technology at the University of California, Riverside, a research team from Oak Ridge National Laboratory, the National Renewable Energy Laboratory and UCR determined that the amount and composition of lignin in the plant's cell wall interact in an unanticipated way to influence release of sugar from the plant.

The research was published as "Lignin content in natural Populus variants affects sugar release," in the Proceedings of the National Academy of Sciences.

Lignin serves as a major roadblock for biofuel production because it forms strong bonds with sugars and interferes with access to these carbohydrates, making it difficult to extract the plant's sugars contained in cellulose and hemicellulose for conversion to transportation fuels.

"The real driver for bioenergy is how to get sugar as cheaply as possible from these recalcitrant materials," Wyman said. "We're looking for clues as to which traits in these poplar materials will lead to better sugar release."

Using a high-throughput screening method, the BESC researchers rapidly analyzed an unprecedented number of poplar core samples in their search to understand the chemical factors that drive sugar yields.

The analysis revealed a correlation between one plant trait, the S/G ratio, and increased sugar yields. The ratio refers to the two main building blocks of lignin -- syringyl and guaiacyl subunits.

"The conventional wisdom is that high lignin contents are bad for sugar release," said lead author Michael Studer. "We unexpectedly found that this statement is only valid for low S/G ratios, while at high S/G ratios lignin does not negatively influence yields. However, replacement of carbohydrates with lignin reduces the maximum possible sugar release."

"Another interesting result was that the samples with the highest sugar release belonged to the group with average S/G ratios and lignin contents. This finding points to a need for deeper understanding of cell wall structure before plants can be rationally engineered for efficient biofuels production," Studer said.

The team's study also pinpointed certain poplar samples that produced unusually high sugar yields with no pretreatment. Biofuel production typically requires various pretreatments, such as applying high temperature and pressure to the biomass. Reducing pretreatment would represent a substantial decrease in the price of liquid transportation fuels produced from lignocellulosic feedstocks like poplar.
"It's very enticing that several of the samples released more sugar than typical with no pretreatment," Wyman said.
Poplar trees, botanically known as Populus, represent the leading woody crop candidate for the production of biomass feedstocks for the creation of biofuels in the U.S. Naturally occurring selections of poplar trees contained wide variations in all observed traits, says Gerald Tuskan, an ORNL plant biologist and one of the co-leads of the study.
"We can mine this natural variability and find extreme poplar phenotypes that have value in increasing sugar yield," Tuskan said. "Moreover, these native individuals are adapted to local environments."
From this work, superior poplar cultivars may soon be available for commercial testing and propagation, yielding plant materials that will contribute to reducing the nation's dependence on fossil fuel based transportation fuels.
The team, supported by BESC at ORNL, included co-lead Mark Davis and Robert Sykes from the National Renewable Energy Laboratory, Jaclyn DeMartini from UCR, and Brian Davison and Martin Keller from ORNL.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Riverside**.

Journal Reference:

1. M. H. Studer, J. D. DeMartini, M. F. Davis, R. W. Sykes, B. Davison, M. Keller, G. A. Tuskan, C. E. Wyman. **Lignin content in natural Populus variants affects sugar release**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1009252108

http://www.sciencedaily.com/releases/2011/03/110329095444.htm

Human Virus Linked to Deaths of Endangered Mountain Gorillas; Finding Confirms That Serious Diseases Can Pass to Gorillas from People

The potential for disease transmission between humans and mountain gorillas is of particular concern because over the past 100 years, mountain gorillas have come into increasing contact with humans. (Credit: Photo courtesy of Mountain Gorilla Veterinary Project)

ScienceDaily (Mar. 29, 2011) — For the first time, a virus that causes respiratory disease in humans has been linked to the deaths of wild mountain gorillas, reports a team of researchers in the United States and Africa. The finding confirms that serious diseases can pass from people to these endangered animals.

The researchers are from the non-profit Mountain Gorilla Veterinary Project; the Wildlife Health Center at the University of California, Davis; the Center for Infection and Immunity at Columbia University; and the Rwanda Development Board.

Their study, which reports the 2009 deaths of two mountain gorilla that were infected with a human virus, was published online by the journal *Emerging Infectious Diseases*, a publication of the U.S. Centers for Disease Control and Prevention.

"Because there are fewer than 800 living mountain gorillas, each individual is critically important to the survival of their species," said Mike Cranfield, executive director of the Mountain Gorilla Veterinary Project and a UC Davis wildlife veterinarian. "But mountain gorillas are surrounded by people, and this discovery makes it clear that living in protected national parks is not a barrier to human diseases."

Humans and gorillas share approximately 98 percent of their DNA. This close genetic relatedness has led to concerns that gorillas may be susceptible to many of the infectious diseases that affect people.

The potential for disease transmission between humans and mountain gorillas (Gorilla beringei beringei) is of particular concern because over the past 100 years, mountain gorillas have come into increasing contact with humans. In fact, the national parks where the gorillas are protected in Rwanda, Uganda and the Democratic Republic of Congo are surrounded by the densest human populations in continental Africa.

Also, gorilla tourism -- while helping the gorillas survive by funding the national parks that shelter them -- brings thousands of people from local communities and around the world into contact with mountain gorillas annually.

The veterinarians of the Mountain Gorilla Veterinary Project, who monitor the health of the gorillas and treat individuals suffering from life-threatening or human-caused trauma and disease, have observed an increase in the frequency and severity of respiratory disease outbreaks in the mountain gorilla population in recent years. Infectious disease is the second most common cause of death in mountain gorillas (traumatic injury is the first). "The type of infection we see most frequently is respiratory, which can range from mild colds to severe

pneumonia," said co-author Linda Lowenstine, a veterinary pathologist with the UC Davis Mountain Gorilla One Health Program who has studied gorilla diseases for more than 25 years.

The two gorillas described in the new study were members of the Hirwa group living in Rwanda. In 2008 and 2009, this group experienced outbreaks of respiratory disease, with various amounts of coughing, eye and nose discharge, and lethargy. In the 2009 outbreak, the Hirwa group consisted of 12 animals: one adult male, six adult females, three juveniles and two infants. All but one were sick. Two died: an adult female and a newborn infant.

Tissue analyses showed the biochemical signature of an RNA virus called human metapneumovirus (HMPV) infecting both animals that had died. While the adult female gorilla ultimately died as a result of a secondary bacterial pneumonia infection, HMPV infection likely predisposed her to pneumonia. HMPV was also found in the infant gorilla, which was born to a female gorilla that showed symptoms of respiratory disease.

The study's UC Davis authors are Cranfield, Lowenstine and Kirsten Gilardi, co-director of the UC Davis Wildlife Health Center's Mountain Gorilla One Health Program. The lead author is Gustavo Palacios, a virologist at the Center for Infection and Immunity at Columbia University in New York. Other authors are from the Mountain Gorilla Veterinary Project, Columbia University and the Rwanda Development Board.

The research was supported by Google.org; the U.S. National Institutes of Health; the Emerging Pandemic Threats PREDICT program of the U.S. Agency for International Development; and a grant from the David and Lucile Packard Foundation.

About mountain gorillas

With only about 786 individuals left in the world, mountain gorillas are a critically endangered species. Mountain gorillas live in central Africa, with about 480 animals living in the 173-square-mile Virunga Volcanoes Massif, which combines Volcanoes National Park in Rwanda, Virunga National Park in the Democratic Republic of Congo, and Mgahinga National Park in Uganda. The remaining population lives within the boundaries of the 128-square-mile Bwindi Impenetrable National Park in Uganda.

About the Mountain Gorilla Veterinary Project

The Mountain Gorilla Veterinary Project, a U.S.-based nonprofit organization, is dedicated to saving mountain gorilla lives. With so few animals left in the world today, the organization believes it is critical to ensure the health and well being of every individual possible. The organization's international team of veterinarians, the Gorilla Doctors, is the only group providing wild mountain gorillas with direct, hands-on care. The Mountain Gorilla Veterinary Project partners with the UC Davis Wildlife Health Center to advance "one-health" strategies for mountain gorilla conservation. http://www.gorilladoctors.org.

Story Source:

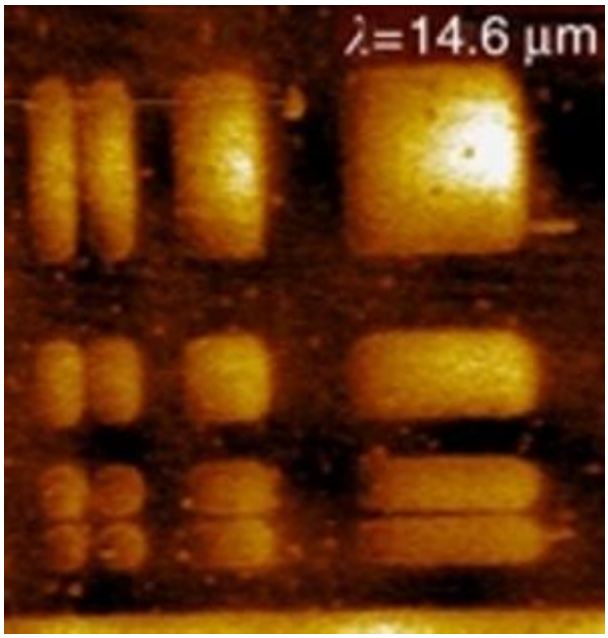
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Davis**.

Journal Reference:

1. Palacios G, Lowenstine LJ, Cranfield MR, Gilardi KVK, Spelman L, Lukasik-Braum M, et al. **Human metapneumovirus infection in wild mountain gorillas, Rwanda**. *Emerging Infectious Diseases*, 2011; DOI: 10.3201/eid1704.100883

http://www.sciencedaily.com/releases/2011/03/110328151738.htm

Researchers Make First Perovskite-Based Superlens for the Infrared



This atomic-force microscopy image shows the subwavelength strontium ruthenate rectangles that were imaged with perovskite-based superlens using incident IR light of 14.6 micrometer wavelengths. (Credit: Kehr, et. al)

ScienceDaily (Mar. 29, 2011) — Superlenses earned their superlative by being able to capture the "evanescent" light waves that blossom close to an illuminated surface and never travel far enough to be "seen" by a conventional lens. Superlenses hold enormous potential in a range of applications, depending upon the form of light they capture, but their use has been limited because most have been made from elaborate artificial constructs known as metamaterials.

The unique optical properties of metamaterials, which include the ability to bend light backwards -- a property known as negative refraction -- arise from their structure rather than their chemical composition. However, metamaterials can be difficult to fabricate and tend to absorb a relatively high percentage of photons that would otherwise be available for imaging.

Now, researchers with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) have fabricated a superlens from perovskite oxides that are simpler and easier to fabricate than metamaterials, and are ideal for capturing light in the mid-infrared range, which opens the door to highly sensitive biomedical detection and imaging. It is also possible that the superlensing effect can be selectively turned on/off, which would open the door to highly dense data writing and storage.

"We have demonstrated a superlens for electric evanescent fields with low absorption losses using perovskites in the mid-infrared regime," says Ramamoorthy Ramesh, a materials scientist with Berkeley Lab's Materials Sciences Division, who led this research. "Spectral studies of the lateral and vertical distributions of evanescent waves around the image plane of our lens show that we have achieved an imaging resolution of one micrometer, about one-fourteenth of the working wavelength."

Ramesh, who also holds appointments with the University of California Berkeley's Department of Materials Science and Engineering and the Department of Physics, is the senior author of a paper in the journal *Nature Communications* titled "Near-field examination of perovskite-based superlenses and superlens-enhanced probe-object coupling."

Conventional lenses create images by capturing the propagating light waves emitted by an object under illumination and then bending these captured light waves into focus. No matter how perfect a conventional lens is, the smallest image it can ever resolve is about half the wavelength of the illuminating (incident) light -- a restriction known as the "diffraction limit." Superlenses overcome the diffraction limit by capturing the evanescent light waves, which carry detailed information about features on an object that are significantly

smaller than the wavelengths of incident light. Because evanescent waves dissipate or "vanish" after traveling a very short distance, conventional lenses seldom ever see them.

"A superlens made out of a metamaterial focuses propagating waves and reconstructs evanescent waves arising from the illuminated objects in the same plane to produce an image with sub-wavelength resolution," says Susanne Kehr, a former member of Ramesh's Berkeley research group and now with the University of Saint Andrews in the United Kingdom. "Our perovskite-based superlens doesn't focus propagating waves, but instead reconstructs evanescent fields only. These fields generate the sub-wavelength images that we study with near-field infrared microscopy."

Kehr is one of two leading authors of the *Nature Communications* paper, along with Yongmin Liu, a metamaterials expert in the research group of Xiang Zhang, who also worked on this study. In 2005, Zhang, who holds joint appointments with Berkeley Lab and the University of California, Berkeley, led the first experimental demonstration of a superlens at optical frequencies.

Kehr and Liu say that perovskites hold a number of advantages over metamaterials for superlensing. The perovskites they used to make their superlens, bismuth ferrite and strontium titan¬ate, feature a low rate of photon absorption and can be grown as epitaxial multilayers whose highly crystalline quality reduces interface roughness so there are few photons lost to scattering. This combination of low absorption and scattering losses significantly improves the imaging resolution of the superlens.

"In addition, perovskites display a wide range of fascinating properties, such as ferroelectricity and piezoelectricity, superconductivity and enormous magnetoresistance that might inspire new functionalities of perovskite-based superlenses, such as non-volatile memory, microsensors and microactu¬ators, as well as applications in nanoelectronics," says Liu. "Bismuth ferrite, in particular, is multiferroic, meaning it simultaneously displays both ferroelectric and ferromagnetic properties, and therefore is a good candidate to allow for electric and magnetic tunability."

This research represents the first application of perovskite materials to superlensing. One of the biggest challenges was to find the right combination of perovskites that would make an effective superlens. The perovskite thin films they fabricated were grown by pulsed-laser deposition and found to be single phase and fully epitaxial. However, this too was a challenge, as Kehr explains.

"Our superlenses consisted of a layer of bismuth ferrite and a layer of strontium titan¬ate with thicknesses of 200 and 400 nanometers, respectively, which is rather thick for epitaxial growth with pulsed laser deposition," she says. "At these thicknesses, accurate thickness and flat interfaces become a problem."

A combination of near-field infrared microscopy with a tunable free-electron laser provided a first of its kind highly detailed study of the spatial and spectral near-field responses of the superlens. This study led to the observation of an enhanced coupling between the illuminated objects -- rectangles of strontium ruthenate on a strontium titanate substrate -- and a near-field scattering probe -- a metal-coated atomic-force microscope tip with a typical radius of 50 nanometers.

"At certain distances between the probe and the surface of the object, we observed a maximum number of evanescent fields," Ramesh says. "Comparisons with numerical simulations indicate that this maximum originates from an enhanced coupling between probe and object, which might be applicable for multifunctional circuits, infrared spectroscopy and thermal sensors."

In their *Nature Communications* paper, Ramesh and his co-authors say that the multiferroic bismuth ferrite layer should make their superlens tunable through the application of an external electric field. This tunability could be used to change the superlensing wavelength or sharpen the final image, but even more importantly, might be used to turn the superlensing effect on and off.

"The ability to switch superlensing on and off for a certain wavelength with an external electric field would make it possible to activate and deactivate certain local areas of the lens," Kehr says. "This is the concept of data-storage, with writing by electric fields and optical read-outs."

Liu says that the mid-infrared spectral region at which their superlens functions is prized for biomedical applications.

"Most biomolecules have specific absorption and radiation features in this range that depend on their chemical composition and therefore yield a fingerprint in the spectra," he says. "However, compared with optical wavelengths, there are significant limitations in the basic components available today for biophotonic delivery in the mid-infrared. Our superlens has the potentials to eliminate these limitations."

This research was carried out by an international collaboration of scientists. In addition to Kehr, Liu and Ramesh, other co-authors of the paper "Near-field examination of perovskite-based superlenses and superlens-enhanced probe-object coupling," were Lane Martin, Pu Yu, Martin Gajek, Seung-Yeul Yang, Chan-Ho Yang, Marc Wenzel, Rainer Jacob, Hans-Georg von Ribbeck, Manfred Helm, Xiang Zhang and Lukas Eng.
The broad range of expertise represented by these co-authors was critical to the success of the research, as Kehr explains.
"Our perovskite oxide superlens was designed and grown in Ramesh's group, but the idea for a perovskite superlens originated with Lukas Eng at the University of Technology in Dresden," she says. "A collaboration at Dresden between Eng and Manfred Helm provided the expertise for combining near-field infrared microscopy and free-electron laser technologies, and Yongmin and Xiang Zhang provided the expertise in optics for interpreting our results."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Lawrence Berkeley National Laboratory**.

Journal Reference:

1. S.C. Kehr, Y.M. Liu, L.W. Martin, P. Yu, M. Gajek, S.-Y. Yang, C.-H. Yang, M.T. Wenzel, R. Jacob, H.-G. von Ribbeck, M. Helm, X. Zhang, L.M. Eng, R. Ramesh. **Near-field examination of perovskite-based superlenses and superlens-enhanced probe-object coupling**. *Nature Communications*, 2011; 2: 249 DOI: 10.1038/ncomms1249

http://www.sciencedaily.com/releases/2011/03/110329134248.htm

First Applications of Europe's Galileo Satellite Nagivation System Showcased

Galileo's receiving technology distinguished itself through its very high precision. For example, the system makes it possible to detect the precise location of avalanche victims. (Credit: © Fraunhofer IML)

ScienceDaily (Mar. 29, 2011) — The first satellites of the the European navigation system Galileo are to be in position in the year 2012 and start their work. Fraunhofer Galileo Labs are showcasing the first applications that use new, improved possibilities provided by satellite navigation.

Whether calculating routes, finding your vehicle, tracking products or simply knowing where you are at the moment, drivers and sailors currently use satellite navigation as a matter of course and rescue personnel and logistics providers have also already discovered the potential it affords them. Up to now, the applications have mainly been based on the direction signals of the military's publicly available Global Positioning Systems (GPS). When the first four of a total of 30 satellites of the European Global Navigation Satellite System (GNSS) Galileo will be put into service in 2012, civilian users will be the main beneficiaries.

"For them, the satellite navigation system will improve successively on all levels," remarked Wolfgang Inninger of the Fraunhofer Institute for Material Flow and Logistics IML in Prien. Positioning via satellite will become more reliable, more precise and safer. For one thing, the user will be able to access more satellites. Galileo will also offer a function for various services that makes it possible to check the correctness of the transmitted position data. This function makes it possible, for example, to carry out environmental impact measurements within flowing traffic. Data from these measurements can be used by the authorities only if they are "legally sound," meaning if each measurement value can be clearly attributed to a measurement site. Current GPS positioning does not provide this.

The Fraunhofer Gesellschaft's five Galileo Labs, at their sites in Berlin, Dortmund, Dresden, Erlangen and Prien respectively, demonstrate how the new possibilities of the GNSS can be used. A mobile environmental monitoring system for measuring pollutant gases and fine dust is currently being developed in the Berlin lab at the Fraunhofer Institute for Production Systems and Design Technology IPK, in cooperation with the Fraunhofer Institute for Physical Measurement Techniques IPM in Freiburg. It is intended to supplement the knowledge gained from the stationary environmental measurements with real-time traffic data. At the beginning of last year, scientists from the IML Prien and local rescue personnel successfully tested a Galileo-

supported positioning system for the victims of avalanches at the Galileo test and development area (GATE) in Berchtesgaden. Eight pseudo-satellites on top of eight mountain tops emit Galileo signals during the application tests.
"During this field test we located the 'avalanche victims' by within a few centimeters," reports Inninger. He estimates that the location precision could double for all GNSS applications due to the fact that there will be more satellites available. In the future, most end-user devices will be able to utilize both GPS and Galileo signals, some devices in conjunction with additional localization methods. Scientists of the Fraunhofer Institute for Integrated Circuits IIS at the Galileo lab in Erlangen are working on a combination of positioning from Galileo and WLAN signals within a building, for example, to make it easier for fire fighters to orient themselves in burning buildings. In the future, the same principle could be used to simplify the management of warehouses in commerce or in manufacturing enterprises. Logisticians at the Galileo lab in Dortmund are developing a system that fully and automatically monitors palettes by means of satellite positioning -- both within and outside the warehouse.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Fraunhofer-Gesellschaft**.

http://www.sciencedaily.com/releases/2011/03/110328093103.htm

Wind Can Keep Mountains from Growing

Researchers sit atop a wind-formed ridge called a yardang located in the Qaidam Basin of Central Asia. The yardangs in that area can be as much as 40 meters (about 130 feet) tall and about a football field (100 meters) apart. (Credit: Paul Kapp, University of Arizona.)

ScienceDaily (Mar. 29, 2011) — Wind is a much more powerful force in the evolution of mountains than previously thought, according to a new report from a University of Arizona-led research team. Bedrock in Central Asia that would have formed mountains instead was sand-blasted into dust, said lead author Paul Kapp.

"No one had ever thought that wind could be this effective," said Kapp, a UA associate professor of geosciences. "You won't read in a textbook that wind is a major process in terms of breaking down rock material."

Rivers and glaciers are the textbook examples of forces that wear down mountains and influence their evolution.

Wind can be just as powerful, Kapp said. He and his colleagues estimate wind can be 10 to 100 times more effective in eroding mountains than previously believed.

The team's paper, "Wind erosion in the Qaidam basin, central Asia: implications for tectonics, paleoclimate, and the source of the Loess Plateau," is in the April/May issue of GSA Today.

Kapp's co-authors are Jon D. Pelletier and Joellen Russell of the UA; Alexander Rohrmann, formerly of the UA and now at the University of Potsdam in Germany; Richard Heermance of California State University, Northridge; and Lin Ding of the Chinese Academy of Sciences, Beijing. The American Chemical Society Petroleum Research Fund and a UA Faculty Small Grant funded the research.

The geoscientists figured out wind's rock-sculpting abilities by studying gigantic wind-formed ridges of rock called yardangs.

Kapp first learned about yardangs when reviewing a scientific paper about Central Asia's Qaidam Basin. To see the geology for himself, he booted up Google Earth -- and was wowed by what he saw.

"I'd never seen anything like that before," he said. "I didn't even know what a yardang was."

Huge fields of yardangs that can be seen from space look like corduroy. Wind had scoured long gouges out of the bedrock, leaving the keel-shaped ridges behind. Kapp wondered where the missing material was.

The team's initial research was conducted using geological maps of the region and satellite images from Google Earth. Then Kapp and his team went to the Qaidam Basin to collect more information about the yardangs, the history of wind erosion and the dust.

"What we're proposing is that during the glacials, when it's colder and drier, there's severe wind erosion in the Qaidam basin and the dust gets blown out and deposited downwind in the Loess Plateau," Kapp said.

The term "loess" refers to deposits of wind-blown silt. Parts of the U.S. Midwest have large deposits of loess.

"Up until 3 million years ago, the basin was filling up with sediment," he said. "Then like a switch, the wind turned on and basin sediments get sandblasted away."

Known as the "bread basket of China," the Loess Plateau is the largest accumulation of dust on Earth. Scientists thought most of the dust came from the Gobi Desert.

In contrast, Kapp and his colleagues suggest more than half of the dust came from the Qaidam Basin. Co-author Pelletier, a UA geomorphologist, created a computer model indicating that dust from the basin could have formed the plateau.
The wind is not having such effects now because the climate is different, Kapp said. Co-author Russell plus other research groups suggest the westerly winds shift north during interglacial periods like that of the current climate and shift toward the equator during glacial periods.
Therefore since the last Ice Age ended about 11,000 years ago, the winds have blown from the Gobi Desert toward the Loess Plateau. During glacial periods, the winds blew from the Qaidam basin toward the Loess Plateau instead.
"During the interglacials, the basin fills up with lakes. … When it goes back to a glacial period, lake sediments blow away," he said. "Our hypothesis is that you have lake development, then wind erosion, lake development, wind erosion, lake development -- and so on."
The team suggests wind erosion also influenced how fast the basin's bedrock is folded. In Central Asia, bedrock folds and crumples because it's being squeezed as the Indian plate collides with the Asian plate.
"The folding accelerated 3 million years ago," Kapp said. "That's when the wind erosion turned on. I don't think it's a coincidence."
During the glacial periods, the winds whisked sediment out of the basin. As a result, the bedrock deformed faster because it was no longer weighed down by all the sediment.
Kapp calls the process "wind-enhanced tectonics." The term "tectonics" refers to forces that cause movements and deformation of Earth's plates.
The whole process is driven by global climate change, he said. "The unifying theme is wind."
Kapp and his team are quantifying the processes further as they analyze more samples they brought back from the Qaidam basin and Loess Plateau.

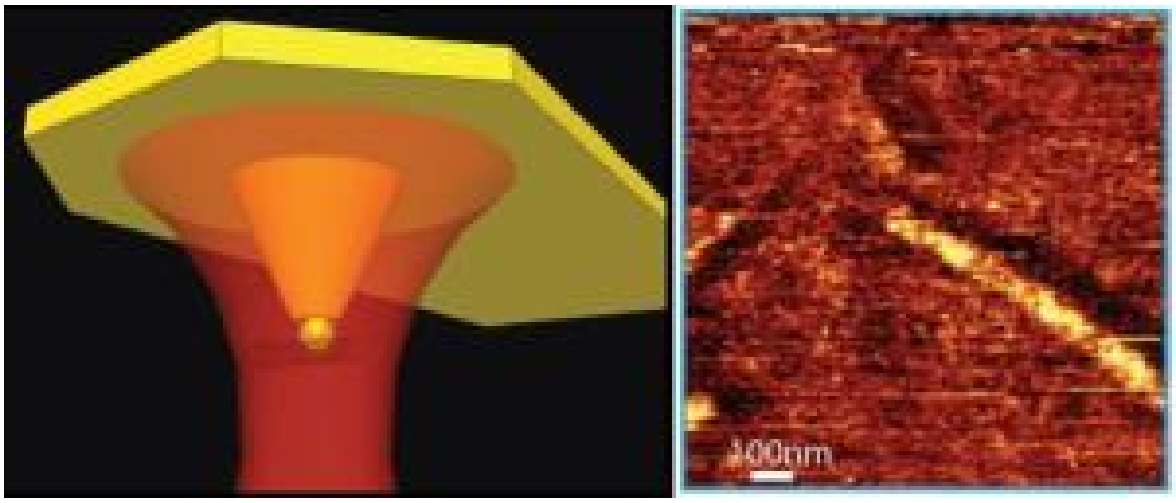
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Arizona**.

Journal Reference:

1. Paul Kapp, Jon D. Pelletier, Alexander Rohrmann, Richard Heermance, Joellen Russell, Lin Ding. **Wind erosion in the Qaidam basin, central Asia: Implications for tectonics, paleoclimate, and the source of the Loess Plateau**. *GSA Today*, 2011; 21 (4): 4 DOI: 10.1130/GSATG99A.1

http://www.sciencedaily.com/releases/2011/03/110328162029.htm

Next-Generation Chemical Mapping on the Nanoscale



Schematic of coaxial probe for imaging a carbon nanotube (left) and chemical map of carbon nanotube with chemical and (right) topographical information at each pixel. (Credit: Image from Weber, et. al)

ScienceDaily (Mar. 29, 2011) — A pixel is worth a thousand words? Not exactly how the saying goes, but in this case, it holds true: scientists at Berkeley Lab's Molecular Foundry have pioneered a new chemical mapping method that provides unprecedented insight into materials at the nanoscale. Moving beyond traditional static imaging techniques, which provide a snapshot in time, these new maps will guide researchers in deciphering molecular chemistry and interactions at the nanoscale -- critical for artificial photosynthesis, biofuels production and light-harvesting applications such as solar cells.

"This new technique allows us to capture very high-resolution images of nanomaterials with a huge amount of physical and chemical information at each pixel," says Alexander Weber-Bargioni, a postdoctoral scholar in the Imaging and Manipulation of Nanostructures Facility at the Foundry. "Usually when you take an image, you just get a picture of what this material looks like, but nothing more. With our method, we can now gain information about the functionality of a nanostructure with rich detail."

The Molecular Foundry is a U.S. Department of Energy (DOE) Office of Science nanoscience center and national user facility. With the Foundry's state-of-the-art focused ion beam tool at their disposal, Weber-Bargioni and his team designed and fabricated a coaxial antenna capable of focusing light at the nanoscale, -- a harnessing of light akin to wielding a sharp knife in a thunderstorm, Weber-Bargioni says.

Consisting of gold wrapped around a silicon nitride atomic force microscope tip, this coaxial antenna serves as an optical probe for structures with nanometer resolution for several hours at a time. What's more, unlike other scanning probe tips, it provides enough enhancement, or light intensity, to report the chemical fingerprint at each pixel while collecting an image (typically 256 x 256 pixels). This data is then used to generate multiple composition-related "maps," each with a wealth of chemical information at every pixel, at a resolution of just twenty nanometers. The maps provide information that is critical for examining nanomaterials, in which local surface chemistry and interfaces dominate behavior.

"Fabricating reproducible near-field optical microscopy probes has always been a challenge," says Frank Ogletree, acting Facility Director of the Imaging and Manipulation of Nanostructures Facility at the Foundry. "We now have a high-yield method to make engineered plasmonic probes for spectroscopy on a variety of surfaces."

To test out the capability of their new probe, the team examined carbon nanotubes, sheets of carbon atoms rolled tightly into tubes just a few nanometers in diameter. Carbon nanotubes are ideal for this type of interactive investigation as their unmatched electronic and structural properties are sensitive to localized chemical changes.

Users coming to the Molecular Foundry to seek information about light-harvesting materials or any dynamic system should benefit from this imaging system, Weber-Bargioni says.

Adds Jim Schuck, staff scientist in the Imaging and Manipulation of Nanostructures Facility at the Foundry, "We're very excited -- this new nano-optics capability enables us to explore previously inaccessible properties within nanosystems. The work reflects a major strength of the Molecular Foundry, where collaboration between scientists with complementary expertise leads to real nanoscience breakthroughs."
This work at the Molecular Foundry was supported by DOE's Office of Science.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Lawrence Berkeley National Laboratory**.

Journal Reference:

1. Alexander Weber-Bargioni, Adam Schwartzberg, Matteo Cornaglia, Ariel Ismach, Jeffrey J. Urban, YuanJie Pang, Reuven Gordon, Jeffrey Bokor, Miquel B. Salmeron, D. Frank Ogletree, Paul Ashby, Stefano Cabrini, P. James Schuck. **Hyperspectral Nanoscale Imaging on Dielectric Substrates with Coaxial Optical Antenna Scan Probes.**. *Nano Letters*, 2011; 11 (3): 1201 DOI: 10.1021/nl104163m

http://www.sciencedaily.com/releases/2011/03/110329095739.htm

Bones Conjure Yellowstone's Ecological Ghosts

This elk skull and other remains recovered during Joshua Miller's study of Yellowstone National Park are revealing details about the region's ecological history. Miller published his findings in the March 28 issue of PLoS ONE. (Credit: Scott Rose)

ScienceDaily (Mar. 29, 2011) — By taking a closer look at animal bones scattered across the wilderness landscape, a researcher at the University of Chicago has found a powerful tool for showing how species' populations have changed over decades or even a century.

"The skeletons of long-dead animals lying on landscapes provide critical insight into our understanding of ecosystem history, especially how populations have changed," said the study's author, University of Chicago alumnus Joshua H. Miller, S.M.'05, PhD'09, a postdoctoral research fellow in biological sciences at Wright State University in Dayton, Ohio.

The study, published in the March 28 issue of *PLoS ONE*, presents data that Miller collected for his UChicago doctoral dissertation. His study provides a deeper context for the many disturbances that are altering ecosystems around the world, including global warming, overharvesting and habitat destruction.

"These changes result in population reductions and extinctions of some species, while others expand and invade new habitats and regions," Miller explained. "Most ecosystems have not been studied over long time spans -- many decades at least -- which hampers the ability of wildlife managers and other scientists to properly document or mediate these dramatic ecological changes."

Surveying the bones of Yellowstone

In research funded by the National Science Foundation, Miller surveyed bones from the skeletons of hoofed mammals (ungulates) in Yellowstone National Park. The bones ranged in age from newly dead to approximately 200 years old.

Then he compared the numbers of specimens from each species documented in bones to surveys of the living populations.

Miller found that all the native species in the living community were recovered and that the order of species from most abundant to least abundant was similar for the bones and the living community. Species whose populations significantly diminished or expanded over the last 20 to 80 years were predictably over- or under-represented in the bones relative to the living community.

"Live elk were much more abundant in the 1990s than they are today," Miller said, "and the bones of Yellowstone feature far more elk than one would predict based on the current Yellowstone community."

Horses, which were replaced by cars as the dominant mode of transportation in Yellowstone in the early 1900s, also are readily found as skeletal remains. Radiocarbon dating confirmed that horse bones were generally remnants from when the cavalry controlled Yellowstone in the late 1800s to early 1900s.

In contrast to these ghosts of larger past populations, species that have recently increased in abundance (bison and the recently arrived mountain goat) are less common in the skeletal record than current living populations would predict. Overall, the bones of Yellowstone correlate well with the area's historical ecosystem and provide more detailed information about the historical community than can be acquired from only studying the ecosystem today.

"Bones provide a great tool for uncovering historical ecological data that allow us to put modern biodiversity in a broader temporal context," Miller said. "The living populations of Yellowstone have been studied for a long time and provide a great opportunity to test how well bones record species' histories. Now we can go the next step and use bone accumulations in regions we have only recently begun studying to obtain critical historical data and establish how ecosystems have changed over the last decades, century or even longer."
Miller's research also suggests that the ecological information contained in the fossil record may provide more biological details on extinct ecosystems than previously thought.
"Josh has shown that the bones of Yellowstone accurately track recent and not-so-recent history of the large mammal populations in this famous North American ecosystem," said Kay Behrensmeyer, curator of vertebrate paleontology of the Smithsonian Institution's National Museum of Natural History. "This should be a wake-up call for ecologists interested in the movements, increases and declines of large mammal populations anywhere -- bones are a relatively untapped and valuable source of ecological data about animals when they were alive."
Miller received the 2008 Romer Prize in paleontology for the research, which was supervised by Susan Kidwell, UChicago's William Rainey Harper Professor in Geophysical Sciences.

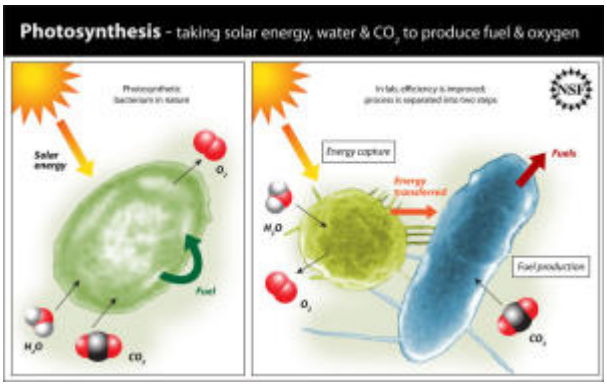
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Chicago**. The original article was written by Steve Koppes.

Journal Reference:

1. Joshua H. Miller. **Ghosts of Yellowstone: Multi-Decadal Histories of Wildlife Populations Captured by Bones on a Modern Landscape**. *PLoS ONE*, 2011; 6 (3): e18057 DOI: 10.1371/journal.pone.0018057

http://www.sciencedaily.com/releases/2011/03/110328171222.htm

NSF Announces New Awards That Will Investigate More Efficient Ways to Harvest Sunlight



In photosynthesis, solar energy is captured and used to produce chemical fuel by a photosynthetic organism. This project is designed to improve the efficiency of this capture and conversion by: 1) separating them into two types of cells: one that captures solar energy and another "factory" cell that produces fuel; and 2) enabling these two different types of cells to communicate with one another via the flow of electrical currents between them. Compartmentalizing the processes of energy capture and fuel production into two different types of cells will allow researchers to optimize environments for each process, and thereby improve the efficiency of each process. (Credit: Zina Deretsky, NSF)

ScienceDaily (Mar. 29, 2011) — Scientists in the United States and the United Kingdom have been awarded funding totaling more than $10.3 million to improve the process of biological photosynthesis. The U.S. National Science Foundation (NSF) and the U.K. Biotechnology and Biological Sciences Research Council (BBSRC) collaborated in issuing these jointly funded awards.

Photosynthesis allows biological systems to use sunlight and carbon dioxide to produce sugars and oxygen. This process is ultimately responsible for the food we eat and the fossil fuels we burn today.

Four transatlantic research teams will explore ways to overcome limitations in photosynthesis that could lead to the development of new methods for significantly increasing the yields of important crops for food production and/or sustainable bioenergy.

The funding agencies used a novel method called an "Ideas Lab" that led to these awards. Ideas Labs are based on the "Sandpit" concept initially developed by the Engineering and Physical Science Research Council (EPSRC) and are designed to stimulate new conversations about old problems.

In September 2010, an Ideas Lab was held in Asilomar, Calif. that focused on stimulating thinking in promising new, or currently under-developed, research areas relevant to photosynthesis. The workshop's goals were to develop innovative and transformative ideas on how to enhance photosynthesis through a multi-disciplinary approach and to bring together researchers to explore new and exciting avenues for future research in photosynthesis across all disciplines.

The result was the generation and real-time review of high-risk but potentially high-impact proposals for increasing the efficiency of photosynthesis.

NSF and the BBRC are now releasing four awards for proposals--each of which addresses a different bottleneck in photosynthesis--that were produced through the alternative approach pioneered at the Ideas Lab. NSF is contributing a total of $5.2 million to support U.S. participants in these projects.

"Photosynthesis is essential for life on Earth," said Joann Roskoski, NSF's acting assistant director for Biological Sciences. "By providing food and generating oxygen, it has made our planet hospitable for life. This process is also critical in addressing the food and fuel challenges of the future. For decades, NSF has invested in photosynthesis research projects that range from biophysical studies to ecosystem analyses at a macroscale. The Ideas Lab in photosynthesis was an opportunity to stimulate and support different types of projects than what we have in our portfolio in order to address a critical bottleneck to enhancing the photosynthetic process."

BBSRC's Director of Research Janet Allen said, "Photosynthesis has evolved in plants, algae and some other bacteria and in each case the mechanism does the best possible job for the organism in question. However, there are trade-offs in nature which mean that photosynthesis is not as efficient as it could be--at around only

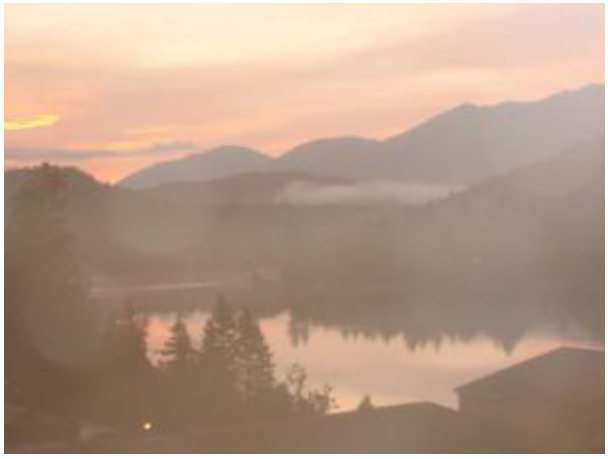
five percent, depending on how it is measured. There is scope to improve it for processes useful to us by, for example, increasing the amount of food crop or energy biomass a plant can produce from the same amount of sunlight. This is hugely ambitious research but if the scientists we are supporting can achieve their aims it will be a profound achievement."
Joanne Tornow, NSF's acting executive officer for Biological Sciences added that "The Ideas Lab is an innovative method for generating new ideas and building new teams of researchers that will undertake potentially transformative projects in areas of high impact, such as photosynthesis. Although NSF's award portfolio is already filled with exciting investments that hold great potential for advancing the frontiers of knowledge, trying new approaches could result in expanding the portfolio in new and unanticipated ways."
The four projects that were selected for funding at the Ideas Lab will conclude in about three years.
"The world faces significant challenges in the coming decades--and chief among these is producing enough sustainable and affordable food for a growing population and replacing diminishing fossil fuels," said Allen. "Even a small change to the efficiency of photosynthesis would make a huge impact on these problems. As these are global challenges, it is apt that we are working across national and scientific boundaries to put together truly international and multidisciplinary research teams."
When the four funded projects conclude, the two funding agencies will examine the approaches taken by these projects for addressing photosynthetic energy in order to determine whether the Ideas Lab approach realized its potential to generate novel and potentially transformative outcomes.
Summaries of the four funded projects follow:

1. Plug and Play Photosynthesis led by Anne Jones of Arizona State University: This project is designed to separate the capture and conversion of solar energy into fuel--processes that may be completed by a single cell--into two different organisms that would communicate with one another through electrical currents flowing between them. This separation of photosynthetic processes into different organisms will enable researchers to optimize environments for each of these processes and thereby improve their efficiency.
2. Exploiting Prokaryotic Proteins to Improve Plant Photosynthesis Efficiency (EPP) led by Stephen Long of the University of Illinois: A metabolic process known as photorespiration reduces the yields of plants including major crops, such as soy, wheat and rice, by an estimated 20 percent to 50 percent. Some blue-green algae have protein structures, called carboxysomes, that reduce such losses. This research aims to adapt and engineer these protein structures into crop plants to minimize photorespiration and boost yield.
3. Multi-Level Approaches for Generating Carbon Dioxide (MAGIC) led by John Golbeck of Pennsylvania State University: Through this project, researchers will attach to the membranes of photosynthesizing cells special proteins that will pump carbon dioxide from the atmosphere into cells. Resulting increases in the availability of carbon dioxide inside these cells will inhibit photorespiration and promote photosynthesis.
4. Combining Algal and Plant Photosynthesis (CAPP) led by Martin Jonikas of Stanford University: The unicellular green alga Chlamydomonas has a pyrenoid--a ball-shaped structure within the cell that helps this algae assimilate carbon to improve its photosynthetic efficiency. The goal of this project is to characterize the pyrenoid and associated components, and transfer them to higher plants in order to improve their photosynthetic efficiency.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

http://www.sciencedaily.com/releases/2011/03/110329134350.htm

No Longer Pining for Organic Molecules to Make Particles in the Air



Pine trees near a lake in US. The fresh scent of pine has helped atmospheric scientists find missing sources of organic molecules in the air -- which, it could well turn out, aren't missing after all. Researchers examined what particles containing compounds such as those given off by pine trees look like and how quickly they evaporate. They found the particles evaporate more than 100 times slower than expected by current air-quality models. (Credit: Copyright Michele Hogan)

ScienceDaily (Mar. 29, 2011) — The fresh scent of pine has helped atmospheric scientists find missing sources of organic molecules in the air -- which, it could well turn out, aren't missing after all. In work appearing in this week's *Proceedings of the National Academy of Sciences Early Edition Online*, researchers examined what particles containing compounds such as those given off by pine trees look like and how quickly they evaporate. They found the particles evaporate more than 100 times slower than expected by current air-quality models.

"This work could resolve the discrepancy between field observations and models," said atmospheric chemist Alla Zelenyuk. "The results will affect how we represent organics in climate and air quality models, and could have profound implications for the science and policy governing control of submicron particulate matter levels in the atmosphere."

Zelenyuk and colleagues at the Department of Energy's Pacific Northwest National Laboratory were able to measure evaporation from atmospheric particles in a much more realistic manner than ever before. This allowed them to show that they are not liquids, as has been assumed for two decades, and to get an accurate read on how fast these particles evaporate. What researchers previously thought takes seconds actually takes days.

Airy Organics

Secondary organic aerosols are tiny bits of chemically modified organic compounds floating in the air. They absorb, scatter or reflect sunlight, and serve as cloud nuclei, making them an important component of the atmosphere.

For a couple of decades, researchers have interpreted laboratory and field measurements under the assumption that these particles are liquid droplets that evaporate fast, which is central to the way these particles are modeled. However, to this day researchers have failed to explain the high amounts observed in the real atmosphere. The never-ending search for extra sources of organics has been frustrating for scientists studying these aerosols.

To re-examine the assumption, researchers at PNNL used equipment that could study the particles under realistic conditions. Zelenyuk developed a sensitive and high-precision instrument called SPLAT II that can count, size and measure the evaporation characteristics of these particles at room temperature. Research and development for SPLAT II occurred partly in EMSL, DOE's Environmental Molecular Sciences Laboratory at PNNL.

SPLAT Surprises

First, the researchers created secondary organic aerosol particles in the lab by oxidizing alpha-pinene, the molecule that makes pine trees smell like pine. Oxidation is the same thing that happens to iron when it rusts, and happens a lot in the atmosphere when aerosols come into contact with gases such as ozone, which is a pollutant when it is low in the atmosphere.
For comparison, the researchers also made particles from other, well-understood organic molecules that are known to form solids or liquid droplets, such as one called DOP. Lastly, they allowed these other organic molecules and the pine-scented SOA particles to mingle to simulate what likely happens in the outdoors.
Monitoring the various particles with SPLAT II for up to 24 hours, the research team found that DOP particles behaved as expected. Organics evaporated from the particles quickly, and faster if the particle was smaller, which is how liquid particles evaporate.
But the pinene-based particles did not. About 50 percent of their volume evaporated away within the first 100 minutes. Then they clammed up, and only another 25 percent of their volume dissipated in the next 23 hours. In addition, this fast-slow evaporation occurred similarly whether the particle was big or small, indicating the particles were not behaving like a liquid.
This lack of evaporation could account for the inability of scientists to find other sources of atmospheric organics. "Our findings indicate that there may, in fact, be no missing SOA," said Zelenyuk.

Slowing Spectators

In the world, the SOAs from pinene co-exist with other organic molecules, and some of these slam onto the particle and coat it. Experiments with the co-mingled SOAs and organic compounds showed the researchers that coated particles evaporate even slower than single-source SOA.
Zelenyuk then tested how close to reality their lab-based SOAs were. Using air samples gathered in Sacramento, Calif., the team found the behavior of atmospheric SOAs (whether from trees and shrubs or pollution) paralleled that of the co-mingled pinene-derived SOAs in the lab and did not behave like liquids. The results suggest that in the real atmosphere, SOA evaporation is so slow that scientists do not need to include the evaporation in certain models. The researchers hope that incorporating this information into atmospheric models will improve the understanding of aerosols' role in the climate.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Pacific Northwest National Laboratory**.

Journal Reference:

1. Timothy D. Vaden, Dan Imre, Josef Beránek, Manish Shrivastava, and Alla Zelenyuk. **On the Evaporation Kinetics and Phase of Laboratory and Ambient Secondary Organic Aerosol**. *PNAS*, January 24, 2011 DOI: 10.1073/pnas.1013391108

http://www.sciencedaily.com/releases/2011/01/110124151708.htm

Revamping MCAT and Pre-Med Education
April 1, 2011

A special panel on Thursday proposed an overhaul of the Medical College Admission Test -- including changes that could encourage would-be doctors to take more social science courses as undergraduates and that might result in some minority and disadvantaged students having better tools to highlight their strengths.

Many parts of the MCAT wouldn't change, including the centrality of sections on the biological and physical sciences. But other changes could be significant enough, several experts said, to change the behavior of undergraduates and the advising that colleges give those seeking to attend medical school.

And aside from issues of what's being added, the plan would also remove the writing section of the test, which officials said has largely been ignored by medical school admissions committees. Even with the writing test gone however, the changes add up to a significantly longer MCAT -- with the 5.5 hour exam expected to grow by 90 minutes.

The plan released Thursday will undergo months of review by the Association of American Medical Colleges, which created the panel and which runs the MCAT. At this point, the likely launch for a revamped MCAT is 2015, 25 years after the last round of changes in the test.

The new MCAT would feature four sections:

- Molecular, cellular, and organismal properties of living systems.
- Physical, chemical, and biochemical properties of living systems.
- Behavioral and social sciences principles.
- Critical analysis and reasoning skills.

The first two sections are largely adapted from the current MCAT (although some of the science would be updated, and the proposal calls for more regular updates). A verbal section that has been part of the test will be transformed into the critical analysis section, and the behavioral and social sciences section will take the place of a general writing section.

Steven G. Gabbe, chair of the committee that drafted the plan and senior vice president for health affairs at Ohio State University, said that the changes -- especially the increased emphasis on the social sciences -- reflected the evolving nature of medicine.

"It's very clear that in this country a large proportion of illness is related to behavior and social and cultural problems," he said. "So we want to encourage the applicant to medical school to be thinking about those and reading about those early." Gabbe recalled that, as an undergraduate, he took a course in "social disorganization," and he said that the topics discussed -- poverty, alcoholism and drug abuse, among others -- are subjects future doctors need to understand.

The message for undergraduates (and their advisers) is "that you do need a solid foundation in the sciences, but you need more than that. You need to think critically and reason, and understand the differences in our society and the patients you see as a physician," Gabbe said. "We need people who are critical thinkers and people who have sensitivity and understanding of different cultures."

The writing portion is proposed for elimination, Gabbe said, because interviews with medical admissions committees found that very few institutions took it seriously. "It really didn't help us, even though it occupied a large portion of the test," he said. Medical schools gain no predictive validity from the writing test beyond what they already know from applicants' college grades.

The panel of medical educators studied and rejected one idea for a radical change in the test -- a shift from the current scoring (15 points for each section) to a pass/fail system. Gabbe said that the idea was seriously considered, but was rejected out of a concern that medical schools would not have as much information about applicants. Further, he said that some members of the panel were concerned that a pass level might end up excluding applicants "from groups underrepresented in medicine." With point totals, he said, medical schools can make their own judgments.

Diversity and Personal Characteristics

The AAMC and most medical schools have repeatedly stated that a more diversified medical student body would benefit patients and American society. But MCAT score gaps have been repeatedly cited as one challenge to admitting more minority students.

White and Asian scores are, on average, quite close, as are scores of men and women, but other ethnic and racial groups lag.

2010 Mean MCAT Scores by Gender and Race/Ethnicity

Sex	
--Men	26.2
--Women	24.1
Race/ethnicity	
--American Indian/Alaska Native	22.7
--Asian	25.7
--Black	19.7
--Latino	21.3
--Native Hawaiian or Pacific Islander	22.2
--White	26.0

Other standardized tests for graduate and professional school admissions have also struggled with such gaps. One relatively recent solution has been the addition of standardized ways for either applicants or faculty members writing them letters of recommendation to -- in a consistent, comparable way -- comment on qualities that might show that a given applicant has potential, beyond what might be reflected in a test score.

The Educational Testing Service, for example, has created the Personal Potential Index as part of the Graduate Record Examination, and pilots have suggested that many more minority applicants do well on these measures than on traditional tests.

The AAMC looked at the PPI, as the ETS tool is called, and opted not to use it, but to consider similar ideas that might be customized for medical schools.

Karen Mitchell, senior director of the MCAT program, said that the AAMC has already been encouraging medical schools to engage in "holistic review" of applicants (not relying solely on the MCAT or any formula).

The recommendations issued Thursday called for the AAMC and medical schools to "[v]igorously pursue options for gathering data about personal characteristics through a new section of the [medical school] application, which asks applicants to reflect on experiences that demonstrate their personal characteristics,

and through standardized letters that ask recommenders to rate and write about behaviors that demonstrate applicants' personal and academic characteristics."

Further, the committee urges medical schools to "[m]ount a rigorous program of research on the extent to which applicants' personal characteristics might be measured along with other new tools on test day, or as part of a separate regional or national event, or locally by admissions committees using nationally developed tools."

Mitchell said that there are several pilot projects that could be models for a new part of the admissions process. Seventeen medical schools in the United States and Canada are doing brief interviews of applicants involving various ethical and social scenarios to learn more about would-be students. Similarly, the medical school association has been studying initiatives in Belgium and Israel, where shifts in the admissions process have resulted in greater diversity of students.

Will the changes currently being proposed -- and possible additional changes designed to capture applicants' personalities and values -- result in more minority applicants scoring well and being admitted? "That's the million-dollar question," Mitchell said.

At the same time, she stressed that the AAMC had already studied all of the proposals being made to ensure that they would not place minority applicants at a disadvantage. For example, the association checked the curricular offerings of every historically black college to be certain that undergraduates there had access to the courses needed to prepare for the new MCAT.

Reactions From Critics and Test-Prep Experts

The National Center for Fair and Open Testing has periodically criticized the existing MCAT.

Robert Schaeffer, public education director of the center, said that the MCAT has been viewed as encouraging "memorization and regurgitation" and is "better at identifying science nerds than candidates who would become capable physicians well-equipped to serve their patients." The changes being proposed appear to be "responding directly" to these critiques, he said.

Schaeffer said that the AAMC was correct to suggest that medical schools not place too much importance on minor differences in MCAT scores. And this is an area, he said, where execution of the ideas, not just saying the right things in a report, is key. "Even the most carefully designed test will still be problematic if its results are misused as the sole or primary factor to make decisions about applicants whose test scores differ by a point or two," he said.

Kaplan Test Prep issued a statement Thursday afternoon suggesting that undergraduates start planning for the changes now, even if they are several years away. Many of the additional skills the MCAT would test are commonly taught in psychology and sociology courses, the statement said, so undergraduates should keep that in mind.

Judene Wright, national content director for the MCAT for the Princeton Review, said that the changes largely made sense to her. She predicted that they would result in "a better pool of applicants" for medical schools.

For medical school applicants, she said, there will be demands that they learn more than what has been considered the basic pre-med program. She also said that the committee was being honest about how the writing test wasn't being used. "We've been hearing that for years," she said.

The committee urged medical colleges to make test prep materials available at low cost, so that applicants will not be at a disadvantage if they can't hire tutors. Wright said she doubted those changes would have an impact on her business or that of her competitors.

She said that she regularly sees clients who studied on their own and scored at average levels, but want to enroll at a top medical school. She mentioned as typical a new student who scored 28 (combined) himself but wants to enroll at a medical school where the average is well into the 30s. Low-costs materials, she said, are unlikely to help such students achieve the changes in scores that they want.

— Scott Jaschik

http://www.insidehighered.com/news/2011/04/01/plan_would_revamp_the_mcat_and_potentially_change_the_nature_of_pre_medical_education

Humanities, For Sake Of Humanity

March 30, 2011

WASHINGTON -- Beware that false idol, the broadly applied metric. Embrace the neglected power of ambiguity and individual human experience.

Those were two of the ideas explored here Tuesday at a daylong session dedicated to the future of the humanities. “We have come to rely on the explanatory power of quantification beyond its usefulness,” said S. Georgia Nugent, president of Kenyon College, during the Symposium on the Future of the Humanities, which was held at Johns Hopkins University's Paul H. Nitze School of Advanced International Studies, in tandem with the Council of Independent Colleges.

Nugent argued that the American public has become too easily persuaded by numbers -- even when those data are biased, flawed or wrong. Invoking Albert Einstein’s famous dictum -- that everything that can be counted does not necessarily count, and that everything that counts cannot necessarily be counted -- she said the public has started to rely too much on quantitative methods. “Some stories cannot be told by numbers,” she said, citing health and education as two areas in which data offer what she called “the illusion of control.”

The alternative, she and other speakers said Tuesday, is a world view that is shaped, at least equally, by the study of the humanities. Such a world view would be mindful of the risk of reaching easy conclusions and placing too much faith in fallible human knowledge, they said. While the precise definition of humanities disciplines varied according to speaker, all the presenters tended to refer to the arts, literature, language, history, philosophy, religion and some types of anthropology (in other words, those areas distinct from the physical and natural sciences, and the social sciences).

Most, if not all, of the speakers also lauded the virtues of these disciplines, while conceding that the attributes they praised also can make these fields unattractive to students seeking certainty in life and utility in their educations. The works studied and methods of interpretation in the humanities, many speakers said proudly,

seek to illuminate the woolly ambiguity, messiness and unique dimensions of human existence as expressed in highly particular times and places -- while also being, in some sense, universal.

“The humanities invite us to think about the human in the most human of ways,” said Victoria Mora, dean of St. John’s College, in New Mexico.

The symposium is the latest effort to restore the humanities to what their advocates see as their rightful place in higher education. Last month, the Commission on the Humanities and Social Sciences was assigned to come up with concrete and actionable plans for those in government, education and philanthropy to strengthen teaching and research in the humanities and social sciences.

But such efforts take place against a bleak backdrop for the humanities. Nearly 12 percent of bachelor’s degrees earned in 2009 were in these disciplines, as defined by the Classification of Instructional Programs of the National Center for Education Statistics, and as tabulated by the American Academy of Arts & Sciences' Humanities Indicators. By another narrower measure used by the National Science Foundation, the humanities are faring worse, at 7.8 percent of all baccalaureate degrees awarded -- or about half the share earned in the early 1970s. That trend, combined with a procession of cuts to university programs and scaled back support from state and federal sources, has conspired to feed the impression that the humanities are in a crisis. (It should be said, however, that many humanists acknowledge that rare have been the times when a crisis was *not* perceived in the humanities.)

No new initiatives or campaigns were unveiled Tuesday, and no elevator speeches polished for delivery to policy makers. Little hand-wringing -- about the culture wars that have roiled these disciplines in recent decades or about the budget cuts that loom today -- took place.

Instead, speakers floated a series of arguments in favor of the importance of the humanities, citing their civic, economic, pedagogic, political, moral, personally transformative and inherent (that is, art-for-art’s-sake) power. And several noted somewhat ruefully that it would be inconceivable for scholars of other disciplines to convene to discuss, say, the future of physics (as in, will there even *be* a future for this discipline?).

Along the way, they made reference to poets, philosophers and novelists as well as the occasional economist or scientist, most of them dead and canonical. The list, in no particular order and in no way exhaustive, included: Aristotle, Plato, Thucydides, Homer, Shakespeare, Coleridge, Keats, Rumi, Nietzsche, Weber, Hobbes, Hegel, Cicero, Kundera, Milosz, Achebe, Darwin, Dickinson, Freud, Jefferson, Buber, Montaigne, Dostoevsky, Descartes and Bellow.

The event took place at Hopkins’s graduate school of public policy and international affairs, and one session was dedicated to the confluence of the humanities and public policy. Douglas C. Bennett, president of Earlham College, in Richmond, Ind., described how the preamble to the U.S. Constitution -- “We the People” -- will fail to mean anything if we collectively lose a sense of whom that “we” describes.

Several speakers invoked the humanities as a means to feed a shared sense of history and culture. Jean Bethke Elshtain, the Laura Spelman Rockefeller Professor of Social and Political Ethics at the University of Chicago’s divinity school, said that, when she was a girl growing up in rural Colorado, her school reading textbook, which featured among others the writings of Willa Cather and W.E.B. DuBois, gave her insight into the lives of people very different from her.

“I was prepared for democratic citizenship,” she said. And, while Elshtain touted the ability of the humanities to broaden Americans’ understanding of their fellow human beings, she also warned against overselling the humanities as some sort of moral curative. Hitler, she noted, loved opera.

Dana Gioia, Judge Widney Professor of Poetry and Public Culture at the University of Southern California and former chairman of the National Endowment for the Arts, bluntly told the academics in the room that public support for the arts is collapsing by bipartisan consensus, and that they must figure out a way to make the case, in a comprehensible way, to politicians who are trying to balance budgets.

He urged scholars in the humanities to speak clearly and inclusively about their subjects, not to assume ironically detached postures. And they should not fear reaching out to people who work in politics, the news media and corporations. “If we want to work with a democratic society,” he said, “we need to work with the components of democracy.”

Gioia said the argument in favor of such disciplines as literature can be made in clear terms. He cited an NEA report from 2007, "To Read or Not to Read," which pulled together research on how the act of reading literature for pleasure correlates with social and economic measures. The report culled studies suggesting that reading for pleasure on a daily or weekly basis is positively associated with higher levels of academic achievement, cultural engagement, voting, voluntarism and even exercise. “Cold statistics confirm something that most readers know but have mostly been reluctant to declare as fact,” the report notes. “Books change lives for the better.”

The report also noted that employers say that reading and writing skills are among the most prized, and least present, skills in high school graduates. But many speakers resisted the notion that the humanities should be framed according to the employability of future graduates or economic utility.

When asked by one audience member how those attending could better “sell the humanities,” Edward Hirsch, president of the John Simon Guggenheim Memorial Foundation, chafed. “We are advocating on behalf of a certain way of thinking,” he said. “Our job is not to sell something. It’s to advocate for something that can’t be sold.”

But Hirsch acknowledged that humanists had not made their case very well outside academe. He, and others, noted that materialism and economic gain had become the prevailing ethos in American society, and that those working in the humanities were trying to swim against that tide.

So, too, are humanists swimming against a tide of abbreviated and divided attention spans, added Kwame Anthony Appiah, Laurance S. Rockefeller Professor of Philosophy at Princeton University. “We have a hard time making complicated arguments,” he said. “Our temperament of mind is not designed for speaking to a world that has decided that 15 seconds is the longest period of time an answer deserves.”

— Dan Berrett

http://www.insidehighered.com/news/2011/03/30/scholars_seek_to_craft_argument_for_urgency_of_the_humanities_in_higher_education

Mental Health, Top of Mind

March 29, 2011

BALTIMORE -- Two Old Dominion University student affairs officials who are reviewing the past 10 years of college counseling literature -- that is, documents related to research, theories and practices -- have found that the theme of "student counseling and mental health needs" appears near the top in most every category of literature; it spans student development, student health, counseling psychology and professional counseling.

That this set of concerns dominates the minds of people in the field was reinforced by the large number of sessions on these topics Monday at the annual convention of the American College Personnel Association. Presentation subjects ranged from behavioral intervention teams and suicide prevention to using positive psychology to help students succeed.

Alan M. Schwitzer and Dana Burnett, professors in counseling and human services and education and leadership, respectively, studied their own university's students to see whether those who are referred to counseling -- and who actually go -- perform better academically and are more likely to graduate than their peers who decline counseling. When they found that the answer is yes -- at least, on that campus -- it raised the question of whether research has found the link elsewhere as well.

The search for an answer led to the review and annotation of 750 articles published in about a dozen leading journals from 1998-2008, and an organization of that research into a website-database that its creators hope will serve as a valuable resource to student affairs professionals. "We would like to stimulate research in areas where it doesn't exist, or doesn't very much exist," Burnett said. "We need to identify where it's coming from and where it's not." For instance, after the Virginia Tech shootings in 2007, Burnett found, surprisingly little of the literature about students in crisis came from college counselors.

Counseling journals are publishing on other topics, though. In addition to student counseling and mental health needs, other subjects that surfaced most often during the 10-year period include serving specialized campus populations; attachment theory (commonly referred to as "helicopter parenting") and self-efficacy; and professional issues and trends.

Another theme that came up -- and that, as one attendee pointed out, is of particular interest as colleges look for ways to cut costs -- is the value of counseling centers. While Burnett said the research does demonstrate their value, he suggested that with the help of those in the audience who might review the website and offer feedback on the project, they could recommend further research on the topic. "We really want this to be a group effort," he said. "We really need to be planning for the next 10 years, and maybe we could influence the way people do their research."

In literature discussing concerns of students, one sub-theme that Schwitzer and Burnett identified as getting significant scholarly attention was that of depression and suicide, which Donn Marshall, associate dean of students at the University of Puget Sound, addressed in another session Monday.

"In the case of suicide prevention, what I think of as a moral imperative," Marshall said, "is that we're really talking about life and death here. That if we're choosing suicide prevention programs, we're really talking about choosing things that are effective in saving lives." To aid colleges in making those tough decisions, Marshall summarized the suicide prevention landscape, identifying programs that are proven to work, as well as those that are unproven but may be a good fit for a given campus. (The complete list is available on the ACPA website, where programs can be categorized under early identification, referral and follow-up; clinical; policy; or case management.)

There are a number of factors that colleges should take into account when implementing a suicide prevention program, including cost and the demographics of the student body. And, he observed, an institution's officials must consider whom they're dealing with: programs can address the entire student body through an educational campaign, or one student who attempted suicide and is at risk of a relapse. The key is knowing your campus, Marshall said.

At Puget Sound, there hasn't been a death by suicide in eight years and 18 days (Marshall keeps track). But that doesn't mean the college found the perfect prevention methods and hasn't changed since. Quite the opposite, actually; both Marshall and student affairs officials in the audience noted that, because humans lose interest in the familiar, it's often more difficult to sustain a program that works than to start an entirely new one.

Marshall noted a few standouts. At the University of Illinois, suicide deaths have plummeted 50 percent since the institution started mandating more than 20 years ago that students who considered or attempted suicide undergo four psychological assessment sessions. While there's no empirical evidence from other colleges using the strategy, its success at Illinois has garnered attention.

A newer method that is backed up by empirical evidence is an online screening program, where counseling centers reach out via e-mail to their student population to offer an online test to measure how they're faring personally, and follow up with feedback about resources and options if a student's response indicates he or she is having problems. The American Foundation for Suicide Prevention has suggested online tests are a "pretty effective" way of reaching students who wouldn't otherwise have sought therapy, Marshall said.

One method that inspired conversation at the session was that of medical leave. Puget Sound allows at-risk students to voluntarily take time off, but convention attendees were more interested in involuntary medical leave, after one person in the audience mentioned Pima Community College, which suspended Jared Lee Loughner; after leaving the college, he carried out the shooting spree in Tucson. The man who posed his question to Marshall asked whether any colleges as a policy assume risk for involuntary student medical leaves.

Marshall said he didn't know of any, but he, like many other student affairs officials, defended Pima's actions. He noted that the college actually sent officers to Loughner's parents to convey their concerns (which illustrates another point Marshall made: communication with parents can be critical). "That's more than my school's policy would do, would require of us," he said. "I'm unaware of any place that does anything more than what they did, and my hat is really off to them."

Behavioral Intervention and Positive Psychology

Another measure Pima has in place is a behavioral intervention team. Such teams exist at many colleges, and student affairs officials from Montgomery College, in Maryland, described the concept in a later convention session. They said that while such teams are not a new idea in higher education, recent shootings and the growth of counseling complexities and diversity in student bodies have caused many colleges to modify or upgrade their own systems.

Behavioral intervention teams are meant to identify and address worrisome student behaviors based on early signs of danger. They are not, the presenters stressed, emergency first-response teams. Rather, they can serve as reporting systems and draw attention to troubled students before they act out. "We see BIT as a process that assists students in being successful," said Monica Brown, dean of student development at Montgomery. "It is important that if students are dealing with mental health issues, or dealing with behaviors of concern, that they get the help they need so they can continue."

Montgomery's behavioral intervention operates through a seven-step process. First, it responds to a student referral from a faculty or staff member. It conducts a preliminary investigation to determine whether it should respond, as opposed to referring the student to another resource if an intervention is not necessary. If the team moves forward, it will then initiate a threat assessment and develop an action plan, which is based on a model that's used consistently for all students (of course, each case is unique and certain details will depend on the student). It makes a recommendation to the dean of students. If the recommendation is green-lighted, the team implements its intervention, or response.

"That can take very different shapes and forms, depending on your case," said Helen Brewer, associate dean of student development at Montgomery. The last step is "wrap-around services," or following up with everyone involved -- including the student, his or her parents, and the person who made the referral in the first place.

One convention presenter explored ways to avoid a referral situation altogether. In her session, Jamie Matthews, community director of university housing at Southern Illinois University at Edwardsville, applied the principles of positive psychology to higher education.

Positive psychology is also an identification method, but rather than the clinical method of pointing out what's going wrong and trying to fix it, it identifies what's going right and tries to replicate it. Matthews said that in the last 10 or 15 years, positive psychology has gained popularity, but it's still mostly anecdotal at colleges. "I think it's growing," she said. "They're dabbling with it."

At a college, the psychologist would discuss with the student his or her strengths to help facilitate growth and learning in both academics and other parts of college life. A major component is helping students understand how they got to college and what role their past experiences should play in their present lives, which is intended to help them figure out where they'll go from here. This can assist the students -- and staff -- in identifying what's important to them and what defines success.

There are various positive psychology models that can apply to higher education, but all of them emphasize understanding students. Other benefits that Matthews pointed to are personal and professional growth for the practitioners, as well as quantitative research opportunities.

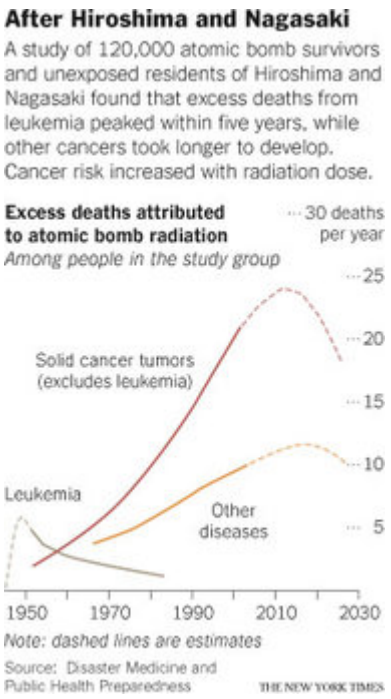
It's important, Matthews said, to balance out the clinical methods with positive psychology strategies. "You can have positive motion at the same time as negative motion," she said. But it's what you do with it, and how you move forward with your students, that counts.

— Allie Grasgreen

http://www.insidehighered.com/news/2011/03/29/acpa_convention_explores_student_mental_health_and_counseling_behavioral_intervention_psychology

Radiation Is Everywhere, but How to Rate Harm?

By DENISE GRADY



Since the first reports last month of damage to nuclear reactors at the Fukushima Daiichi power plant, the lingering question has been whether drifting plumes of radioactive elements from the plant will harm people in Japan or other parts of the world. For many people, the biggest fear is cancer.

Certain levels of radiation exposure are known to increase the risk of cancer, but scientists disagree about the effects of very low doses of the sort that may have occurred so far in Japan.

Some researchers say it is reasonable to use data from high doses to calculate the risk of smaller and smaller doses. They argue that any exposure to radiation raises the risk of cancer, though probably by only a small amount in the case of small doses.

But others say that estimating risk for doses near zero is nonsensical, and some believe there is a threshold dose, or limit below which there is no risk from exposure.

Dr. John Boice, for example, a professor of medicine at Vanderbilt University who studies radiation effects in humans, warns that risk calculations based on tiny doses are themselves risky.

He argues that there is little data on doses below about 10 rem, but that some risk estimates nonetheless go down to a tenth of a rem or less. (He is also the scientific director of the International Epidemiology Institute in Rockville, Md., a private group that studies radiation with grants from government and industry.)

“I can take a low dose, multiply it by a million people and estimate a risk,” Dr. Boice said, but he said professional groups like the Health Physics Society discourage it. “We say, don’t do that. Don’t multiply a tiny dose by millions and say there will be thousands of deaths. It’s inappropriate, misleading and alarmist. You’ve gone orders of magnitude below where we have proof of any effects at all.”

But Dr. David Brenner, director of the Center for Radiological Research at Columbia University, is among those who believe there is no threshold. Radiation damages DNA, he says, and just one damaged cell can become the seed of a cancer, though it takes decades to develop. He is studying the possibility that in terms of causing cancer, low doses of radiation might be more dangerous than calculations based on high doses would predict.

Current estimates by government agencies for risks from low doses rely on extrapolation from higher doses.
In the United States, most government agencies use a unit called the rem to measure radiation doses. (Europe and Asia use the unit millisievert, which equals 0.1 rem.) According to the Environmental Protection Agency, people receive 0.3 rem per year from natural background radiation.
If 10,000 people are each exposed to 1 rem, in small doses over a lifetime (above the natural background exposure), according to the agency, the radiation will cause five or six excess deaths from cancer. In a group that size, about 2,000 would normally die from cancers not caused by radiation, so the extra dose would raise the total to 2,005 or 2,006.
So far only minute amounts of radioactivity from the Japanese reactors have been detected in the United States, in milk on both the East and West Coasts, and in rainfall in Massachusetts. American officials say instruments can detect levels so vanishingly small — far below the natural background level of radiation — that they pose no threat.
In parts of Japan, radioactivity has been detected at various times in milk, meat, vegetables and tap water, on the ground and in the sea around the power plant.
Levels in tap water in certain areas have sometimes been high enough for authorities to tell people to drink bottled water, and the Japanese government has banned the shipment of milk and produce from some prefectures.
Milk from those regions has been found to contain radioactive iodine, which accumulates in the thyroid gland and can cause cancer, especially in children. Levels in the milk have exceeded those considered a cause for concern in the United States.
A quarter mile from the Fukushima plant (residents have been evacuated from a 12-mile zone around the plant) radiation levels of 0.1 rem per hour have been measured, and researchers agree that four days of such exposure would increase a person's risk of cancer. But some would argue that an even shorter exposure would raise the risk.
Many of today's risk estimates are based on a study of 200,000 people who survived the atomic bombing of Hiroshima and Nagasaki in August 1945. More than 40 percent are still alive.
The research has been going on for 63 years, and an article reviewing its findings was published in March in the journal Disaster Medicine and Public Health Preparedness.
So far, it is uncertain how relevant the results from bomb survivors are to members of the public in Japan who may have been exposed to radiation from the reactors.
"One concern is trying to find out what dose these people actually received" from the Fukushima reactors, said Dr. Evan B. Douple, the first author of the article on the bomb survivors and the associate chief of research at the Radiation Effects Research Foundation in Hiroshima, which studies the survivors and is paid for by the governments of Japan and the United States. It is the successor to the Atomic Bomb Casualty Commission, which was created in 1947.
Dr. Douple said the method of exposure was also different: The bomb survivors received their entire doses all at once to the full body, but exposure from the reactors may be gradual.
"Here radioisotopes are drifting in water and air, and not necessarily producing an external whole-body exposure and are being taken up in very small doses into the body," he said. "So far the information we've been receiving is that actually the doses of exposure are not what one would call intermediate or high doses, but are very low."
The bomb survivors received radiation doses ranging from negligible to high; high would be 200 rem or more, what Dr. Douple called a "barely sublethal dose." But 61,000 people were estimated to have received half a rem or less, and 28,000 received half a rem to 10 rem.
Their doses were calculated based on factors like how close they were to the center of the bomb and whether they were inside buildings. For comparison, the study also includes 26,000 people who lived in the same cities but were not exposed to radiation because they were not present during the bombings.
The researchers monitored the two groups — exposed and nonexposed — to determine whether radiation caused disease.
Radiation did increase the risk of cancer. "But the risk of cancer is quite low, lower than what the public might expect," said Dr. Douple. He said that the researchers themselves had expected to find more cancer than they did.

Among the survivors, leukemia was the first cancer to appear. Cases increased within five years of the bombing and then began declining at the 10-year mark.

Of 120,000 survivors in one study group, 219 with radiation exposure had died of leukemia from 1950 through 2002, the latest year with published data. But only 98 of those cases, or 45 percent, were excess deaths attributed to radiation.

However, when the leukemia deaths were sorted by radiation dose, it was clear that risk increased with dose. Among people who received the highest doses (100 rem or more), 86 percent of the leukemia deaths were a result of radiation, compared with only 36 percent of the leukemia deaths in those with exposures from 10 rem to 50 rem. Among those who received half a rem to 10 rem, only 4 of 77 leukemia deaths, or 5 percent, were estimated to be excess deaths caused by radiation.

Solid tumors — affecting the colon, breast, liver, lung or other organs — took longer than leukemia to develop, Dr. Douple said.

In a study group of 100,000, there were 7,851 deaths from solid cancers among people exposed to radiation, but only 850, or 11 percent, were estimated to be excess cancer deaths due to radiation. As with leukemia, the risk increased with radiation dose. Some organs were more sensitive than others. For instance, radiation increased cancer risk in the breast, but not the prostate.

Dr. Douple emphasized that at very low doses, the risk was also very low. But he also said that there was no indication of a threshold, or a level below which acute radiation exposure would have no effect, or a smaller effect than would be predicted based on higher exposures.

Does the bomb data apply to Fukushima? Hiroshima and Nagasaki were the worst case, Dr. Douple said. It is possible to extrapolate from them to the very low-dose range detected so far, but in doing so, he said, there are "big uncertainties."

But he added that Japanese scientists from the institute have been summoned to Tokyo, to help figure out what the potential health effects might be and to plan ways to detect and study them.

http://www.nytimes.com/2011/04/05/health/05radiation.html?_r=1&nl=health&emc=healthupdateema2