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December 2005

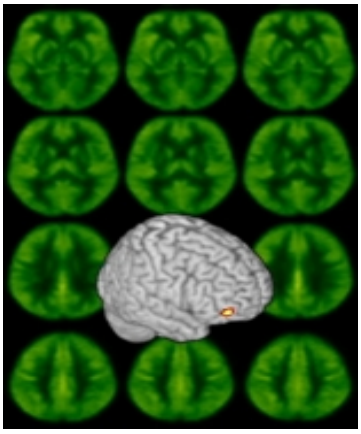
NSF AT WORK

Brain Images Show Effects of Stress

The holiday season is notorious for the emotional stress it evokes. Now, researchers have come up with a non-invasive way to see the effects of psychological stress in an area of the brain linked to anxiety and depression. This research has important implications for how practitioners treat the numerous long-term health consequences of chronic stress.

Researchers used functional magnetic resonance imaging (fMRI) to detect increased blood flow in the prefrontal cortex of individuals subjected to stress. Further, the increased flow continued when the stressor was removed, suggesting the effects of stress are more persistent than once thought.

Supported by NSF, the National Institutes of Health, and the U.S. Air Force, this research will pave the way to develop improved strategies to prevent or correct the long-term health consequences of chronic stress. For more on this underlying non-invasive fMRI procedure, see "Researchers Use Imaging Technique to Visualize Effects of Stress on Human Brain."

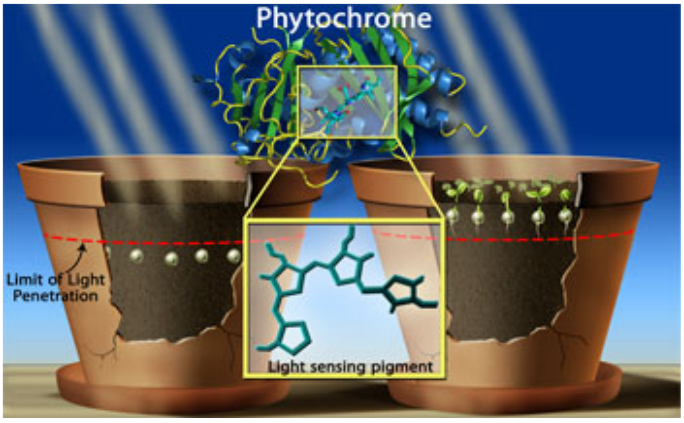


The yellow area depicts the detected activation in the right prefrontal cortex of the brain, an area long associated with anxiety and depression. The background image shows the mean cerebral blood flow of volunteers participating in stressful tasks. Credit: Univ. of Pennsylvania School of Medicine.

For the Love of Light: Phytochrome's 3-D Shape Revealed

Plants use light for energy during photosynthesis, as well as to govern basic processes such as seed germination, flowering, and, in autumn, dropping of leaves. NSF-supported scientists recently revealed the 3-D structure of the light-detecting protein, phytochrome. The researchers determined that phytochrome is twisted into a molecular knot, an uncommon shape for any protein. The scientists theorize the knot helps give phytochrome an overall stability as it snaps back and forth between two different forms in response to changes in light color.

Knowing the 3-D structure of phytochrome will allow researchers to determine the specific switching mechanism plants use to respond to light and how the light-derived signals are propagated within the plant. Nanotechnologists may also find a light-activated switch useful as they develop novel microscopic devices. Read NSF's press release, "Scientists Shed Light on Plant Responses" for more details about phytochrome's form and function.



Scientists revealed the 3-D shape of phytochrome when it interacts with a light-sensitive pigment. Phytochrome, discovered some 40 years ago by USDA scientists, helps guide development in bacteria, fungi and plants. Credit: N. Rager-Fuller, NSF; J.R. Wagner, Univ. of Wisconsin-Madison; J.S. Brunzelle, Northwestern Univ., and K.T. Forest and R.D. Viestra, Univ. of Wisconsin-Madison.

DNA Studies Show Microevolution in Penguins

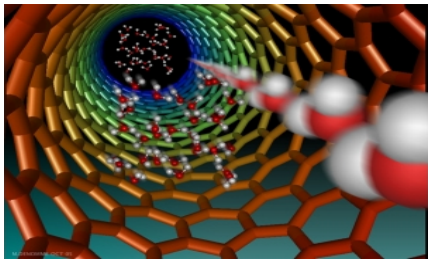
By comparing the genetic code from 6,000-year-old remains of Adelie penguins in Antarctica with that of modern Adelies living at the same site, researchers have shown that microevolution, the process of evolutionary change at or below the species level, has taken place in the population.

Penguins at Cape Royds on Ross Island, Antarctica. Credit: P. West, NSF.

The new study, conducted by an international team of researchers from Italy, New Zealand and the United States, also reveals slight variations in the coding of the modern penguin's genes. The researchers found that the DNA sequences for some genes had become longer over time, and that the frequency of some of the different genes had changed as well.

The researchers also theorize that cyclical break-offs of enormous Antarctic icebergs could be the source of a remarkable genetic similarity among contemporary penguin colonies. For more on Adelie penguins and how icebergs affect them, see NSF's press release entitled, "DNA Studies Show Microevolution in Penguins."

Fluids Race Through Nearly Frictionless Carbon Nanotubes



In this illustration, water travels through carbon nanotubes at a rate 10,000 to 100,000 times faster than models predict. Credit: M. Denomme, Univ. of KY.

Inside living cells, fluids flow rapidly through microscopic, nearly frictionless protein channels. Until now, man-made nanoscale structures have not been able to mimic the speeds of natural systems because the fluids flow slowly along the walls. A team of engineers, including one NSF CAREER awardee, recently found that carbon nanotubes only seven-billionths of a meter in diameter channel many fluids in a nearly friction-free manner. With some fluids, the interiors of the tubes were so slippery that the liquids sailed through 10,000 to 100,000 times faster than models had predicted.

The fabrication techniques for these nanotubes easily adapt to large-scale production--important for industries that need to separate commodity chemicals. The technology could one day be used to deliver drugs through the skin or in specialized chemical sensors. For more on the tiny tubes, see NSF's "Slippery When Wet."

Arkansas University Introduces Minority Students to Environmental Research

Mentorship is alive and well at Arkansas State University, where geochemist Robyn Hannigan has established a program to immerse minority and female students in the study of environmental science. The result has been a double success for science and education. The program, Research Internships in Science of the Environment (RISE), gives some students their first experience doing research. A Native American from a disadvantaged community, Hannigan knows from experience that science only appeals to many students after they have personally conducted hands-on research.

Arkansas State University professor Robyn Hannigan believes science holds natural appeal for curious minds. Credit: C. Fitzwater.

With funding from NSF's Research Experiences for Undergraduates program, Hannigan designed RISE to increase diversity in the scientific workforce. Since 2001, RISE has supported the summer research projects of more than 30 undergraduate students. For more, see "RISE Program Proves that Undergraduate Research Experiences Help Recruit Minority Scientists."

Faces of NSF Research

NSF Award Takes Root with Marianne Krasny's Nurturing

In 2001, Cornell University professor Marianne Krasny received a grant from NSF's Informal Science Education program to create Garden Mosaics, a project that merges community gardening with scientific investigation and education in urban areas. Since then, the project has expanded into dozens of cities across the U.S. and abroad, receiving recognition from national educational groups and gardening associations.

Meet Marianne Krasny.

NSF: What sparked your interest in science education?
Krasny: Like many girls, I wanted a career that helped people. I worked as a leader for National Outdoor Leadership School and in youth services. Then I took a bike trip through South Texas, Mexico, Belize, and Guatemala; the erosion caused by terracing on steep slopes made an impression. My position at Cornell allows me to combine science and helping people.

NSF: What's the most rewarding part of your work?
Krasny: Observing professional and personal growth in my graduate students. Opportunities to venture into and talk with people in urban and international communities I normally would not have access to. Relationships with colleagues in which we have a constant and challenging exchange of ideas.

NSF: Has working with Garden Mosaics changed your approach to education?
Krasny: Definitely. It has led to new ideas about embedding science education within multicultural understanding, intergenerational mentoring, and community action.

NSF: Are you yourself a gardener?
Krasny: My daughter is the gardener. Mostly I help her.

Read more about Marianna Krasny's project in NSF's Discovery, "Science, Education and Community: Organically Grown."

NSF in the News

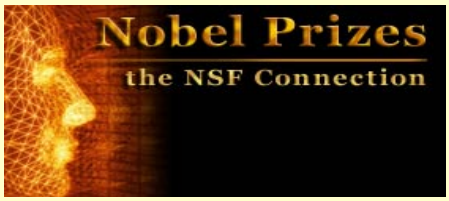
Way-Out Weather: Cold Fronts in Space -- USA Today (12/06/05)
Researchers funded by NSF and NASA have developed a way to combine ground and space observations to create a never-before-seen view of electrified storms in the upper atmosphere.

Dredging Led to Deep Trouble, Experts Say -- New Orleans Times-Picayune (12/09/05)
Dredging the 17th Street Canal in New Orleans to increase the capacity of a local pump station likely led to the collapse of the floodwall at the site during Hurricane Katrina, according to an NSF-sponsored investigative team.

Researchers Engineering Better Technologies for the Blind -- San Francisco Chronicle (11/27/05)
University of California at Santa Cruz professor Roberto Manduchi has received backing from NSF to develop a laser-based range-sensing device that can relay spatial information back to users. The electronic instrument emits various sounds, alerting users about a curb, steps, or other obstacles nearby. The technology is geared towards the sight impaired.

Manufacturing Gets Personal: Fab Labs Unshackle Imaginations -- Associated Press (11/07/05)
The MIT Center for Bits and Atoms started installing Fabrication Labs three years ago as free community resources in places as distant as India and Ghana. The labs each come with commercially available tools, including a laser cutter and milling machine; a sign cutter to create graphics or plot flexible electronic circuits, and electronic assembly tools. The labs were designed with the help of a five-year, $12.5 NSF grant.

Did You Know?



Of the 504 individuals who have received the Nobel Prize since 1952 (the first year NSF awarded research grants), 166 or 33% received NSF funding at some point in their careers.

See NSF's "NSF-Funded Nobel Prize Winners in Science Through 2005" Fact Sheet for a breakdown of medal recipients by discipline.

NSF PERSPECTIVES

A Conversation with the NSF Director

Bement denotes cyberinfrastructure as the tie that binds.

"NSF has several goals this fiscal year, and our emergent cyberinfrastructure initiative is literally the tie that binds these goals together and will help make them achievable and I hope to illustrate this."

"Our long-term goal at NSF is to build a cyber-infrastructure that joins the ranks of the electrical power grid and the interstate highway system; that is, a true utility that is ubiquitous, reliable, adaptable and powerful."

"NSF's priorities for fiscal year 2006 are reinforced by the cyberinfrastructure initiative. ***One of our goals is to strengthen core disciplinary research, or as I like to call it, to continually dog the frontier.*** It is fundamental discovery that opens up new regions of the frontier."

"The best cyberinfrastructure, the best scientific research and education, must be built around and upon people. We need researchers and educators who are proficient in the science disciplines, and who will know how to use new cybertools."

Excerpts from Dr. Bement's luncheon keynote *at the NASULGC annual meeting on 11/13/05.*

NSF FY 2006 Budget Signed

On November 22, 2005, the President signed the Science, State, Justice, Commerce and Related Agencies Appropriations Act of 2006 (H.R. 2862) into law (P.L.109-108), yielding a three percent increase for the National Science Foundation (NSF). The agency's budget rebounds to $5,653.37 million--3.3 percent higher than the FY 2005 funding level and nearly one percent above the President's FY 2006 request level.

The law provides $4,387.52 million for the Research and Related Activities Account, an amount four percent above the FY 2005 appropriation and 1.2 percent above the President's request for FY 2006. The Education and Human Resources Account is provided $807 million, an increase of 9.5 percent over the FY 2006 request. The law provides $193 million for the Major Research Equipment and Facilities Construction Account, an amount 11 percent above the FY 2005 level and 22 percent below the President's request. The law also contains an across-the-board cut of 0.28 percent, which will reduce the NSF total by roughly $17 million. The aforementioned numbers do not reflect this rescission.

This budget cycle was the first in which NSF's appropriation was considered in the newly configured Science, State, Justice, Commerce and Related Agencies Appropriations Act. This bill is the principal source of financial resources to support the Departments of Justice and Commerce, including the National Oceanic and Atmospheric Administration; the National Aeronautics and Space Administration; NSF; and a number of independent agencies and commissions, including the Securities and Exchange Commission, the Small Business Administration, and the Federal Trade Commission.