National Science Foundation
WHERE DISCOVERIES BEGIN

# NSF CURRENT
NATIONAL SCIENCE FOUNDATION

***April 2010***

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## NSF AT WORK

### Reducing Our Carbon Footprint With Fire

Credit: National Interagency Fire Center, Boise, Idaho

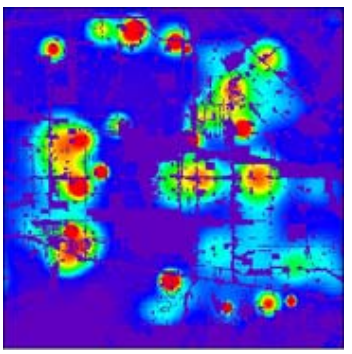
The use of prescribed burns to manage western forests may help the U.S. reduce its carbon footprint. Results of a new study, funded by the National Science Foundation (NSF), show that such burns, often used by forest managers to reduce underbrush and protect bigger trees, release substantially less carbon dioxide than wildfires of the same size. The results were published last month in the journal *Environmental Science & Technology*.

"It appears that prescribed burns can be an important piece of a climate change strategy," says Christine Wiedinmyer of the NSF-funded National Center for Atmospheric Research (NCAR) in Boulder, Colo. "If we reintroduce fires into our ecosystems, we may be able to protect larger trees and significantly reduce the amount of carbon released into the atmosphere by major wildfires."

Forests have emerged as important factors in climate change. Trees store, or sequester, significant amounts of carbon, thereby helping offset the large amounts of carbon dioxide emitted by vehicles, factories and other human sources. When trees burn, much of that carbon is returned to the atmosphere. It can take decades for forests to sequester the amount of carbon emitted in a single fire.

Wiedinmyer and her colleagues found that widespread prescribed burns can reduce fire emissions of carbon dioxide by 18 to 25 percent and by as much as 60 percent in certain forests. Read more **here**.

### Fighting Crime With Math



**NSF-funded investigators** at UCLA and the University of California (UC), Irvine, have teamed up with police in Los Angeles to find ways to fight the spread of crime. The researchers developed a mathematical model that has revealed the existence of two types of crime hotspots: super-critical hotspots that give rise to a rapid chain reaction of lawlessness, and sub-critical ones that result in large spikes of criminal activity in an otherwise stable area.

Super-critical hotspots form from small crime spikes spread over a large area. When police force is applied to this type of hotspot, new spots of crime bud off from existing ones. These buds form around small spikes of activity away from police presence, and the crime

Burglary hotspots in LA crime model. Credit: University of California

continues. Police action applied to sub-critical hotspots, on the other hand, is found to suppress crime, since the area surrounding the hotspot is relatively stable.

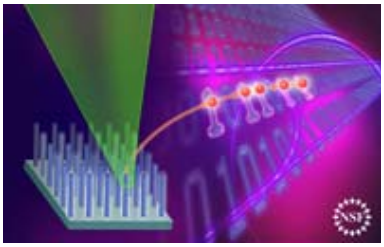
One of the investigators, Andrea Bertozzi of UCLA, explains that the model can reveal which type of hotspot may be acting in a certain part of the city. "Policing actions directed at one type will have a very different effect than policing actions directed at the other type," she says.

George Tita of UC Irvine and Jeff Brantingham and Martin Short of UCLA also participated in the study. "Our model was originally built around a model for residential burglaries," explains Short. "However, based on real data, we believe the ideas in the analysis apply to a variety of crime types."

Read more about the work and watch videos of the mathematical simulations **here**.

## Computing With Diamonds

NSF-funded investigators have recently discovered that the same physical process that gives some diamonds a stunning yellow color can also turn the sparkling gemstones into computing devices that use light, instead of electrons, to store and transmit information.



Matrix of diamond nanowires with NV color centers emits stream of photons. Credit: Zina Deretsky, NSF

The team of scientists, led by Marko Loncar of **NSF's Nanoscale Science and Engineering Center (NSEC) at Harvard**, developed the new device based on tiny wires constructed from diamond crystals. The diamond contains nitrogen vacancy (NV) color centers formed when a nitrogen atom, which normally turns diamonds yellow, sits next to a vacant site. NV centers can function as registers in quantum computers, storing information as quantum bits, or qubits, in place of the normal magnetic bits found in standard computing systems.

Although quantum computing has been an intriguing possibility for some time, the location of the color centers deep within the diamond crystal prevented transmission of information from one location to the other. Loncar, who is also an **NSF CAREER awardee**, explains: "What was missing was an interface that connects the nano-world of a color center with the macro-world of optical fibers and lenses." The new diamond nanowires greatly increase the probability that quantum computing may one day become a reality. Read more about this work **here**.

## NSF Dispatches Rapid Response Research Vessel to Chile

The research vessel *Melville* undertakes a rapid response mission to Chile. Credit: SIO/UCSD

NSF-funded scientists aboard the research vessel *Melville* are undertaking an expedition to explore the rupture site of the recent 8.8-magnitude earthquake off the coast of Chile. The rapid response expedition is possible because the *Melville* had been conducting research in the Chilean coastal area when the earthquake struck.

An important aspect of the mission involves swath multibeam sonar mapping of the seafloor to produce detailed topographic maps. Data from measurements of the earthquake zone will be made public soon after the research cruise ends, according to Julie Morris, division director for ocean sciences at NSF. The researchers plan to compare the new data with pre-quake data obtained by German scientists at the Leibniz Institute of Marine Sciences, with the goal of finding changes caused by the earthquake rupture.

"We'd like to know if the genesis of the resulting tsunami was caused by direct uplift of the seabed along a fault, or by slumping from shaking of sediment-covered slopes," says research team member Dave Chadwell of the Scripps Institution of Oceanography at the University of California, San Diego. Daily updates from Chadwell and others on the research mission are available on the group's blog, **SIOSEARCH**. Read more about the project **here**.

## Did You Know?

On Feb. 19, 2010, NSF and the University of Southern California (USC) School of Cinematic Arts announced a new partnership designed to forge collaborations between scientists and entertainment scholars with the goal of producing materials that inspire and inform audiences about science and engineering concepts. The partnership establishes the Creative Science Studio, which will provide NSF-funded researchers with novel opportunities to create engaging and informative expositions of their work for the public. In addition, USC students will gain experience with complex and cutting-edge scientific concepts. "This novel and creative partnership will enlist the power of the entertainment media to inspire audiences to learn more about science and engineering," explains Thomas Kalil, deputy director for policy in the White House Office of Science and Technology Policy. Read more about the innovative partnership **here**.

USC production area. Credit: School of Cinematic Arts, USC

## Faces of NSF Research

### Social Networking Among Bacteria

Bonnie Bassler. Credit: Princeton University

Bonnie Bassler, **NSF-funded investigator** at Princeton University, is fascinated by the social lives of bacteria. She has discovered that bacteria communicate using a chemical language. Her realization, that these tiny organisms form a social network and communicate with each other using a process called quorum sensing, has transformed the way biologists think about bacteria and may one day lead to new types of antibiotics.

Quorum sensing begins when bacteria release small molecules into the surrounding medium. These molecules are detected by neighboring bacteria that are essentially able to "count" how many of their brethren are present by the type and strength of the chemical signal. Some chemical signals allow bacteria to talk only with neighbors just like them, while other molecules allow communication between bacterial species.

The ability of bacteria to count their numbers is crucial to their virulence. In order to infect a host organism, bacteria do not want to begin releasing toxins too soon, and quorum sensing allows them to restrain their attack until enough of their numbers are present, so they have some hope of overcoming the host's immune system. Bassler has shown that this basic communication mechanism is common to some of the world's most virulent microbes, such as those responsible for cholera and plague.

Bassler's work in bacterial communication grew from her interest in finding out how information flows between the cells in the human body. Quorum sensing, she says, allows a colony of bacteria to act essentially like a multi-cellular organism. "If we can understand the rules or paradigms governing the process in bacteria," she says, "what we learn could hold true in higher organisms."

It seems appropriate that a scientist who is committed to understanding another species' communication methods would be devoted to communicating with her own species. Bassler is very involved in talking with the public about science and has developed a series of presentations for a lay audience, including one highly popular **TED lecture**. She also presented the **2009 Howard Hughes Holiday Lecture** for teachers and educators.

In addition, Bassler has worked with the Liz Lerman Dance Exchange to develop a traveling dance piece entitled **Ferocious Beauty Genome**, with the Baltimore Science Center on the permanent exhibit, "**Cells: the Universe Inside Us**," and with a whole host of other organizations including **NOVA scienceNOW**, **NPR** and others. To read more about Bassler's work, visit her **Web site**.

## NSF in the News

**Climate Change Prediction Project Launched** (*United Press International* and *Scientific American*) NSF has teamed up with the U. S. Departments of Energy and Agriculture to develop

higher-resolution computer models to better predict climate change and guide policy and decision makers.

**Modern Dogs Likely Descended From Middle Eastern Wolves** (*New York Times*, *NPR*, *ABC News* and others) By comparing DNA from dogs and wolves, NSF-funded researchers from UCLA have shown that domesticated dogs can be traced back to wolves living somewhere in the ancient Middle East.

**Plan to Fertilize Ocean With Iron Could Lead to Ecological Disaster** (*London Free Press*) Research partially funded by NSF has shown that adding iron to the ocean to halt global warming encourages the growth of toxic algae. Iron doubles the amount of toxin produced, threatening other marine life.

**AIDS Virus Can Hide in Bone Marrow** (*Associated Press*) The AIDS virus can hide in bone marrow, avoiding drugs and surfacing later to cause illness, according to research partially funded by NSF.

**Language DVDs Don't Promote Learning in Kids** (*The Guardian*) A new study, funded by NSF, has shown that exposing young children to vocabulary-building DVDs does not improve language skills.

## The Ripple Effect

### Improving the Quality of Disabled Americans' Lives Through Technology

The Census Bureau estimates that twenty percent of Americans have some type of disability, about half of which are considered severe. With an aging population, that percentage is expected to rise over the coming decades.

The **Quality of Life Technology (QoLT) Center**, an NSF Engineering Research Center jointly managed by Carnegie Mellon University and the University of Pittsburgh, is working to turn cutting-edge discoveries in computing, engineering, robotics and other fields into new devices and tools that can improve disabled peoples' lives.

In March, **NSF announced** a **$1.5 million Innovation Award** to the QoLT Center to help start-up companies affiliated with the center move these new technologies to the marketplace. The new advances will help millions of Americans continue to be productive and successful members of society.

Portion of child's jawbone of *Ardipithecus*, a recently discovered ancestor of humans. Credit: Tim White.

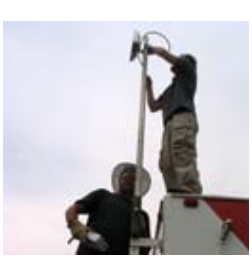
### What Does It Mean to Be Human?

A new exhibit that explores what it means to be human has recently opened at the Museum of Natural History at the Smithsonian Institution in Washington, D.C. The exhibit, partially funded by NSF, provides detailed and up-to-date research findings of the Human Origins Initiative at the Smithsonian.

The initiative's goal is to explore the universal human story over a broad time scale and to stimulate new research that will deepen our understanding of what makes us unique as a species and how we came to be.

For more information, explore the exhibit's **Web site**.

### Ten Years of Extending the Wireless Frontier Into Public Service



HPWREN investigators mount

This winter marked the tenth anniversary of the **High Performance Wireless Research and Education Network (HPWREN)**, a wireless technologies research platform managed by the University of California, San Diego. Centered in California's San Diego, Riverside and Imperial counties and supported by NSF, HPWREN looks into ways wireless technologies can better serve academic researchers and the broader public.

In addition to linking up academic institutions ranging from elementary

schools to national supercomputer centers, police and firefighters use the network to work across jurisdictions. Native reservations use it to break through geographic isolation. And during the area's historic wildfire season a couple of years ago, evacuated residents used the system's scores of cameras to see if their houses were safe. HPWREN has demonstrated how wireless networks can make communities smarter, safer and more cohesive.

an antenna for communications during California's wildfire season. Credit: HPWREN

*The National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science and engineering. In fiscal year 2010, its budget is $6.9 billion. NSF funds reach all 50 states through grants to over 1,900 universities and institutions. Each year, NSF receives about 48,000 competitive requests for funding, and makes over 11,300 new funding awards. NSF also awards over $400 million in professional and service contracts yearly. Contact* ***NSF's Office of Legislative and Public Affairs*** *for more information or for permission to reuse newsletter images.*

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