



National Science Foundation
WHERE DISCOVERIES BEGIN



July 2012

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NSF AT WORK

Today's Climate More Sensitive to Carbon Dioxide Than in Past

Previous studies of the earth's climate have documented a strong correlation between atmospheric carbon dioxide concentrations and global climate. However, paleoclimate researchers recently found that the two were not as closely correlated about 5-12 million years ago. The evidence came from deep-sea sediment cores from the late Miocene period.

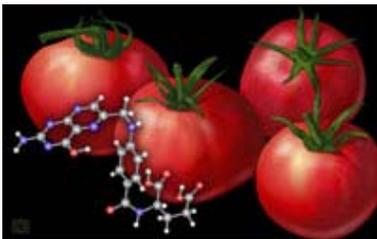
During that period, temperatures across a broad swath of the North Pacific were 9-14 degrees Fahrenheit warmer than today, while atmospheric carbon dioxide concentrations remained low--at levels near those recorded prior to the Industrial Revolution.

The **NSF-supported study**, led by ocean scientists at the University of California-Santa Cruz, shows that changes in ocean circulation during the last five million years allowed the planet's climate to become more closely coupled to changes in carbon dioxide concentrations in the atmosphere. The research also demonstrated that the modern climate more readily responds to changing carbon dioxide levels.



The drillship *JOIDES Resolution* was used to obtain the deep-sea cores. Credit: IODP

Tomato and Corn Genomes Hold Clues to Improving Varieties



Analysis of crop genomes can speed efforts to develop improved varieties. Credit: *Nicolle Rager Fuller, NSF*

Researchers have fully sequenced the tomato genome and completed the most comprehensive analysis to date of the corn genome--important steps in developing improved crop varieties.

The genome of the tomato, *Solanum lycopersicum*, was decoded for the first time, using the "Heinz 1706" variety, and **published in May**. The tomato was found to contain some 35,000 genes that influence taste, pest resistance, nutritional content and other characteristics. The multi-year project capped years of work by researchers from 14 nations. The multi-institution U.S. team was headed by researchers at Cornell University and the U.S. Department of Agriculture (USDA) Agricultural Research Service. In a related development, researchers identified the gene that controls tomato **ripening**.

A second international team, led by Cornell and the Agricultural Research Service, published **two new reports** on the corn genome. The studies reveal clues about corn's evolution, genetic

diversity and ability to adapt to changing climates and habitats. The results could boost international efforts to increase yields, expand the areas where corn can be cultivated and produce varieties better equipped to resist pests and disease.

Both efforts were supported with funding from NSF and USDA.

Multicolored Beam Tightly Focused by Tabletop Laser

For the first time, researchers have produced a laser-like, directed beam of light that simultaneously streams ultraviolet, X-ray and in-between wavelengths. The **new technology** is the first to produce a coherent beam that includes X-rays in a tabletop-sized system.

Engineers from NSF's **Engineering Research Center for Extreme Ultraviolet Science and Technology**, led by Colorado State University, headed the international research project. Members of the team explain their experiments in this **video**.

The team focused intense pulses of infrared light--each just a few optical cycles in duration--into a high-pressure gas cell. This converted part of the original laser energy into a coherent continuum of light that extends well into the X-ray region of the electromagnetic spectrum. The X-ray burst has extremely shorter wavelengths that will make it possible to probe the tiniest, fastest physical processes in nature, such as the dance of electrons and ions in molecules as they undergo chemical reactions.

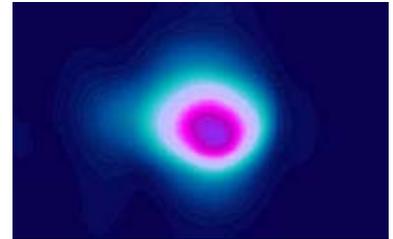


Image of a coherent, laser-like X-ray beam as it hits a surface. *Credit: Tenio Popmintchev, JILA & University of Colorado-Boulder*

Government "Ignites" Broadband Networks With New Partnership

NSF is the lead federal agency for the public-private partnership **US Ignite, launched June 14** by the White House. US Ignite will create a national-scale testbed for researching and developing networks employing ultra-fast broadband, including future Internets that could run up to 100 times faster than today's Internet.

The initiative will build on NSF's Global Environment for Networking Innovation program, which funds 300 researchers and 60 universities across the country. Nearly 100 new partners, including cities, will join them in the new partnership. Research will continue to focus on topics such as cybersecurity, network performance and cloud computing. Applications taking advantage of next-generation networks have the potential to transform health, education, public safety and transportation; for example, they could include new environmental sensor, manufacturing and supply, emergency response and weather prediction systems. Learn more in the **NSF press release and videos**.

DID YOU KNOW?



Graduate students measure bamboo growth. *Credit: Sue Nichols, Michigan State University*

Graduate Enrollment in Science and Engineering: On the Rise

Graduate enrollment in science and engineering (S&E) programs soared over the past decade. In 2010, a record number of 556,532 graduate students were enrolled in these programs, up 35 percent from 2000. An even bigger increase was seen among first-time, full-time graduate students enrolled in these programs--the number grew by 50 percent.

S&E graduate programs also became more diverse, as enrollment increased for most of the minority groups that are underrepresented in S&E fields. The number of female S&E graduate students grew by 40 percent over this period, outpacing the growth rate for men (30 percent). And S&E graduate enrollment grew at a much higher rate for Hispanics, American Indians/Alaska Natives and African Americans than for whites (65 percent, 55 percent, 50 percent and 25 percent, respectively).

The data are from a new **InfoBrief** from NSF's National Center for Science and Engineering Statistics.

California Scientist Draws Inspiration From Butterflies

Arthur Shapiro turned to nature to cope with what he describes as a "difficult childhood." In nature, he found more than just an escape; he found a world of wonderful flying creatures. Now a researcher with the title Distinguished Professor, **Shapiro** has tallied approximately 130,000 individual records of 160 butterfly species and subspecies across central California.

Shapiro's trajectory highlights his passion for phenology--the study of periodic animal life cycle events and how these are influenced by variations in the fauna. After spending long hours of his childhood walking in the woods and fields around Philadelphia, he focused his interest on insects, especially Lepidoptera, the order of insects that includes butterflies and moths. As a teenager, he was already keeping phenological records of butterflies.

After receiving a Ph.D. in entomology from Cornell University, Shapiro went on to teach in the Department of Evolution and Ecology at the University of California-Davis, where he has been since 1971--all the while exploring nearby sites stretching from Suisun Marsh to Donner Pass to the Sierra Valley. Over 40 years, Shapiro has made more than 6,300 trips to **11 sites** he established, collecting data on butterflies.



Art Shapiro has tracked butterflies for decades. *Credit: Shapiro Lab, Dept. of Evolution & Ecology, UC-Davis*

Shapiro's collection represents the world's largest set of site-specific data on butterfly populations collected by one person using a strict research protocol. An NSF Biological Databases and Informatics **grant** supported his creation of a **digital database** that covers more than 35 years of field studies, allowing rigorous analysis.



The Western White butterfly has been a focus of Shapiro's research for 40 years. *Credit: Shapiro Lab, Dept of Evolution & Ecology, UC-Davis*

Over the years, he and his research team have **studied changes** in the geographic and altitudinal distribution of butterflies. As the climate warms, they observed that butterflies that normally breed at 7,000-foot elevations have shown up with increasing frequency at 9,000 feet. At the highest elevation site, more species are appearing than in the past, due to the upslope movement. However, because it takes longer for plants to move to higher altitudes, the butterflies may not have the resources they need and may not survive. At lower elevations, butterfly populations have decreased due to urbanization and landscape changes.

Shapiro is also trying to reconstruct the history of the high-mountain butterflies on the west coast of North America through phylogeography--the geography of genetic variation. By understanding how plants and animals reacted to climate change in the past, scientists can predict how they will fare in the future.

Shapiro plans to be in the field for as long as he can because he loves what he does. "One of the most enjoyable things for me in life is walking in the mountains alone," he says. "I communicate with nature; I get close to Heaven."

-- Ayesha Monga Kravetz

BP Oil Spill Disrupted Microbes on Gulf Coast Beaches (*The Times Picayune*) NSF-funded research shows a dramatic drop in diversity among the microbial communities that form one of the lowest links in the Gulf's food chain.

Scientists Map Genome of Fetus With Non-invasive Test (*Fox News*) Scientists used samples of the mother's blood and father's saliva to sequence the genome of a human fetus, detecting subtle variations with very high resolution.

Did Lasers Find Gold-laden Lost City of Ciudad Blanca? (*MSNBC*) Archaeologists using

NSF-funded airborne laser mapping technology located possible ruins under Honduras' forest canopy.

U.S. Cities Trail Latin America in Climate Change Efforts (*USA Today*) An MIT survey funded by NSF found 95 percent of major Latin American cities planning for climate change, compared with 59 percent in the United States.

THE RIPPLE EFFECT

NSF Hosts Presidential Teacher Awardees

The White House and NSF hosted recipients of the **Presidential Award for Excellence in Mathematics and Science Teaching** from all 50 states, the District of Columbia and two territories in late June. The **97 awardees**, who teach in grades 7-12, were selected by a panel of distinguished scientists, mathematicians and educators and were **honored by the Vice President** while in Washington. Each of the teachers receives a \$10,000 award from NSF.

Ecologists Call for Preservation of Planet's Biological Diversity

As national leaders prepared for the **Rio+20** United Nations Conference on Sustainable Development, 17 scientists released a **call for action** on protecting the planet's remaining biological diversity. The declaration was published in the journal *Nature*.

Over the past two decades, strong scientific evidence has emerged showing that decline of biodiversity reduces the productivity and sustainability of ecosystems, according to the international team led by NSF-supported ecologist **Bra dley Cardinale** of the University of Michigan. Such loss also decreases the ability to provide society with goods and services like food, wood, fodder, fertile soils and protection from pests and disease.



Frog on Sakhalin Island, Russia. *Credit: Pamela J. Woods*

The Rio+20 conference, held on June 20-22 in Rio de Janeiro, Brazil, marked the 20th anniversary of the 1992 Earth Summit in the same city. The earlier summit resulted in an explosion of interest in understanding the impact of biodiversity on the earth's ecosystems.

Coming July 11: Science of the Summer Olympics

How does swimmer Missy Franklin use fluid dynamics to move quickly through water? What biomechanics help make Usain Bolt the fastest sprinter? Explore the engineering and technology at work in swimming, track, weightlifting and other sports to be featured in the 2012 Olympic Games that start July 28 in London. The free 10-part video series "**Science of the Summer Olympics**," produced by NSF, NBC Learn and NBC Sports, is the fourth installment in the "Science of Sports" franchise. The National Science Teachers Association will provide free lesson plans for each video. Find previous "Science of Sports" videos **here**.

NSF Director Visits Science and Technology High School



NSF Director Subra Suresh meets with students. *Credit: Max Reinsel,*

In a visit to Thomas Jefferson High School for Science and Technology in May, NSF Director Subra Suresh encouraged 300 students and teachers to continue their pursuit of science, technology, engineering and mathematics (STEM). He noted that advances in these areas are the foundations for innovation and economic success and, therefore, the building blocks of the nation's future.

Thomas Jefferson, located in Alexandria, Va., ranks among the **top ten STEM high schools in the nation**, with its use of groundbreaking teaching methods and lab equipment. The National Research Council report **Successful K-12 STEM Education** cited the school as a model for STEM schools to follow. The school was recognized by President Obama, who **signed the American Invents Act** there.

Thomas Jefferson High School

"Our mandate is not only to support science and engineering research, it is also to support human capital development, the future workforce of the country, and brilliant minds like you sitting in the room here,"

Suresh told the audience. He toured the school labs and watched students' presentations on their research.

-- *Jacinta Leyden & Ayesha Monga Kravetz*



*The National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science and engineering. Its Fiscal Year 2012 budget is \$7.0 billion. NSF funds reach all 50 states through grants to nearly 2,000 colleges, universities and other institutions. Each year, NSF receives more than 50,000 competitive requests for funding, and makes about 11,000 new funding awards. Contact NSF's **Office of Legislative and Public Affairs** at 703-292-8070 for more information or for permission to reuse newsletter images. Editor: Amber Jones. Contributors: Jacinta Leyden, Ayesha Monga Kravetz, Christine Hamel.*



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