



National Science Foundation
WHERE DISCOVERIES BEGIN



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NSF Plans Headquarters Move to Alexandria

The General Services Administration (GSA) has signed a 15-year lease for a new state-of-the-art building to house the NSF headquarters. The selected site is located at the Hoffman Town Center in Alexandria, Va., across the street from the Eisenhower Avenue Metrorail station. NSF anticipates that design and construction will take three or four years and that the move will take place by the end of 2016. The agency will remain in its current location near the Ballston Metrorail station in Arlington, Va., until then.



Conceptual design for the new NSF headquarters. Credit: The Hoffman Company

In 2008, NSF began exploring options that included a potential new headquarters, in anticipation of the 2013 expiration of its 20-year lease at the Ballston location. The agency involved employee teams in the process of determining requirements for the building that will accommodate changing needs for the next 15-20 years.

GSA's site selection was based on several minimum requirements, including proximity to Metrorail and other transportation, as well as hotel and residential options to accommodate NSF's visitors and staff. Other requirements included access to high-speed telecommunications services and the ability to improve energy and space efficiency and reduce operating costs. NSF is responding to federal requirements for using space more efficiently by exploring options for technology, furniture, and building interiors with built-in flexibility.

The new NSF building will be Leadership in Energy and Environmental Design (LEED) Certified-Silver, reflecting standard requirements for newly built, federally occupied buildings.

Follow the Puma: Tracking Animals With Smart-Phone, Video-Game Technologies

Wildlife researchers at the University of California-Santa Cruz have **created a collar** that simultaneously tracks the location and the behavior of an animal. The collar uses GPS and satellite-tracking technology and is being employed to monitor the location and activities of pumas that live close to urban populations in the San Francisco Bay Area.

The collar, developed in the lab of NSF-funded wildlife ecologist Christopher Wilmers, provides a diary of an animal's life. It logs every leap, run and rest period as the animal moves through the wilderness and to urban areas and back. By studying the physiology, behavior and ecology of the puma, Wilmers and his students are gaining insights into the ecological consequences of puma predation, physiological and behavioral differences between males and females, and ways in which members of the species communicate.

Previous tracking technologies provided little information about animal behavior and physiology. These aspects are critical to understanding how terrestrial mammals respond to stimuli such as climate, interactions with other organisms and land-use changes such as landscape development. Recent breakthroughs in sensors and power consumption made it possible to incorporate low-cost components such as those found in the iPhone and Nintendo Wii into collars that continuously monitor movement and behavior.

To see video of the collars in action, visit the website of the Santa Cruz Puma Project.



Chris Wilmers with an anesthetized puma wearing the tracking collar.
Credit: Wilmers Lab

Magnetic Material Removes Heavy Metal From Water

Polluted water can contain a toxic and carcinogenic form of the heavy metal chromium. Researchers at Lamar University in Beaumont, Texas, have demonstrated the extraordinary ability of **a magnetic material** to remove this metal from water. Chromium molecules bind to the surface of the material in a process called adsorption. The heavy metal can then be separated from the material for recycling with the use of a magnet.

The novel material is highly efficient at removing chromium from water in just a few minutes--significantly faster than the hours or even days needed by conventional activated-carbon adsorbents. The innovative removal process also satisfies a new U.S. Environmental Protection Agency requirement for the treatment of wastewater containing low concentrations of chromium pollutants.

To create the composite magnetic material, Zhanhu Guo and colleagues at Lamar used graphene, a one-atom-thick sheet of carbon, as a substrate and coated it with magnetic nanoparticles. In experiments, the researchers found that the nano-scale composite could adsorb chromium both quickly and in large quantities, and that the material's properties allow for easy separation from a liquid. The use of a permanent magnet makes the recycling process more effective and economically feasible.



Credit: Thinkstock

Migration of the Monarchs: A Movie and a Role for Citizen Scientists

The monarch butterfly makes one of the longest migrations on Earth, crossing an entire continent to reach a location in the Sierra Madre Mountains of Mexico--a place the butterfly has never been. An NSF-funded IMAX film "**Flight of the Butterflies**" follows the monarch's perilous, year-long, and 3,000-mile journey with stunning cinematography from an award-winning team. The film also tells the story of Canadian



A monarch butterfly. *Credit: Michelle Solensky, University of Minnesota*

zoologist Fred Urquhart's 40-year search for the secret hideaway of millions of the colorful butterflies, discovered on a remote mountain peak 10,000 feet above sea level. In 2008, the United Nations Educational, Scientific and Cultural Organization (UNESCO) declared the monarch butterfly sanctuary a World Heritage Site.

In addition to raising awareness of the butterfly and the importance of protecting its habitat, the movie aims to increase understanding of the scientific process and the role of citizen scientists in that process. Thousands of volunteers across North America helped tag and track the insects during Urquhart's quest, as they do to this day--through **Monarch Watch**. A pair of citizen scientists working with Urquhart first discovered the monarch's haven.

The film and accompanying educational activities were produced by the Maryland Science Center, in collaboration with SK Films and other partners. One of the partners, NSF-supported conservation biologist Karen Oberhauser of the University of Minnesota, was recently honored by the White House as a **Citizen Scientist Champion of Change**.

The film is enjoying four-star reviews and has been seen by approximately 2 million people on 125 screens in the United States and 11 other countries.

*Learn how the annual migration helps monarch butterflies escape disease in this **NSF Highlight** at "Science, Engineering and Education Innovation" on Research.gov.*

The Secrets of Rubber: Solved!

From boots to aircraft tires to adhesives, rubber materials have long played an important role in consumer and industrial products.

A few years ago, NSF-funded scientists from Illinois and Colorado, working together, **solved a rubber mystery** which had mystified physicists for more than half a century. Stretchy materials work well as long as they are not stretched too far. Rubber bands usually stretch in precise proportion to the force applied: twice the force results in twice the increase in length.

At a certain point, however, rubber bands require an abnormally large force to stretch further. While scientists have long known that stretching rubber causes the polymers inside to become more aligned, the mystery of what causes the normal behavior to cease and the polymers to exhibit the anomalous resistance to further stretching remained unsolved.

When elastic material is stretched, the tangle of polymer molecules begins to straighten. The NSF-funded researchers discovered that, although the polymer strands never become as tight as guitar or harp strings, they do become tight enough to vibrate together. This vibration produces energy, and the energy changes the effect of the force as much as the untangling process does. Having identified this factor, the researchers wrote and quantified the theory in order to expand scientists' future ability to predict the properties of elastic materials.

Because many systems rely on the normal elastic response of polymers in order to function properly, the discovery could impact a wide variety of stretchable products, including garbage bags and high-performance plastic composites.



Credit: Thinkstock

Students to Study Plastic Pollution in the Atlantic Ocean

Undergraduate students participating in the Sea Education Association's SEA Semester program will join professional oceanographers aboard a scientific research vessel this fall. Together they will explore questions about the amount and fate of plastic debris floating in the Atlantic Ocean.

The "Great Pacific Ocean Garbage Patch" received a lot of attention after scientists aboard a research vessel explored it in detail in 2009. In that excursion, researchers measured the size of the Pacific garbage patch, took samples of the plastics, and analyzed the types of plastic and their potential effect on marine life.

What is less well known is that the western Atlantic Ocean hosts a **similar collection** of plastic litter. NSF-supported researchers from the Woods Hole Oceanographic Institution and SEA, both in Massachusetts, and the University of Hawaii conducted a **detailed study** of the garbage patch in 1986-2008. More than 64,000 pieces of plastic were collected at 6,100 locations sampled yearly. The team found that the size of the Atlantic debris collection did not increase during those years despite a rapid increase in the overall production and disposal of plastic. This finding has led to further studies, still ongoing, to find the "missing plastic."



Millimeter-sized plastic pieces collected from the Atlantic. *Credit: SEA/Marilou Maglione*

The opportunity to participate in such studies gives students a chance to address a global environmental problem while training for a career in ocean studies. In 2010, SEA Semester alumni joined researchers aboard a federally funded expedition in the Atlantic, dubbed *Plastics@SEA*. In 2012, alumni again participated in a cruise, this time to explore the impact of the Japanese tsunami on the Pacific garbage patch.

In fall 2013, SEA Semester will pair undergraduate students from schools that include Colorado College, the University of North Carolina-Chapel Hill, and Boston University with researchers to continue the Atlantic studies. Information about the Atlantic cruise is available at the SEA [website](#).

NSF Releases Master Plan for McMurdo Station

NSF recently released a **master plan** for upgrading McMurdo Station, the largest U.S. research station in Antarctica, located on Ross Island. The plan will increase energy, logistical and resource efficiency.

McMurdo is one of three year-round stations operated by NSF on the Antarctic continent. The station serves as the gateway for U.S. scientists and logistical support of their operations, including supplies arriving via aircraft and ships. McMurdo has been in operation since 1955.

The master plan envisions the core of the station as several interconnected structures, including the Albert P. Crary Science and Engineering Center, the largest laboratory on the continent; a food, storage, administration and operations center; and dormitory-style housing. At the periphery of the core area are facilities for power generation, water treatment, trades work, vehicle maintenance, cargo handling and warehousing. This consolidation will allow for more efficient workflow, including the flow of cargo through McMurdo to field sites and South Pole Station. The master plan is intended to be implemented in phases that preserve the ability to conduct operations during construction.

The need for long-range planning was noted in a July 2012 report on U.S. Antarctic Program (USAP) logistics, conducted by a **Blue Ribbon Panel** commissioned by the White House and NSF. In the report, the panel made numerous recommendations for streamlining and modernizing USAP-supported science and science support.



The future McMurdo Station as envisioned in the master plan. *Credit: NSF*

How Can We Be Safe From Tornadoes? (*CNN*)--The NSF-supported Doppler on Wheels project has mapped the winds in nearly 200 different tornadoes. Scientists are currently analyzing nearly 30 terabytes of data--the equivalent of about 8,000 DVDs--collected during the multi-year VORTEX2 experiment.

Allosaurus Muscles Hint at Good Table Manners (*New York Times*)--Allosaurus, a smaller cousin of Tyrannosaurus rex, was a dexterous hunter that tugged at prey like a modern-day falcon, according to scientists in the Visible Interactive Dinosaur project. The NSF-funded project aims to "flesh out" dinosaur skeletons.

World's Research Funders Launch Open Access Action Plan (*Nature*)--At a meeting of the Global Research Council, the heads of about 70 research agencies agreed to encourage open access to science publications resulting from spending by the agencies. The council was launched at an NSF-organized meeting in 2012.

NSF Grants Reward Student Ideas for Improving Graduate Education (*Inside Higher Ed*)--More than 500 graduate students submitted ideas in the NSF Innovation in Graduate Education Challenge, which offered monetary prizes.

Editor's Note

*Dear readers: This is my last issue as editor of the NSF Current newsletter. I hope you have enjoyed my selections of research and education outcomes from NSF investments. I encourage you to continue enjoying NSF news and features at nsf.gov, science360.gov, and **SEE Innovation**. Sincerely, Amber Jones*



*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 was \$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.*



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