CURRENT
NATIONAL SCIENCE FOUNDATION

Special Earth Day Edition: April 2008

NSF AT WORK

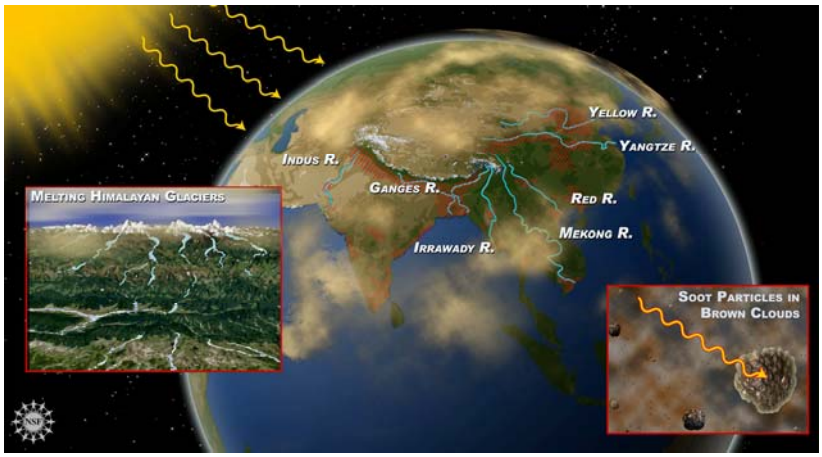
Emperor penguins are the largest of all penguins, standing up to 115 centimeters (42 inches) tall and weighing 38 kilograms (84 pounds). Credit: Glenn Grant, NSF

Climate Change From a Penguin Perspective

Penguins, like other species, face changes to their environment brought on by warming temperatures. With a frozen record of penguin bones stretching 30,000 years into the past, along with extensive field research on modern colonies, scientists know more about how penguins adapt to rapid climate change than just about any other species on the planet.

At an NSF-supported Web site on penguin science, discover how giant icebergs, disappearing sea ice and shifting weather patterns are affecting penguins. A television special on the topic, entitled *Return to Penguin City,* premiered on Animal Planet on March 23, 2008. See a clip at www.penguinscience.com/.

Soot Pollution Amplifies Warming



Soot particles contribute to the melting of Himalayan glaciers, affecting the water supply of people living downstream. Credit: Nicolle Rager Fuller, NSF

Soot in the atmosphere produced from burning wood, coal, cow dung and diesel fuel has a warming effect in the atmosphere three to four times greater than prevailing estimates, according to a recent review by NSF-funded researchers V. Ramanathan and Greg Carmichael in *Nature Geoscience*. Incomplete combustion of biofuels produces "black carbon" (BC), a major component of soot. The complex contribution of soot and BC to climate has been difficult for researchers to unravel. Through careful analysis, Ramanathan and Carmichael have concluded that BC emissions contribute as much as 55% of the current warming caused by carbon dioxide, making BC the second highest contributor to global warming after carbon dioxide, according to the *Nature Geoscience* article.

Field observations have determined global "hotspots" for BC emissions, including much of south and Southeast Asia. Much of this pollution comes from burning biofuels for home cooking and heating, and burning forest and cropland for agricultural purposes. Ramanathan's prior NSF-sponsored research indicated that one of the consequences of sooty pollution has been the rapid melting of the Himalayan glaciers, which are affected both by warming atmospheric temperatures and by increased solar absorption caused by black carbon deposits on ice and snow.

For more on this research, see the Scripps Institution of Oceanography press release.

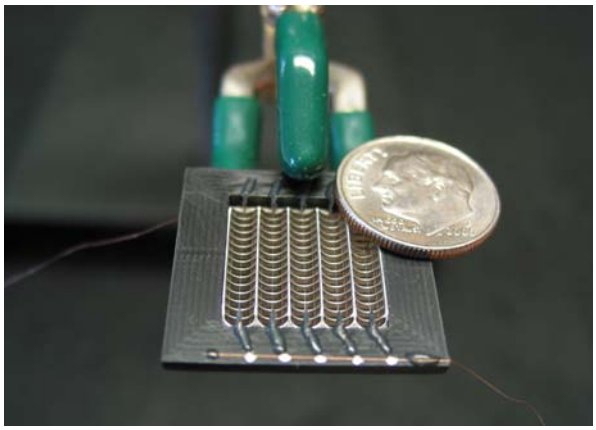
Cinquefoil wildflowers in Colorado will be monitored by participants of Project BudBurst. Credit: Carlye Calvin, UCAR

Wildflower Blooms Provide Climate Clues

Volunteers from around the nation are tracking climate change by observing the timing of flowers and foliage. Project BudBurst, operated by the University Corporation for Atmospheric Research (UCAR) and a team of partners, allows students, gardeners and other citizen scientists in every state to enter their observations into an online database that will give researchers a detailed picture of our warming climate.

The project, launched in February, will operate year-round to monitor early- and late-blooming species in different parts of the country throughout their life cycles. Project BudBurst builds on a pilot program carried out last spring, when several thousand participants in 26 states recorded the timing of the leafing and flowering of hundreds of plant species. See the NSF press release for more details.

From Ideas to Innovations: New Energy-Efficient Fan Out-Chills Competition



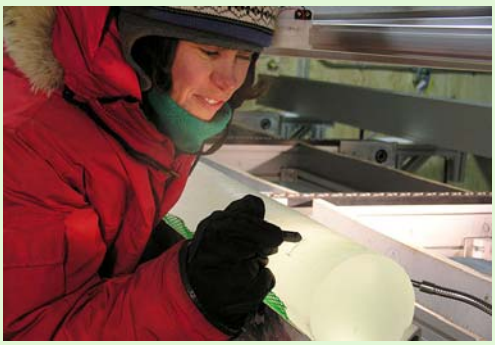
Researchers have developed a new micro-fan only slightly larger than a dime. The new fan can generate winds on the same scale as a laptop computer fan, but uses far less energy. Credit: Dan Schlitz and Vishal Singhal, Thorrn Micro Technologies

Computer chips pack an ever-increasing number of tiny transistors into a tight space. Keeping microprocessors cool is a must because the heat generated during operation can endanger the delicate circuitry of modern chips. Dan Schlitz and Vishal Singhal, two former Purdue graduate students, are taking their original NSF-funded research to the next level with their new company, Thorrn Micro Technologies. The researchers created a miniaturized cooling device that uses the same physical property that drives silent household air purifiers. It is now ready for testing as a silent, ultra-thin, low-power and low maintenance cooling system for laptop computers and other electronic devices.

The compact, solid-state "fan," developed with support from NSF's Small Business Innovation Research program, is the most powerful and energy efficient fan of its size. It produces three times the flow rate of a typical small mechanical fan and is one-fourth the size. For more on this tiny cooler and how it works, see the latest NSF press release.

Did You Know?

NSF designated an estimated $205.25 million in fiscal year 2008 for climate change research. These funds are appropriated through a variety of different programs, with research focusing on the interactions between natural factors, human activities and their effects the climate system. NSF, along with thirteen other agencies involved in the U.S. Global Change Research Program, promotes data acquisition and information management activities necessary for global change research, modeling Earth system processes, the development of new, innovative Earth observing instruments and platforms, and the development of advanced analytic research methods.



Scientist Rebecca Anderson of the Desert Research Institute examines a section of an ice core recovered from a depth of 500 meters (1,640 feet). Credit: Kendrick Taylor

Faces of NSF Research

Scientist Develops Robots That Really Move

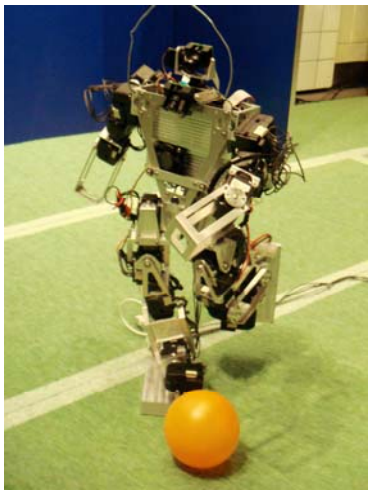
Virginia Tech graduate student Karl Muecke (left) watches Professor Dennis Hong adjust the humanoid robot DARwIn. Credit: Dennis Hong

Drawing from the workings of biology, Dennis Hong has created a novel approach that is changing the world of robotics.

Hong, an assistant professor of mechanical engineering and director of Virginia Tech's Robotics and Mechanisms Laboratory (RoMeLa), received an NSF Faculty Early Career Development Program (CAREER) Award for research on robotic locomotion. CAREER grants are NSF's most prestigious award for creative junior faculty, who are considered as academic leaders of the future.

The Whole Skin Locomotion device is inspired by the mobility motion of an amoeba. Credit: Dennis Hong

Hong's Whole Skin Locomotion (WSL) device works by contracting and expanding actuating rings, which are embedded in a surface of a hollow tube. The mechanism works on essentially the same principle as the cytoplasmic foot of an amoeba. The rings pull the tube forward, and when they reach the end of the tube they contract and the WSL turns itself inside out.



The DARwIn robot can perform complex behaviors, including soccer-playing. Credit: Dennis Hong

"This unique mobility makes the WSL the ideal locomotion method for search and rescue robots that need to travel over and under rubble," said Hong. He hopes that his research will encourage other engineers to design robots that work like living things.

Hong's students have also developed DARwIn (Dynamic Anthropomorphic Robot with Intelligence), a humanoid robot that can navigate obstacles and difficult terrain and even exhibit complex behaviors, such as soccer-playing. DARwIn was the only U.S. entry invited to compete in the Humanoid Division of RoboCup 2007, an international autonomous robot soccer competition. In addition, DARwIn won second place in a mechanical design competition and made the cover of *Servo*, a robotics trade magazine. Watch DARwIn on YouTube.

Karl Muecke, a Ph.D. student in Hong's lab, envisions a bright future for robots. "If you have a robot that is just like a human in dexterity and size, they can do everything you can--they can vacuum the floor and, potentially, even make you breakfast."

NSF in the News

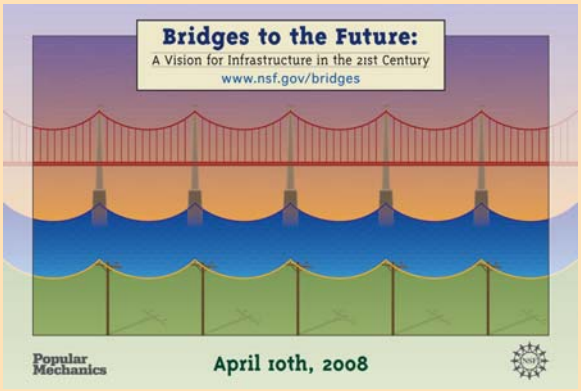
NSF Head: All Hail the Cluster (*Wired 3/14/2008*) — A large-scale computing collaboration between Google, IBM and NSF holds the key to some of science's most pressing puzzles, NSF director Arden L. Bement, Jr., said in a conversation with *Wired* editors.

Grand Canyon Still Grand but Older (*New York Times 3/7/2008*) — An improved uranium-lead dating technique dates the beginnings of the Grand Canyon to 17 million years ago--some 11 million years earlier than previous estimates.

Corn Genomics Pops Wide Open (*Science 3/7/2008*) — Researchers at Washington University in St. Louis, Mo., announced the completion of a draft genome of a well-studied maize strain called B73. B73's full sequence "is going to underpin all the research that we do in maize genomics," predicts Patrick Schnable of Iowa State University in Ames.

Webcast Event: Bridges to the Future

On April 10th, NSF and *Popular Mechanics* will team up for an afternoon webcast about the state of the nation's infrastructure. Three panels of experts will discuss the future of the power grid, water resources and safety, and the design and protection of transportation and built environments. Webcast participants will have the opportunity to join in the discussion by phone or email. To watch the live webcast, visit www.nsf.gov/bridges on April 10, 2008, starting at 12:30 p.m. EDT. For more coverage of the conference and a special report on American infrastructure, visit www.popularmechanics.com/rebuilding.



North Seattle Community College adjunct faculty member Sonya Remington shows students how to measure carbon dioxide flux in campus wetlands. Credit: Ann Murkowski

Preparing Undergraduates for Global Challenges of the Future

Despite decades of research on teaching and learning, undergraduate STEM education in the United States is not fully meeting the challenges of producing the next generation of scientists capable of addressing global issues, according to a team of leading educators. An NSF-funded project undertaken by the National Research Council and the Wisconsin Center for Education Research seeks to identify new strategies for improving STEM education based on real data about success. During 2008-09, this "National Endeavor" project will bring together key thinkers from inside and outside academia to translate those strategies into plans for effecting change in institutions of higher education.

Visit the project Web site for more information and to register for the conferences.

Grand Challenges for Engineering

A diverse committee of experts from around the world, convened by the National Academy of Engineering at the request of NSF, announced 14 grand challenges for engineering in the 21st century that, if met, would improve how we live.

"Tremendous advances in quality of life have come from improved technology in areas such as farming and manufacturing," said committee member and Google co-founder Larry Page. "If we focus our effort on the important grand challenges of our age, we can hugely improve the future."

Watch a video of the members of the committee discussing engineering's Grand Challenges. Credit: NSF and National Academy of Engineering.