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March 2007

NSF AT WORK

Research Predicts Global Warming Will Lead to Emergence of New Climate Zones

Climate change is affecting ecosystems from the tropics to high mountains like the Himalayas. Credit: JupiterImages Corporation.

Global warming could re-make the world's climate zones by 2100, according to recent NSF-funded research. The study suggests that some polar and mountain climates will disappear altogether--with possibly fatal consequences for plant and animal species. Moreover, formerly unknown climate zones are expected to emerge in the tropics.

A climate zone is defined by its temperature, humidity, and rainfall. The researchers used models to translate carbon dioxide emission levels into climate change. The study suggests that if current rates of carbon dioxide and other greenhouse gas emissions continue, novel climate zones may appear on up to 39 percent of the world's land surface, and 48 percent of current global land climates may disappear.

The change in temperature is likely to be greater in the Arctic and Antarctic because when winter snow and ice melt, their ability to reflect sunlight goes away, too, accelerating the warming effect. For more information, see NSF's "New Modeling Study Forecasts Disappearance of Existing Climate Zones."

Biologists Develop Large Gene Dataset for Rice Plant

Scientists have developed a large dataset of rice gene sequences. The information will lead to an increased understanding of how genes work in rice, an essential food for much of the world's population.

The analysis of rice was based on gene sequences representing nearly 47 million messenger ribonucleic acids (mRNA) molecules and three million small ribonucleic acids (RNAs), a larger dataset than has been reported for any other plant species.

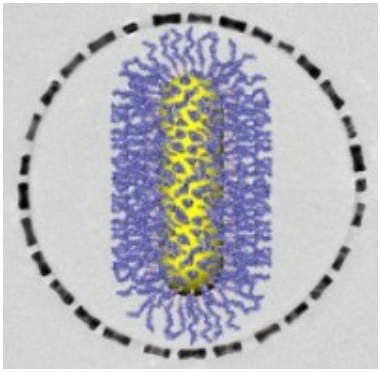
Using advanced gene sequencing technologies and high-powered computer-based approaches, NSF-supported researchers examined both normal gene expression (via mRNAs) as well as small RNAs in rice.

Small RNAs are considered one of most important discoveries in biotechnology in the last 10 years. They play an important role in gene regulation. And, they have been associated with many important biological processes, such as responses to stress.

Plant biologists have reported a new understanding of how genes work in rice. The research helps scientists better understand this essential food crop. Credit: Fangming Xie, IRRI.

For more on small RNA research--a leading edge in plant biotechnology--see the NSF press release.

Self-Assembling Nanorods May Lead to Invisible Objects



Transmission electron microscopy (TEM) image of a circular superstructure of hybrid nanorods templated by a water microdroplet. Credit: Bishnu Khanal.

NSF-supported chemists have discovered that tiny building blocks known as gold nanorods spontaneously assemble themselves into ring-like superstructures. This finding could potentially lead to the development of novel nanodevices like highly sensitive optical sensors, superlenses, and even "invisible" objects for use in the military.

Like many nanoscale objects, gold nanorods are several billionths of a meter, or 1,000 times smaller than a human hair. When the nanorods are organized into a ring, significant changes occur in their optical and electromagnetic properties. The rings can have technological applications in the area of metamaterials, which have enormous potential in opto-electronics, communications and military applications.

Thousands of well-defined rings can be produced in a matter of seconds using this novel approach. See Rice University's press release for more on the story.

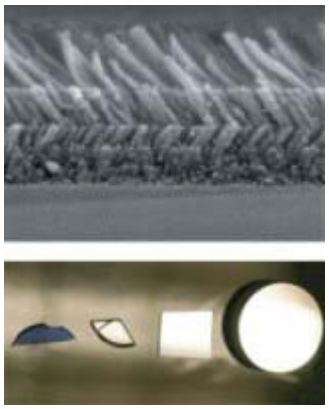
Non-Reflecting Material May Help Solar Cells Catch More Sun

NSF-supported researchers have created an anti-reflective coating that allows light to travel through it, but lets almost none bounce off its surface. The coating--made of silica nanorods--reflects almost as little light as do molecules of air.

At least 10 times more effective than the coating on sunglasses or computer monitors, the material may be used to channel light into solar cells or allow more photons to surge through the surface of a light-emitting diode (LED).

By preventing reflections, the coating would allow more light, and more wavelengths of light, to transmit through the protective finish on a solar cell surface and into the cell itself. Engineers may be able to use such a technique to boost the amount of energy a cell can collect, bypassing current efficiency limits.

See NSF's "New Coating Is Virtual Black Hole for Reflections" for details.

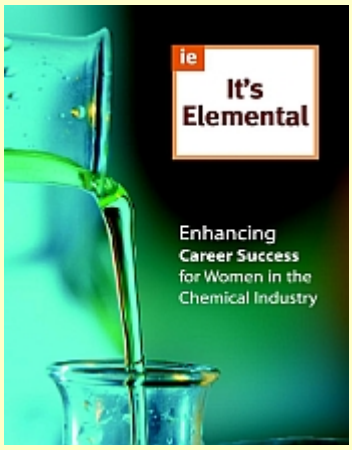


Layers of silica nanorods look like shag carpet when viewed with a scanning electron microscope (top). When coated on a surface, the new material looks darker (bottom left) than other anti-reflective coatings. Credit: E. F. Schubert and J. K. Kim, Rensselaer Polytechnic Institute.

Did You Know?

An NSF-funded study, *Project Enhance*, is seeking to identify factors that facilitate or hinder the career success of women scientists and engineers working in industry. This three-year study uses the chemical industry as the model sector to analyze the career paths of women trained in science and engineering. Over 1,700 women completed the survey, and a sampling of the responses that have been tabulated thus far reveals that:

- When asked about advancement and honors with their company, 50.9% of the women said that they had been nominated for a professional award or honor.
- When asked whether their companies provided particular benefits and whether or not they had used those benefits, 44% of the women said their company provided child care subsidy and of those, 13.8% used the subsidy.
- When asked about the "perks" that were part of the contract negotiation, 77.6% said they were satisfied with the lab space they received.



A new survey of women scientists in chemical companies focuses on career advancement issues.

Visit the Project Enhance Web site for more information on this study.

Faces of NSF Research

NSF Survey Reveals...
Arctic Family Ties and Traditional Activities Vital to Communities

A newly released NSF-supported survey of indigenous Arctic people indicates that an overwhelming majority of the region's native people believe that traditional pursuits such as hunting, boat-building and manufacturing crafts are key to their identity.

More than 7,000 interviews were conducted between 1998 and 2001 to gather the survey data. A crucial element of the project was the inclusion of indigenous people in conceptualizing the survey instrument and collecting data. "This research is an excellent example of NSF's efforts to increase the participation of traditionally underrepresented groups in the sciences," said Anna Kerttula de Echave, director of the Arctic social sciences program in NSF's Office of Polar Programs.

A new study of living conditions in the Arctic indicates that traditional ways of life are important to indigenous peoples and that wages earned in the cash economy often are used to support traditional folkways. Credit: Narwhal Tusk Research and Glenn Williams, photographer.

"Four decades ago, as wage work rapidly became more common in the north," the survey noted, "scientists and policymakers assumed that indigenous people would take advantage of opportunities to participate in the cash economy, abandoning harvest and traditional food processing activities."

However, the survey results indicate that despite lifestyle changes that have swept into these northern communities, traditional values still are important to native peoples, and they are willing to use their earnings in the cash economy to support those ways of life.

Despite historical efforts by national governments to assimilate native peoples and encourage them to give up native tradition in favor of wage labor, nine out 10 Inuits continue to think traditional activities are paramount to their identity.

In Alaska, most products of hunting, fishing and gathering do not enter the market economy. Rather, subsistence products are directly consumed by the harvesting household, given away or exchanged. Cash plays an important role in the Alaska mixed economy, however. Money buys snow machines, gas and ammunition.

Unlike previous attempts to sample and quantify information about the lives of indigenous Arctic peoples, the aim of this NSF-funded research was to measure the quality of life conditions in ways that Arctic residents find important. The survey also documents and compares living conditions among the indigenous peoples of various regions of the Arctic and improves the understanding of living conditions in ways that will benefit Arctic residents.

NSF in the News

Duke Scientists Build Cancer-Detecting Probe -- *Durham Herald-Sun (NC) (03/26/07)* -- Researchers at Duke University have developed a light-based probe that can detect the earliest signs of cancer in cells that line internal organs almost instantly. The effort was funded by the National Science Foundation.

Just How Addicted Are People to Their BlackBerry Devices -- *Network World (03/26/07)* -- MIT doctoral student Melissa Mazmanian has received funding from the National Science Foundation to study people's BlackBerry habits. "I've found that people struggle with when and where is it okay to use their BlackBerry," Mazmanian said in an MIT press release.

Technology Report From Europe: R&D Paradigm Shifting -- *Electronic Business (03/20/07)* -- The European Institute of Technology [EIT] is intended to strengthen Europe's research efforts, but a larger change will be needed to accomplish this goal. A 2006 Battelle Memorial study showed that over a 12-year period Europe had increased R&D spending by approximately 5 percent, while China had increased spending by 17 percent. The study also showed that 28 percent of companies in Europe planned to increase R&D spending in 2007, but 48 percent did not; in China, 65 percent planned to increase R&D spending, and only 10 percent did not.

"Perspectives"
from
NSF Director Arden L. Bement, Jr.
as included in
"Purdue's Engineering Edge: Where Breakthroughs Begin"

Winter 2006-07 Publication
from
Purdue University's College of Engineering

My years at Purdue hold many good memories, but without doubt, the enthusiasm and commitment of the engineering students is the most vivid. These young people come to their studies believing, as generations of engineers have done, that they can and will accomplish something valuable for the nation and the world.

We count on them to hold steadfastly to this vision, melding principle and practice, as they move on to professional positions and make their unique contributions to society. The grand mission for universities is to provide them with the knowledge and skills they will need to realize their ambitions and dreams. Nothing less than the nation's future prosperity depends upon meeting this challenge successfully.

The accelerating pace of scientific discovery and technological change, fired by more robust computing and networking, is the locomotive driving the relentless pressure of global competition. The nations that are pulling ahead are those that quickly embrace new knowledge, regardless of its source, and that propel their citizens along new educational, economic, and technological pathways.

In this changing environment, we cannot afford to be complacent about our nation's ability to sustain its long history of leadership in science, engineering, and technology. Intellectual and human capital, infrastructure, and investment in research and development are the three fundamental requirements for survival in the new "knowledge economy." This is a lesson that nations like China and India are quickly learning, as they build powerful economic momentum through a burgeoning science and engineering workforce and research capacity.

Crafting an educational environment to keep pace and excel is an enormous challenge. As Director of the National Science Foundation, I abide by the Foundation's enduring precept that research and education are two sides of the same coin. Inviting students to be partners in exploring science and engineering frontiers is the best way to prepare the next generation of science and engineering talent, and should be proffered early and often. As they leave the university to enter the workforce, these freshly minted engineers carry with them the experience and know-how to be genuine leaders in innovation.

The flip side of the coin is a focus on transformational research. The Foundation's unique role within a broader U.S. research and development enterprise is to search out and support the most promising fundamental research at the frontiers of discovery. Dogging the frontier is imperative because revolutionary concepts are generally found in unexplored territory. This is the realm of transformational ideas that can spawn innovative technologies, solve major dilemmas that challenge our societies, and dramatically change our lives.

Purdue's engineering programs take a fresh approach to research and education. Discovery Park, with its many multidisciplinary centers, serves as a resource for industry, government, and the educational community at large. A focus on grand themes in energy, environment, disease, and education, puts a spotlight on important social goals in a world increasingly dependent on complex technologies to solve human quandaries. Both are significant responses to the changing research and education landscape, propelled by the accelerating pace of discovery and innovation, and shaped by the realities of globalization.

The ultimate purpose of the science and engineering enterprise is to put knowledge to work for the growth of the economy and the well-being of society. Education is the font from which every such vital transformation flows. We must continue to encourage our students to turn the familiar world upside down.