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February 2006

NSF AT WORK

NSB Releases Science and Engineering Indicators 2006

The biennial *Science and Engineering Indicators 2006* was released by the National Science Board on Feb. 23, 2006.

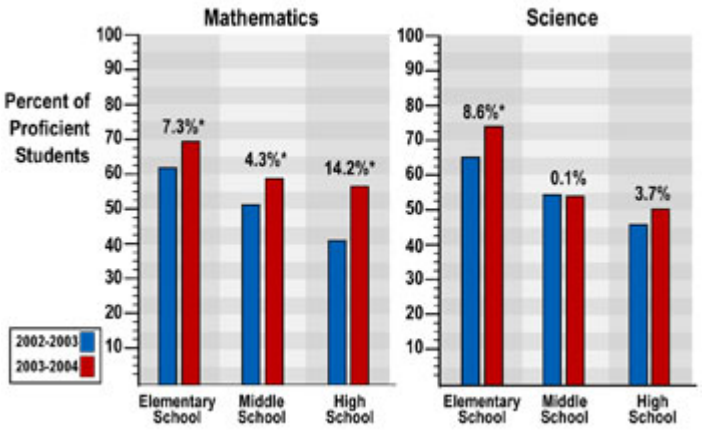
Indicators 2006 reports:

- The number of science and engineering degrees awarded at all levels in the U.S. is rising, especially bachelor's and master's degrees.
- Graduate enrollment is trending upward for all major U.S. demographic groups.
- International spending on research and development is growing rapidly.
- China is keeping pace with the U.S. in the growth of its high-technology production relative to its total manufacturing output.
- U.S. patent applications from the Asia-8 nations (South Korea, Indonesia, India, Malaysia, Philippines, Singapore, Taiwan and Thailand) are growing rapidly.

See *Indicators 2006* for additional findings. Its companion policy report, *America's Pressing Challenge – Building a Stronger Foundation*, contains recommendations to improve U.S. science and engineering education.

Science and Engineering Indicators 2006 *is now available. Credit: National Science Board.*

Math and Science Partnership Program Scores High Grade



Analysis of early data from NSF's MSP program shows K-12 student proficiency rising in conjunction with new educational approaches. Student achievement at 130 participating schools improved. The percentage of students "at or above proficiency" is shown for two school years; the percentage change between the two years is atop each pair of bars. The "" denotes a statistically significant change at the 0.05 level (i.e., 1 in 20 chance the change results from random chance). Credit: NSF.*

Elementary, middle- and high-school students participating in NSF's Math and Science Partnership (MSP) program during the 2002-2003 and 2003-2004 school years showed significant improvements in mathematics and science proficiency, according to a first analysis of data the foundation has gathered.

High-school math students showed the greatest improvement with 14.2 percent more "at or above proficiency" after one year of MSP participation. Elementary school students performed better in both math and science with 7.3 and 8.6 percent more reaching or exceeding proficiency, respectively.

These data, the first available since MSP's establishment in 2002, were collected from 130 partnership schools that received first-round MSP awards. After a complete analysis of the data, results from the first-year evaluation will be publicly available at NSF's MSP Web site in spring 2006. For more on the data to date, see "NSF's Math and Science Partnerships Make the Grade."

Ancient Tyrannosaur Proves Most Primitive Yet Discovered

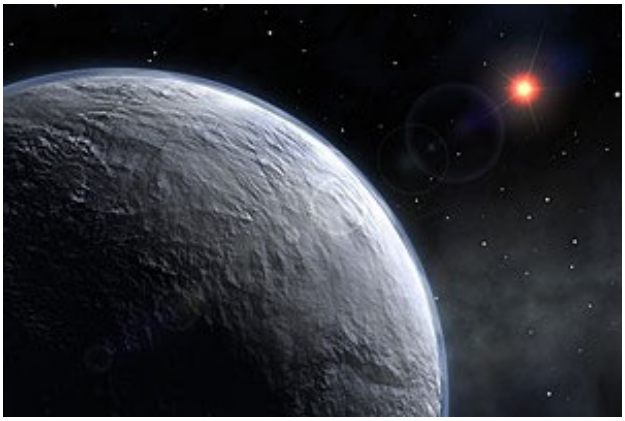
Scientists have discovered the oldest known relative of T. rex. Credit: Zhongda Zhang, Institute of Vertebrate Paleontology and Paleoanthropology.

A 40-foot-long dinosaur fossil discovered in China's Junggar Basin appears to be a new genus and species of dinosaur -- as well as the most primitive tyrannosaur yet found. The small dinosaur, *Guanlong wucaii*, is a type of dinosaur known as a coelurosaur, which is closely related to birds and much smaller than its legendary relative -- the 15-foot-tall, 40-foot-long *Tyrannosaurus rex*.

A team of researchers supported by NSF and the National Geographic Society identified the dinosaur based on the skeleton's cranial features and long, shallow snout. Still, *Guanlong* is identified as a tyrannosaur based on the shape of its teeth and skull openings as well as its pelvic features, said James Clark of George Washington University in Washington, D.C. The findings were reported in the journal *Nature*.

See the NSF press release "Scientists Discover Oldest-Known and Most-Primitive Tyrannosaur" for more information.

One Step Closer to Answering, "Are We Alone?"

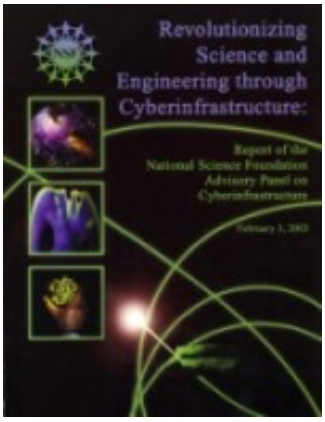


Artist's rendition of the newly discovered extrasolar planet. Credit: European Southern Observatory.

Using a relatively new planet-hunting technique, researchers discovered what is likely the most Earth-like planet detected to date. Planet OGLE-2005-BLG-390Lb -- the smallest planet yet found orbiting a star outside our solar system -- is located more than 20,000 light years away in the constellation Scorpio, near the center of our Milky Way galaxy.

This discovery was made possible by gravitational microlensing, a technique based on a concept first discussed by Albert Einstein in the early 20th century. This technique can spot worlds one-tenth the mass of our own. The recent discovery suggests this may be an exceptional technology for finding distant planets with traits that could support life. For more information on this recent discovery or microlensing, see NSF's "Closer to Home" press release.

Atkins to Head NSF's Office of Cyberinfrastructure



Cover of NSF's Advisory Panel on Cyber-infrastructure report, also known as the "Atkins Report." Atkins, who co-authored the report, will soon head NSF's OCI. Credit: NSF.

NSF has named distinguished computer scientist Daniel E. Atkins to head its newly created Office of Cyberinfrastructure (OCI). Atkins, a professor in the School of Information and in the Department of Electrical and Computer Engineering at the University of Michigan, Ann Arbor, has made major contributions to high-performance computer architecture, and led or participated in the design and construction of seven experimental machines including some of the earliest parallel computers.

Atkins will join NSF on June 5, 2006, as Director of the OCI, which has a FY 2006 budget of $127 million. The President's budget request for OCI in FY 2007 calls for $182.42 million -- an increase of $55.3 million, or 43.5%. The OCI will work closely with all NSF offices and directorates to realize the Foundation's emerging Vision for 21st Century Discovery.

Faces of NSF Research

Biologist Tackles Plant Disease, One Genome at a Time

Cornell University Professor Alan Collmer

With funding from NSF's Plant Genome Research Project, Cornell University's Alan Collmer led the effort to sequence the genome of a tiny plant pathogen, *Pseudomonas syringae*. Because the genome of *Arabidopsis* -- one of the pathogen's plant hosts -- was already known, scientists now have a full host-pathogen model to help understand plant disease.

NSF: *How do you think the age of genomics has advanced the plant sciences?*
Collmer: Just as a blueprint guides the building of a house, a complete genome sequence can guide the integration of many reductionist studies into an understanding of the whole organism as a living system...The databases, biological tools, and web resources that collect around a genome project help to nucleate a research community that is larger than the sum of its parts.

NSF: *What are the guiding research questions that drive your work?*
Collmer: Plants are surrounded and probed by a myriad of microbes but are parasitized by relatively few. How do plants defend themselves, and what are the molecular secrets of successful pathogens? Over the past 20 years our field has made tremendous progress in understanding a few virulence systems...But these pioneering studies have also revealed bewilderingly complex webs of molecular interactions.

NSF: *What gives you the most satisfaction in your work?*
Collmer: I get the most satisfaction from teaching and working with young scientists, which I have been fortunate to do with students from the high school level to the postdoctoral level. It is gratifying to see a new generation of students nurturing the clear-eyed curiosity and analytical skills that will enable them to pursue a profession, serve society, and (particularly important these days) join a world-wide community that is linked by shared curiosities rather than dogma.

For more on Collmer's research, see "Of Plants and Pathogens: A Model Relationship" on the NSF website.

NSF in the News

America Can't Afford to Lose Its Edge -- *St. Louis Post-Dispatch* (02/16/06) President Bush has pledged to dramatically increase the budget of the National Science Foundation. Federal investments in science have directly impacted the lives of every American. For example, NSF funding helped in the early development of the Web, fiber optics, and bar codes.

Prospects Bright for Bush's Competitiveness Plan -- *Los Angeles Times* (02/12/06) The Bush administration has budgeted $5.9 billion for the American Competitiveness Initiative in fiscal 2007, including $1.3 billion in new spending to train teachers and support research activities through agencies like the National Science Foundation.

Spreading Cybersecurity -- *Washington Post* (02/09/06) The National Science Foundation has awarded a D.C.-regional consortium a four-year, $3 million grant to boost the number of cybersecurity technicians in the area and enhance the safety of the Internet. The consortium has established a "virtual regional center" dubbed CyberWatch to aid its efforts.

Mine Buster Targets Breast Cancer -- *Wired* (01/31/06) University of Arkansas associate professor of electrical engineering Magda El-Shenawee is adapting technology she created to detect land mines to detect early-stage breast cancer. Her efforts gained a boost from a three-year, $470,000 National Science Foundation grant aimed at collaboration with researchers at the University of Mississippi who are working on small sensors compatible with her software.

Did You Know?

Fundamental research supported by NSF led to the development of magnetic resonance imaging (MRI). Paul Lauterbur of the University of Illinois, Urbana-Champaign, was first to propose and demonstrate the use of magnetic resonance to produce images -- a discovery that resulted in his 2003 Nobel Prize.

The world's first magnetic resonance scanner (1977). NSF-supported research led to the development of MRI technology. Credit: Courtesy FONAR Corporation.

Today, MRIs are used to visualize tumors, bleeding, injury and infections. According to one report, an estimated 24.2 million MRIs were performed in the U.S. in 2003.

An MRI machine generates a strong magnetic field that causes molecules in the body to align themselves according to their own magnetic properties. That realignment is detected, and the resulting data are converted into images of organs and structures in the body, with no known harmful effects.

Radiation oncologist Timothy Jamieson, a partner in the Florida & Georgia Radiation Oncology Group, said that in his daily fight against cancer, the MRI's sensitivity is superior to other methods used to visualize tumors -- it is critical in brain cancers, for example. Additionally Jamieson commented, "With today's increased awareness of the risks associated with exposure to radiation, the MRI is seen as a valuable alternative to technologies dependent on x-rays -- like CT scans that have perhaps been overprescribed."

Excerpts from NSF Director Arden Bement's Testimony before the House Committee on Science regarding NSF's FY 2007 Budget Request on Feb. 15, 2006.

"The President's request for NSF for 2007 is $6.02 billion, or a 7.9 percent increase over the appropriation enacted last year. As part of the President's American Competitiveness Initiative (ACI), this request represents the first step in the Administration's firm commitment to doubling the NSF budget over the next 10 years."

"The ACI encompasses all of NSF's investments in research and education. These investments – in discovery, learning, and innovation – have a longstanding and proven track record of boosting the nation's economic vitality and competitive strength."

"Frontier research is NSF's unique task in pursuing the Administration's research priorities within the larger federal research and development effort. Over the years, NSF has advanced the frontier with support for pioneering research that has spawned new concepts and even new disciplines."

"With this first installment of the ten-year commitment to double NSF's budget, we will be able to capitalize on the many areas of emerging promise already on the horizon."

"The President's American Competitiveness Initiative makes clear the larger rationale for investments in science and engineering. This is to put knowledge to work—to improve the quality of life and enhance the security and prosperity of every citizen. NSF is committed to cultivating a science and engineering enterprise that not only unlocks the mysteries of the universe but that addresses the challenges of America and the world."

For additional details, see the complete Testimony Before the House Science Committee *(02/15/06) or the* FY 2007 Budget Presentation *(02/06/06).*

Buckius Highlights U.S. Lead in Nanotechnology Research in Hill Testimony

Richard Buckius, NSF's Assistant Director for Engineering, discussed advances in fundamental nanotechnology research in testimony before the Senate Commerce, Science and Transportation Committee on Feb. 15, 2006.

"Nanotechnology is truly our next great frontier in science and engineering, and it represents an entirely new realm of technological capabilities. By tailoring molecules and even manipulating individual atoms, scientists and engineers now have the ability to design materials, medicines, electronics, and machines at the tiniest, most fundamental level," Buckius said.

Buckius elaborated on NSF's clearly defined and vitally important role in the federal nanotechnology research and development portfolio. "Our focus is on fundamental science and engineering research and education. This research is supported primarily through grants to individuals and teams at our nation's academic institutions," he said.

NSF's FY 2007 budget request for the National Nanotechnology Initiative (NNI) is $373 million. Within this total investment, $65 million will be allocated to 50 new nanoscale interdisciplinary team awards.

Buckius continued, "The United States currently is the world leader in nanotechnology, and that offers tremendous advantages as the field grows and matures over the next decade. The current vision for the U.S. investment in nanotechnology has proven remarkably fruitful."

Significant accomplishments made possible by NSF investments are among the national pay-off. Since the inception of the NNI in FY 2001, NSF has supported approximately 3,000 active R&D projects, and founded 24 centers, networks, and user facilities (nearly half of the total created by the entire NNI). In 2005 alone, NSF educated or trained about 10,000 students and teachers in nanotechnology.

For the entire testimony, see "Advancing the Frontiers of Nanotechnology Through Fundamental Academic Research."