

**Written Statement
of
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Chairman, National Science Board**

**Before the
Committee on Appropriations
Subcommittee on Science, the Departments of State, Justice, and Commerce,
and Related Agencies
United States House of Representative**

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Chairman Wolf, Representative Mollohan, and members of the Subcommittee, I appreciate the opportunity to testify before you. I am Warren Washington, Senior Scientist and Section Head of the Climate Change Research Section at the National Center for Atmospheric Research. My testimony today is my last with you in my capacity as the Chairman of the National Science Board (the Board, NSB). I, along with seven of my fellow Board Members, retire from the Board on May 10. It has been my great pleasure to serve on the Board for 12 years, the last 4 as Chairman.

On behalf of the Board and the widespread and diverse research and education communities that we all serve, I thank the Members of this Committee for your long-term commitment to a broad portfolio of investments in science, technology, engineering, and mathematics (STEM) research and education. While it is critical that our Nation significantly increase our support for this portfolio, it is also important that these investments be diverse and balanced.

The Congress established the National Science Board in 1950 and gave it dual responsibilities:

- Oversee the activities of, and establish the policies for, the National Science Foundation (the Foundation, NSF); and
- Serve as an independent national science policy advisory body to the President and the Congress on policy issues related to science and engineering (S&E) research and education.

The Board greatly appreciates Congressional support of the Board, the Foundation, and their programs and activities. Bipartisan legislation being introduced in both houses of Congress will help to provide additional tools to ensure the American science and technology (S&T) enterprise remains the envy of the world. Congressional Member participation in the Board's December Hearing on 21st Century Education in Science, Mathematics, and Technology helped to highlight this important issue.

This Subcommittee, both majority and minority members, played a crucial role in urging the Board to undertake a process to consider establishing a special commission to deal with this important topic. The Board thanks Chairman Wolf's staff for all their help in arranging that first hearing here on Capitol Hill. Last month we held the second Board hearing at the University of Colorado, and we will hold our third and final hearing next week at the University of Southern

California. The significant input we have received during these hearings, as well as the urging of members of Congress and many independent stakeholder groups, will likely lead the Board to formally establish a special blue-ribbon commission later this month.

However, I would like to provide some general comments regarding the NSF FY 2007 budget request, then update you on National Science Board activities over the last year and some of our priorities for the coming year, including this commission.

FY 2007 NSF BUDGET REQUEST

In August 2005, the National Science Board reviewed and approved an NSF FY 2007 budget request that was submitted to the Office of Management and Budget (OMB) in September 2005. The Board generally supports the President's budget request before you today, and we are greatly encouraged by the overall level of increase in the total NSF FY 2007 budget request. Given the overall cut to non-defense domestic discretionary spending, the Board respects and appreciates that the President's budget request recognizes the importance of returning NSF to significant positive growth. We are cognizant of the current Federal fiscal constraints that our Nation faces and that there are many worthy competing interests for limited resources.

Nearly a year ago, Members of Congress requested that the Board, in its role as the policy making and oversight body of the NSF, develop a bold new vision for NSF. The Board was also requested to factor Federal fiscal realities into its vision for the future of NSF. The *National Science Board 2020 Vision for the National Science Foundation (NSB 05-142, www.nsf.gov/nsb/documents/reports.htm)* was delivered to Congress, as requested, two months ago. This document provides a vision statement for NSF that is informed by a sense of our Nation, our knowledge of the trajectory of global science and engineering research, and our confidence in a promising future. We have also provided Strategic Priorities, Near-Term Goals, and Enabling Strategies for achieving this vision.

The Board envisions a prosperous America that is powered by innovations flowing from the latest transformative scientific ideas with a workforce among the most scientifically and technically competent on the planet. We see an America in which every student graduates from high school with a sufficient grasp of the fundamental concepts in S&T to live a full and productive life in an increasingly technological world and whose research and higher education enterprises - among the most creative and fruitful in the world - bring together the best minds for inquiry, discovery, and teaching. The Board also envisions an America whose knowledge, skills, and values are respected and influential in setting the aspirations and policies of the global research and technology enterprise.

The National Science Board's 2020 Vision for NSF is that the Foundation will:

- Drive the cutting edge of fundamental and transformative research;
- Tap the talents of all our citizens, particularly those belonging to groups that are underrepresented in the science and research enterprise, and continue to attract foreign students and scientists to the U.S.;

- Develop and test new approaches to teaching science to elementary and secondary school students and catalyze partnerships among schools, museums, aquariums, and universities to put these techniques into effective practice;
- Provide the bright minds in our research institutions with the tools and instruments needed to probe the frontiers of knowledge and develop ideas that can transform our understanding of the world; and
- Maintain the financial and talent resources to be an effective agent for excellence in the critical national enterprises of learning, discovery, and innovation.

The President's FY 2007 NSF budget request is a significant step towards achieving the Board's 2020 Vision for NSF. The Board fully supports the FY 2007 NSF budget focus on the four funding priorities that address current national challenges as well as strengthening the core portfolio's of NSF's research investment. We also recognize that a budget request of \$6.02 billion, representing a 7.9 percent increase over NSF's FY 2006 budget, is a significant investment in NSF programs in a time of National fiscal austerity.

Nevertheless, it is incumbent on the Board, in our role as an independent advisory body to both the President and Congress, to note that this still represents a significant gap between the existing congressionally authorized FY 2007 NSF budget of approximately \$10 billion that was included as part of the NSF Act of 2002, which sought to double the NSF budget in 5 years. The President's American Competitiveness Initiative again calls for a doubling of the NSF budget over a 10-year period. The Board welcomed the 2002 congressional authorization to double NSF's budget, the President's new call for a doubling of NSF's budget and all past efforts to double NSF's budget. However, we would respectfully suggest that the time to implement these admirable authorizations and initiatives has never been more urgent than now.

Members of this House Appropriations Subcommittee are familiar with the recent National Academy of Sciences study, headed by Norm Augustine, that described the unique and long-term value of programs in science and engineering research and education, like those at NSF, to ensuring the future economic health of our Nation, maintaining U.S. preeminence in discovery and innovation, and providing valuable contributions to homeland security efforts. A review of the National Science Board's just released *Science and Engineering Indicators 2006* ([NSB-06-01, www.nsf.gov/nsb/](http://www.nsf.gov/nsb/)) report should provide ample evidence of troubling trends that the Board, the National Academies and others have been highlighting regarding our Nation's future ability to remain preeminent in the global enterprise of discovery and innovation.

A critical mass of support, at least in principle, seems to have been attained with support from the President, both parties of Congress and the Nation regarding the need to significantly increase our Nation's broad portfolio of investments in science, engineering, mathematics, and technology research and education. It is also important, however, that this portfolio be diverse and balanced. Two NSF directorates, in particular, seem out of balance with the rest of the NSF budget over the last 2 years – Education and Human Resources (EHR) and Biological Sciences (BIO). Should this Subcommittee determine that additional funds, beyond the Administration's request, can be made available to NSF in FY 2007, the National Science Board would

recommend support for a strong and growing role for the NSF in the Nation's investment in S&E education, and addressing basic biological research.

Nearly a quarter century ago, the National Science Board's Commission on Pre-college Education in Mathematics, Science and Technology assessed the state of U.S. pre-college education in the subject fields and found it wanting. In the intervening years, we have failed to raise the achievement of U.S. students commensurate with the goal articulated by that Commission — that U.S. pre-college achievement should be “best in the world by 1995” — and many other countries have surpassed us. Not only are they not first, but by the time they reach their senior year, even the most advanced U.S. students perform at or near the bottom on international assessments. There is now an even more pressing need to build a new foundation. The *Science and Engineering Indicators 2006* report clearly describes the extent of the dilemma; the time to act is now.

In 1983 the U.S. Department of Education's National Commission on Excellence in Education published the report, *A Nation At Risk*. This document stated: “By the year 2000, U.S. students will be the first in the world in mathematics and science achievement,” expressing alarm on the “rising tide of mediocrity [in education] that threatens our very future as a Nation and a people.” Despite these two reports – *A Nation At Risk* sounding the alarm and the NSB Commission report recommending solutions – and many others since then, we continue to slip further behind. The converging trends and stresses within our Nation’s K-12 science and system are clearly documented in *Science and Engineering Indicators 2006*.

As the Board has stated in our just released policy report entitled, *America’s Pressing Challenge – Building a Stronger Foundation* ([NSB-06-02, www.nsf.gov/nsb/](http://www.nsf.gov/nsb/)), if the U.S. is to maintain its economic leadership and compete in the new global economy, the Nation must prepare today’s K-12 students better to be tomorrow’s productive workers and citizens. Changing workforce requirements mean that new workers will need ever more sophisticated skills in STEM. This emerging workforce, consisting of degreed and highly skilled technical workers, will need to begin developing their mathematical and science skills early in their educational career. In addition, the rapid advances in technology in all fields mean that even those students who do not pursue professional occupations in technological fields will also require solid foundations in science and math in order to be productive and capable members of our Nation’s society. We simply cannot wait until our students reach 18 years old to begin producing the intellectual capital necessary to ensure this future workforce; the time is now to get serious about this problem and better sharpen our efforts at all grade levels, in order to dramatically accelerate progress, lest we find ourselves, as a Nation, unable to sustain our high technology based quality of life.

Education is a core mission of NSF, which not only promotes research, but also shares in the responsibility for promoting quality math and science education as intertwining objectives at all levels of education across the United States. NSF’s highly competitive peer-review process is second to none for openly and objectively identifying, reviewing, selecting, funding and providing stewardship for the very best STEM proposals and programs in research and education.

The NSF Mathematics and Science Partnerships (MSPs) are important tools for addressing a critical - but currently very weak - link between pre-college and higher education. The NSF MSP Program provides for the collaboration between pre-college and college to promote excellence in teaching and learning, therefore facilitating the transitions for students from kindergarten through the baccalaureate in STEM disciplines. The added benefit for our Nation is those students who do not choose STEM careers become the informed scientifically literate voting citizens we need for the 21st Century.

NSF has the mandate, depth of experience, and well-established relationships to build the partnerships for excellence in STEM education. The Board, therefore, continues to stand by our 2004 formal policy statement ([NSB-04-02](http://www.nsf.gov/nsb/documents/testimony.htm), www.nsf.gov/nsb/documents/testimony.htm) strongly urging that continued, full funding of the MSP Program at NSF be sustained over the long term as an essential component of a coordinated Federal effort to promote national excellence in science, mathematics and engineering. We also note with great concern that the FY 2007 NSF Budget provides for only a 2.5 percent increase from FY 2006 for the Education and Human Resources Directorate – still leaving this important component of our Nation’s STEM education initiative over 3 percent below its FY 2005 level.

Another example of an area of NSF’s diverse portfolio that would warrant attention should the Congress find additional funds beyond the President’s request, is the Biological Sciences Directorate. Biology essentially had a zero budget increase from FY2005 to FY 2006, and has the smallest FY 2007 percent increase of any of the NSF Research and Related Activities Directorates.

In general, the Biological Sciences budget of NSF has been small in recent decades, relative to the fact that some of the most spectacular advances in science over the last 50 years have been in this field. The emergence of biology at the forefront of scientific advances began with the discovery of the structure of DNA by Watson and Crick in 1953 and has accelerated ever since. Among the many landmark discoveries was the validation of the universal genetic code in the late 1960’s. For instance, the work on determining the genetic code was performed in England using a bacterial virus, a “bacteriophage”. These and many other discoveries have been recognized by numerous Nobel prizes.

One major factor that may have inadvertently contributed to a perceived lack of need to significantly increase the NSF Biology budget may have been the dramatic budget increases over the last 10 years for the National Institutes of Health (NIH). However, NIH and NSF have different missions and foci in regards to supporting basic research in biological sciences. The NSF physical sciences are well deserving of significant budget increases, but so are the other facets of NSF’s diverse portfolio. The spectacular advances in structural biology have depended largely on the development of innovative new technology, some of which has been funded by NSF. Biology today is as basic a science for exploring our world as physics, chemistry, and mathematics have always been. Biologists are by far the largest community of scientists benefiting from synchrotron radiation sources; structural biologists have long been one of the major driving forces for better and bigger computing facilities; and the daily visual imaging technology used in the analyses of proteins or whole cells is on par with needs for this technology in physical sciences. It is also widely recognized that advances in biological sciences

are instrumental in fostering applications that often lead to commercial innovation. Yet funding of biology has decreased as a proportion of the NSF budget in the last 8 years.

Notwithstanding the Board's concern regarding NSF's EHR and BIO budgets, I would emphasize that the NSB supports the integrated portfolio of investments in S&E research and education represented in the NSF FY 2007 budget proposal. It thoughtfully blends support for the core disciplines with encouragement for interdisciplinary initiatives, brings together people from diverse and complementary backgrounds, provides infrastructure for research and STEM education, and strengthens the NSF's management of the enterprise.

The Board fully supports the proposed FY 2007 funding for the Major Research Equipment and Facilities Construction (MREFC) account that permits the initiation of three new MREFC projects. Members of the House Appropriations Subcommittee are aware of the exciting opportunities at the frontiers of knowledge that we are unable to pursue without the cutting edge facilities that are funded under this account. The Board reiterates our support and priority order for these three "new start" MREFC projects with highest priority for the Alaska Regional Research Vessel (ARRV), followed by National Ecological Observation Network (NEON) and the Ocean Observations Initiative (OOI).

The President's budget request for NSF also continues to foster S&T that enhances our homeland security. NSF activities in this area include Critical Infrastructure Protection, Research to Combat Bioterrorism, Cybercorps Scholarships for Service, Counterterrorism, and Physical/Information Technology Security. By enabling future discovery and innovation, NSF supports our Nation's long-term prosperity and security. The requested funding for Homeland Security related projects is \$384.21 million, representing a 12.4 percent increase over FY 2006. Nearly half of the requested increase will support a new NSF-wide activity that seeks to advance fundamental knowledge in new technologies for sensors and sensor networks, and in the use of sensor data in control and decision-making across a broad range of applications, particularly those that bear on the prediction and detection of explosive materials and related threats.

OVERVIEW OF NSB ACTIVITIES DURING THE LAST YEAR

During the last year, the Board accomplished a great deal, even while going through a continuing evolution in terms of its operation. I will not attempt to describe all of our accomplishments, but I would like to briefly highlight some of these accomplishments.

NSF Oversight and Policy Direction

A significant example of the Board's effort to provide oversight and policy direction to NSF was the completion of a revised process for the identification, review, approval and prioritization of large facilities projects. Under the revised process, the Board approved six major NSF awards totaling over \$540 million, and approved the termination of an MREFC project.

The Board also approved a policy statement on Respective Roles of NSF Management and the Office of Inspector General in the Settlement of Administrative Investigatory Matters, as well as approved Guidance for NSF Centers Programs.

Perhaps most importantly, we approved the *National Science Board 2020 Vision for the National Science Foundation*

Advice to the President and Congress

In terms of advice to the President and Congress, the Board published and disseminated several important reports, including:

- *Long-Lived Digital Data Collections* ([NSB-05-40](http://www.nsf.gov/nsb/documents/reports.htm),
www.nsf.gov/nsb/documents/reports.htm)
- Review of the NSF Merit Review system ([NSB-05-119](http://www.nsf.gov/nsb/documents/reports.htm),
www.nsf.gov/nsb/documents/reports.htm)
- *Science and Engineering Indicators 2006* report.
- The Board's S&E Indicators "Companion Piece" policy report that focuses on STEM education, entitled *America's Pressing Challenge – Building a Stronger Foundation*.

Further, the NSB provided testimony to congressional hearings, and responded to other specific questions and inquiries from Congress.

Improved Outreach and Communication by the Board

The Board also continues to increase and improve our direct outreach and communication with OMB, OSTP, Congress, other Federal agencies, various interest groups and the outside science and engineering research and education community.

For example, the Board held

- a Capitol Hill hearing (with simultaneous Web cast) on 21st Century Education in Science, Mathematics and Technology with Members of Congress testifying;
- two public workshops on Transformative Research (Arlington, VA and Santa Fe, NM);
- a public workshop on Engineering Workforce Issues and Engineering Education (Massachusetts Institute of Technology);

In an effort to facilitate more openness of Board meetings in accord with the Sunshine Act, we expanded our practices for:

- providing public notice of all our meetings in the *Federal Register* and on the NSB Web site;
- treating teleconferences of committees as 'meetings,' subject to the requirements of the Government in the Sunshine Act;
- providing much more information to the public in a more timely manner regarding meeting discussions and decisions; and
- encouraging public comment during the development of Board publications.

The National Science Board Office (NSBO) is contracting to develop monitoring and evaluation tools, to expand outreach, and measure the impacts of NSB statements, resolutions and reports; and to redesign the NSB Web site to promote transparency, accessibility, and utility for the public. The Board's practice of holding its data gathering workshops around the country will be expanded in FY 2006 and 2007 to increase opportunities for the public to attend Board activities.

The Board has also continued its recognition of outstanding science, engineering and science education accomplishments through the Vannevar Bush Award, Alan T. Waterman Award, and Public Service Awards.

Ongoing and Future Board Activities

The Board has much to do in 2006 and 2007. Perhaps one of the most important actions is to oversee the implementation of the Board's 2020 Vision for NSF and approval of the new NSF Strategic Plan. We also will need to make a final decision on how to proceed with the creation of a Board Commission on 21st Century Education in Science, Mathematics, and Technology.

Two of our Task Forces, Transformative Research and Hurricane Science and Engineering will hold additional workshops and present the Board with draft final reports for Board approval.

Our Task Force on International Science Partnerships will literally be taking the Board around the world in 2006 and 2007, and our *ad hoc* Task Group on Engineering Education is poised to present us with recommendations that will impact university engineering programs and the future engineering workforce.

In addition to the Board matters of oversight and policy direction to NSF and providing advice to the President and Congress, there will also be significant transitions taking place on the Board itself. In a few short months, eight Board Members, four of whom have served on the Board for 12 years, will leave the Board. The Board will also be electing a new Chairman and Vice-Chairman, with committee chairmanships open to new appointments by the new Chairman of the Board.

FY 2007 NSB BUDGET

The Board's Budget Request for FY 2007 seeks resources to carry out its statutory authority and to strengthen the Board's oversight responsibilities for the Foundation. Effective communications and interactions with our constituencies contribute to the Board's work of identifying priority S&T policy issues, and developing policy advice and recommendations to the President and Congress. To this end, the Board will continue to increase communication and outreach with the university, industry and the broader S&E research and education community, Congress, Federal S&T agencies, and the public. The Board's activities will aim to support global leadership in discovery and innovation based on a continually expanding and evolving S&T enterprise in this country, and will ensure a principal role for NSF programs in providing a critical foundation for S&E research and education.

Among other activities in FY 2007, the Board expects to complete its study of NSF identification, development, review and funding of transformative research, and provide new guidance for NSF policies regarding such research. It will also provide national policy recommendations following completion of the work of its Commission on 21st Century Education in Science, Mathematics and Technology. While many of these recommendations will be at a national system level, a number will also focus specifically on the role NSF can and should play in supporting the development of an adequate and diverse S&E workforce for the future. The Board's examination of university level engineering education will also be completed and recommendations provided in FY 2007. The Board's Task Force on Hurricane Science and Engineering will also be producing a final report that is expected to outline a specific role for NSF in addressing interdisciplinary needs of an integrated national research program. The NSB International Task Force expects to complete its examination of the role of the Government in international science and engineering in response to the changes that have occurred in recent years to the global dynamics for S&E research, education, politics, and workforce. The Board will continue to review and approve NSF's actions for creating major NSF programs and funding large projects. It is also expected that the Board will be reviewing a new NSF Strategic Plan and guiding its implementation that is expected to address the Board's 2020 Vision for NSF.

Essential to the conduct of Board business is a small and independent, yet adequate, core of full-time senior policy, clerical and operations staff, supplemented by short-term temporary contractual support as needed for various Board endeavors. This core of Board support is augmented by the Foundation as it continues to provide accounting, logistical and other necessary resources in support of the NSB and its missions. In addition to the NSBO's essential and independent resources and capabilities, external advisory and assistance services are especially critical to support production of NSB reports and supplement the Board staff's general research and administration services to the Board. These external services provide the Board and its Office with the flexibility to respond independently, accurately and quickly to requests from Congress and the President, and to address issues raised by the Board itself.

By statute, the Board is authorized five professional positions and other clerical staff as necessary. In consultation with the Congress, the Board has defined these five professional positions as its senior S&E policy staff, and the clerical positions as Board staff that support Board operations and related activities associated with the conduct of its meetings and oversight responsibilities. At my direction, the NSB Executive Officer, who reports directly to the Board Chair and also serves as the NSBO Director, has identified options for broadening the NSBO staff capabilities to better support the broad mission of the Board. The NSBO staff provides both the independent resources and capabilities for coordinating and implementing S&E policy analyses and development, and the operational support that are essential for the Board to fulfill its mission.

The full impact of increasing the number of professional positions to the statutory level, along with necessary clerical and support staff, is expected to occur in FY 2007, with increased attention to addressing new skill requirements. Nevertheless, the results of a strategic restructuring of NSBO management and operations over the last 2 years (since implementation of the changes incumbent in the December 2002 NSF Re-Authorization Act), has led to more

efficient use of appropriated resources while retaining the ability to support an active Board agenda. More efficient operations, in combination with a completion of Board Office equipment upgrades in FY 2006, has positioned the Board to propose an FY 2007 budget that represents a reduction of \$40,000, or -1.0 percent, over the FY 2006 Current Plan. However, it is important to note that our proposed FY 2007 budget provides the minimum level of support for essential Board activities.

CLOSING REMARKS

This is a difficult time for Federal S&E research and education budgets and the organizations and individuals that rely on Federal support. For over 50 years the Federal government has sustained a continual, visionary investment in the U.S. research and education enterprise in the expectation that such investment would benefit all Americans. That Federal effort has expanded the horizon of scientific discovery and engineering achievements far and wide, leading to the realization of enormous benefits to the Nation's prosperity and security.

We know what works – we have a very long history of success to draw on. In 1946, legislators contemplating the creation of a national science foundation were disturbed by the relative weakness of America in basic scientific discoveries. This weakness was evidenced by several factors, including the scarcity of U.S. researchers awarded Nobel Prizes in chemistry, physics, and medicine and a serious deficit of trained American scientists. By the 1960s, evidence of the success of the Foundation they established was abundant: U.S. researchers were regularly honored for their accomplishments in the sciences by many authorities, including the Nobel Foundation, and the American education enterprise that trained scientists and engineers became the envy of the world.

We know the expanding frontiers of knowledge offer enormous opportunities for research and innovation. We also know that the education of all our citizens in the fundamentals of math, science and engineering must continue to be enhanced if the U.S. is to remain eminent in critical S&T disciplines. As other nations ramp up their investment in the infrastructure for S&E research and innovation, we cannot be complacent. The Federal investment in the Nation's S&T is a necessity for the Nation's future prosperity and security. The U.S. must sustain its advantages through continued wise, adequate Federal support for our S&E enterprise.

In recognition of fiscal realities, the National Science Board pledges that we will guide NSF by setting priorities, to make difficult programmatic budget decisions and, as a result, to obtain the best return on the taxpayers' investment. However, even in a time of budget constraints, we cannot ignore the Nation's growing dependence on innovation for economic prosperity and the ever-improving quality of life Americans have come to expect. The Board recognizes that competing priorities may impose fiscal constraints that limit the Foundation's, and so the Nation's, aspirations. In weighing these competing priorities, the Nation must realize that the challenges we defer today will be faced by our children, and the opportunities we forego today will be charged to their future.