NATIONAL SCIENCE FOUNDATION FY 1997 AUTHORIZATION

HEARING

BEFORE THE

SUBCOMMITTEE ON BASIC RESEARCH

OF THE

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTH CONGRESS

SECOND SESSION

MARCH 22, 1996

[No. 45]

Printed for the use of the Committee on Science

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*Ranking Minority Member
**Vice Chairman

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NATIONAL SCIENCE FOUNDATION FY 1997 AUTHORIZATION

FRIDAY, MARCH 22, 1996

U.S. HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON BASIC RESEARCH,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met at 9:38 a.m. in Room 2318 of the Rayburn House Office Building, the Honorable Steven H. Schiff, Chairman of the Subcommittee, presiding.

Mr. SCHIFF. I am going to call the subcommittee meeting to order, please.

Today the Subcommittee is convening to receive testimony from Director Neal Lane and Deputy Director Anne Petersen of the National Science Foundation on NSF's budget request for fiscal year 1997 and beyond.

As most in the audience know, the National Science Foundation is an independent federal agency established in 1950 to promote and advance scientific progress in the United States.

It accomplishes this principally by funding research and education activities at more than 2000 colleges, universities, and other research institutions throughout the United States.

NSF provides about 25 percent of basic research funding at universities and over 50 percent of the Federal funding for basic research in certain fields of science including math and computer sciences, environmental sciences, and the social sciences.

Moreover, NSF plays an important role in precollege and undergraduate science and mathematics education through programs of model curriculum development, teacher preparation, and enhancement, and informal science education.

As I mentioned at our Subcommittee's hearing this past Tuesday on NSF's Partnership for Advanced Computational Infrastructure Program, as this Congress continues to find new ways to balance the budget, government agencies are looking to maximize the value of each taxpayer dollar.

Of the Federal Government agencies, the National Science Foundation is one of the best at running a lean and efficient organization.

I extend my compliments to Dr. Lane, Dr. Petersen, and all their employees.

The National Science Foundation Research Programs are better off in fiscal year 1996 than they were in fiscal year 1995, and the other bellwether of the basic research community, the National Institutes of Health, received a 5.7 percent increase in fiscal year 1996.

Also, the basic research programs at the Department of Energy received an increase. And, according to the Congressional Research Service, the total R&D increased 1.5 percent over fiscal year 1995.

I realize that certain programs were not increased, but overall during this time of fiscal responsibility I believe the science community has done well.

As both the Administration and the Congress work toward our mutually agreed upon goal of a balanced budget, we must remember that basic science is a long-term investment.

In particular, we must make sure that the budgets from fiscal year 1997 through the Year 2002 when the budget must be balanced under Congress's and the Administration's agreement, in the end provide basic science programs with stability and responsible funding profiles.

The Republican Budget Resolution adopted last year commits us to increasing NSF's research account by 3 percent each year.

In my letter of invitation to Dr. Lane for this hearing, I requested that NSF provide the Subcommittee with a detailed estimate of NSF's projected spending for the fiscal years 1998 through 2002.

I look forward to discussing these figures with NSF today.

As we all know, science is included in the discretionary spending portion of the federal budget, and in both Republican and Democratic plans. Increasing pressure is being placed on discretionary spending to balance the budget.

The science community is going to have to make its voice heard if it expects to be treated fairly. I commend Dr. Lane for his recent speeches urging his scientific colleagues to recognize their civic responsibility and engage in educational discussions with our citizens and their elected representatives.

Certainly other communities are doing so with respect to the importance of their discretionary programs.

But as our Full Committee Chairman, Mr. Walker, likes to point out, when Congress asks for priorities from the science community, the answer that comes back is often "all the programs are good and should receive funding."

As Dr. Frank Press reported to the Science Committee last month, the science community needs to make the hard choices and recommendations for the future.

Let me cite one recent positive example. This past Tuesday this subcommittee received testimony from Dr. Ed Hayes on the tough decisions his task force recommended for the Supercomputer Centers Program within NSF.

I commend Dr. Hayes and Dr. Lane for looking at the budget realities and at the research opportunities, and coming forward with a proposed reconstructed program to meet those two conditions.

Add to the fact that both the current facilities operators and the users community endorsed the proposal and you have a truly unique proposal, the type Congress appreciates receiving.

This is exactly the type of science policy advice that Congress needs.

Support for the National Science Foundation has been bipartisan on this Committee. As we go forward with the budget debates, I believe the Science Committee will continue to have support from both sides of the aisle.

Before welcoming Dr. Lane and Dr. Petersen to explain the NSF's budget, let me just state that I particularly look forward to hearing about the long-term funding profile of NSF, the decision to terminate the academic research infrastructure program, NSF's safety concerns at Antarctica, and the future of the Antarctica program, and changes in the Education and Human Resources Directorate, and the increase in funding for the LIGO program.

But before calling upon Dr. Lane and Dr. Petersen, I would like to recognize my Ranking Member of the Subcommittee, Congressman Bud Cramer from Alabama, who is recognized for any opening remarks he would like to make.

Mr. CRAMER. Thank you, Mr. Chairman. I will be brief.

I am pleased to join the Chairman in welcoming Dr. Lane and Dr. Petersen and senior staff this morning to review the NSF budget for fiscal year 1997.

This is going to be a tough year for us again, but an important year for NSF. The Science Committee has a long history, as the Chairman pointed out, of bipartisan support for the Foundation.

This support arises from a recognition that NSF plays a central role in developing and sustaining the academic research enterprise of the nation.

The wide-ranging activities NSF supports underpins our technological strength both through the generation of new knowledge and the education of scientists and engineers.

In particular, NSF's programs support research and science and engineering, the operation of national research facilities in such fields as astronomy and oceanography, the acquisition of scientific instruments, and I hope the modernization of research facilities, which is an issue that I want to bring to your attention today.

A program that is near and dear to my district is the EPSCOR program. It is a program that is a notable example of just what a state like Alabama can do with the NSF to promote scientific activity.

In fact, nearly all of NSF's programs affect the future of the nation's research capability because they are closely tied to the education of new generations of scientists and engineers. That is an issue that is near and dear to my heart, how we can project out there.

Now the NSF budget request for fiscal year 1997 provides real growth approaching 5 percent above the expected appropriations level for the current fiscal year.

I am pleased that the President's budget does reflect this growth. The budget request, however, does raise a policy issue which has long been of interest to this committee. That is, as I said earlier, the need for refurbishment of academic research facilities.

So I am going to listen to you today to talk to me about that impact and what that means for the future, particularly after the painfully slow progress in establishing and obtaining appropriations for the program.

It is naturally disappointing to see NSF now propose to abandon it.

Again, under these circumstances it is my pleasure to welcome you, Dr. Lane and Dr. Petersen, and I will look forward to your testimony today.

Thank you.

Mr. SCHIFF. Dr. Lane, you are welcome to proceed. Welcome to the Subcommittee.

STATEMENTS OF DR. NEAL LANE, DIRECTOR, NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C.; AND DR. ANNE PETERSEN, DEPUTY DIRECTOR AND CHIEF OPERATING OFFICER, NATIONAL SCIENCE FOUNDATION, ACCOMPANIED BY DR. LUTHER WILLIAMS, ASSISTANT DIRECTOR FOR EDUCATION AND HUMAN RESOURCES

Dr. LANE. Thank you, Chairman Schiff, Mr. Cramer, Members of the Committee:

It is a great pleasure for us to appear before you today to provide an overview of our budget request for the coming year.

I am accompanied this morning by Dr. Anne Petersen, who is Deputy Director and Chief Operating Office of the National Science Foundation.

My remarks this morning will provide an overview of the rationale behind our budget, and some highlights of our request.

I have attached a summary of our budget request to my testimony and ask that it be made a part of the record.

Mr. SCHIFF. Without objection, it will be entered as part of the record.

Dr. LANE. Thank you, Mr. Chairman.

This is an extraordinarily exciting time for science. It is an exciting time to be at the NSF, and we appreciate the opportunity to share just some of that excitement with you today.

We are in what we are calling a "golden age for scientific discovery" where frequent breakthroughs are occurring in virtually every field—from astronomy, to materials science, to genetics, to elementary particle physics.

Moreover, the research often moves so seamlessly into applications that we sometimes fail to notice the transition.

NSF, for example, supports research in optical and electromechanical systems that has potential applications in areas as varied as sensors that detect wear and tear on bridges and roadways in real time, or that can change the shape and response of an air foil on an airplane to changing air conditions, or perhaps even provide ways to steer aircraft; medical devices that allow doctors to conduct surgery without leaving visible scars; new techniques for manufacturing integrated circuits.

The fact that cutting edge technologies like these are being developed in U.S. universities and laboratories is no accident.

Our national capacity for education and research at the very frontiers of science and engineering remains the envy of the world. It forms the heart of science and technology in this country, an it keeps the U.S. competitive in a global economy.

Our budget request for this fiscal year 1997 is needed to maintain the momentum that we have developed. Our requested $3.325

billion is a 4.6 percent increase above the House and Senate Appropriations Conference Report for fiscal year 1996.

After inflation is taken into account, this is a modest increase. But in a time of very tight budgets, it reaffirms the priority we give to investments in the Nation's future.

The NSF's strategic plan which was approved by the National Science Board a year-and-a-half ago, served as the starting point for developing our budget.

Three goals were set forth in that plan: maintaining a world leadership position in all aspects of science, mathematics, and engineering; employing new knowledge in service to society and excellence in science, mathematics, engineering, and technology education at all levels.

These reflect NSF's overall mission.

In developing the budget with these goals in mind, we first sought balance across the agency. NSF is the only federal agency with the responsibility to support research and education in all fields of science and engineering.

We intend to continue this balanced support across the major fields while retaining the flexibility to move quickly into new and emerging areas.

A second consideration was to encourage action across boundaries. Artificial separations between research and education, for example, do not serve the interests of either.

We are committed to reducing organizational and cultural barriers to interdisciplinary research—because the most exciting science and engineering often occurs at the boundaries of disciplines.

Finally, we developed our budget with an emphasis on partnerships. Our principal partners are, of course, institutions and individuals, and universities and colleges, who are the recipients of roughly three-fourths of our research funding.

But we also encourage partnerships with the states, with the private sector, with other agencies, to industry—with all those who have a stake in the science and engineering enterprise.

Let me just take a few moments to highlight how these principals are translated into numbers in the budget request.

The balance principle is reflected in the decisions we made to balance the responsibility for the support of research across all areas of science and engineering with our obligation to promote excellence in education.

Just over half of our budget—56 percent—goes for research project support for individual investigators, research groups, and research centers.

Of the remaining 44 percent, 20 percent is for education and training, and 20 percent for research facilities, which are required for frontier research in many areas of science and engineering.

This leaves about 4 percent for the administration and management of the Foundation. Let me emphasize, 96 percent of our budget goes out in competitively-reviewed and evaluated research and education activities in all the states and territories. Only 4 percent goes for the administration and the management of these activities here with the NSF staff.

A word is now in order about the change in our support of research facilities. NSF supports large, world-class, multi-user research facilities that are complicated, that are expensive, and that require a long-term commitment of support for operations and upgrades.

Included in this list are optical and radial telescopes, particle accelerators, high-field magnet lab, laser inferometer gravitational wave observatory, and the Antarctic facilities, Research Fleet, and other facilities.

The budget request also includes $95 million for Major Research Equipment Account which will be used to support the continued construction of LIGO, and important safety, health, and environmental improvements necessary to maintain the U.S. research activities in the Antarctic.

In order to accommodate our highest priorities, we have found it necessary to eliminate support for the renovation of research facilities under the Academic Research and Infrastructure Program.

I recognize that there are some who will be disappointed with this decision, but in these times of constrained budgets, difficult choices have to be made. Let me assure you that the decision was not an easy one, and it was made only after much discussion and debate.

Consistent with recommendations provided in the National Performance Review which stressed re-examination of our role and our specific objectives, we have concluded that this renovation of academic buildings might reasonably be supported through nonfederal sources such as states, the private sector, or the academic institutions themselves.

This decision provides us with the resources that will accommodate research and education activities which are of a higher priority. We will continue our competitive program to support instrumentation at all levels at colleges and universities.

The second principle used in developing the budget is building bridges across many types of boundaries. This principle is exemplified in the integration of research and education at all levels.

We make the integration of research and education a major theme in our planning. There is a wealth of information pointing to the value of inquiry-based learning as a superior way for students to learn, and also as a way of teaching problem-solving skills to transfer from one subject to another.

In the future, employers will increasingly need workers who are not only well-versed in science and technology concepts, but who are adept at learning through experimentation, through inquiry, critical evaluation and discovery all characteristics of the research culture.

We are currently planning awards that recognize achievement and that encourage future efforts to integrate research and education.

Some research universities have shown leadership in developing innovative programs to broadly involve students in research and inquiry-based learning and to involve their best researchers in science and engineering education at all levels.

We want to recognize those efforts, and to encourage them to share their ideas and experience with other institutions.

We are also in the final stages of a comprehensive examination of the current state of science, mathematics, engineering, and technology education at the undergraduate level.

The project will offer an overview of the needs and opportunities for all undergraduate students and examine how science literacy for the entire country is related to undergraduate education.

We hope that these efforts are responsive to the concerns of Members of the Committee who have been persistent in their focus on the need to ensure the highest possible quality of undergraduate education in our nation's universities and colleges.

As I mentioned earlier, the education and training program function accounts for approximately 20 percent of our overall budget and will total $657 million, an increase of 5.3 percent over fiscal year 1996.

Many activities such as research experience for undergraduates, research in undergraduate institutions, and the Faculty Early Career Development Program that cut across our research and education functions.

One could argue that all of the NSF programs have an education and training component since they develop participants' knowledge and skills.

Likewise, there are many cross-cutting interdisciplinary activities such as earthquake research, biotechnology, civil infrastructure systems, environment and global change, high-performance computing and communication, manufacturing and materials.

These interdisciplinary activities interact with one another and also contain a coordinated, focused educational component.

A third principle guiding our budget planning is working in partnerships. Our investment directly involved 200,000 researchers, teachers, and students at over 2000 colleges, universities, and research institutions, including almost 600 businesses.

Indirectly our programs affect literally millions of people, but the larger impact would not be possible without partnerships. Forming these partnerships will bring together the best minds in our society, sharing ideas and resources in order to improve research and education.

It is particularly important that NSF build on its role as a catalyst, linking elements of society that share an interest in improving education, maintaining scientific and engineering leadership, and using scientific and engineering knowledge to our common benefit.

As one measure of the impact of these partnerships, last year NSF leveraged $1.4 billion from partners, including over $250 million from industry in support of research programs in which NSF was involved.

Other major partners in these activities are academic institutions, states and other federal agencies.

For example, our program called Grant Opportunities for Academic Liaison with Industry, or GOALI, which provides opportunities for a variety of industry-university linkages, is slated to increase by over 40 percent to $18 million in 1997.

To conclude, we have structured this budget request to allow us to sustain the momentum in science and engineering that we built over the past half-century. As a result of our successes, we are on the threshold, or perhaps in the midst of a truly revolutionary era of discovery ranging from the origins of the universe, to the discovery of a new state of matter, to manufacturing microscopic machines.

We have at our fingertips today an array of experimental instruments, computers, information networks that enable us to design and carry out research that would have been impossible just a few years ago.

Over the next decade, the potential for rapidly increasing our understanding of both the natural world and that shaped by humans, and applying new knowledge and technologies resulting from that research, is staggering.

Mr. Chairman, we appreciate this opportunity to present this discussion of our fiscal year 1997 budget request and the rationale behind the proposals.

Dr. Petersen and I would be pleased to respond to any questions you might have.

Mr. SCHIFF. Dr. Petersen, do you have any separate remarks you would like to make at this time?

Dr. PETERSEN. No, I do not.

Mr. SCHIFF. Thank you, Dr. Lane.

[The prepared statement of Dr. Lane follows:]

TESTIMONY OF

DR. NEAL LANE

DIRECTOR, NATIONAL SCIENCE FOUNDATION

BEFORE THE

SUBCOMMITTEE ON BASIC RESEARCH

HOUSE COMMITTEE ON SCIENCE

MARCH 22, 1996

Chairman Schiff, Mr. Cramer, members of the committee, it is a pleasure to appear before you to provide an overview of our budget request for the coming fiscal year. I am accompanied this morning by Dr. Anne Petersen, Deputy Director of NSF.

My remarks this morning will provide a brief overview of how we went about putting our budget request together and review some highlights of that request. I have attached a summary of our budget request to my testimony and ask that it be made a part of the record.

Mr. Chairman, our budget request for fiscal year 1997 is $3.325 billion. This is a 4.6 percent increase above the House and Senate appropriations conference report for fiscal year 1996. After inflation is taken into account, this is a modest increase, but in a time of very tight budgets it reaffirms the priority we give to investments in the nation's future.

The NSF strategic plan, which was approved by the National Science Board a year and a half ago, served as the starting point for developing our budget. The goals set forth in the plan—maintaining a world leadership position in all aspects of science, mathematics, and engineering; employment of new knowledge in service to society; and excellence in science, mathematics, engineering, and technology education at all levels—reflect NSF's overall mission.

In addition to looking to our strategic plan for guidance, we made specific decisions about allocating resources by applying three principles. First, we have sought balance across the agency, both as a way of ensuring continuity in our programs and as a way of fulfilling our responsibility as the only federal agency that supports research and education in all fields of science and engineering. We intend to continue this balanced support across major fields while retaining flexibility to move quickly into new and emerging areas.

Second, the budget encourages action across boundaries. We must look beyond artificial separations that occur between research and education in order to encourage more inquiry-based learning. We are also committed to reducing organizational and cultural barriers to interdisciplinary research because there is much exciting science and engineering at the boundaries of disciplines and because such separations tend to limit our vision.

Finally this budget promotes partnerships. Our principal partners are, of course, institutions and individuals in universities and colleges. This strong commitment to academic research is reflected in our request for research and related activities, which increases by 8.7 percent, to just under $2.5 billion. Roughly three-fourths of both the total and the increment for FY 1997 will support activities based at colleges and universities. But we also encourage partnerships with the states, the private sector, with other agencies, and with all those who have a stake in the science and engineering enterprise.

Let me take just a few moments to highlight how these principles are translated into numbers in the budget request. The balance principle is reflected in the decisions we have made that balance our responsibility to support research across all areas of science and engineering with our obligation to promote excellence in education. Just over half of our budget—56 percent—goes for research project support for individual investigators, research groups, and centers. Of the remaining 44 percent, 20 percent is for education and training and 20 percent is for research facilities, which are required for frontier research in many areas of science. This leaves about 4 percent for the administration and management of the foundation.

A word is in order about a change in our support of research facilities. NSF supports large, world-class, multi-user research facilities that are complicated, expensive, and require a long-term commitment of support of operations and upgrades. Included in this list are optical and radio telescopes, particle accelerators, the high-field magnet lab, laser interferometer gravitational-wave observatory (LIGO), the Antarctic facilities, the research fleet, and other facilities. The budget request also includes $95 million for our Major Research Equipment account, which will be used to support the continued construction of LIGO and important safety, health, and environment improvements necessary to maintain U.S. research activities in the Antarctic and the continuing U.S. presence at the South Pole.

In order to accommodate our highest priorities, we have found it necessary to eliminate support for the renovation of research facilities under the Academic Research Infrastructure Program. I recognize that there are some who will be disappointed with this decision, but in these times of constrained budgets, difficult choices must be made. Let me assure you that this decision was not easy and it was made only after much discussion and debate. Consistent with recommendations provided in the National Performance Review, which stressed a reexamination of our role and specific objectives, we have concluded that this renovation of academic buildings might reasonably be supported from non-federal sources, such as states, the private sector, or the academic institutions themselves. This decision provides us with resources that will accommodate research and education activities which are of a higher priority. We will continue our competitive program to support instrumentation at colleges and universities.

The second principle used in developing the budget is building bridges across many types of boundaries. This principle is exemplified in the integration of research and education at all levels. We have made the integration of research and education a major theme in our planning. There is a wealth of information pointing to the value of inquiry-based learning as a superior way for students to learn and also as a way of teaching problem-solving skills that transfer from one subject to another. In the future, employers will increasingly need workers who are not only well versed in science and technology concepts, but who are adept at learning though experimentation, inquiry, critical evaluation, and discovery—all characteristics of research.

We are currently planning awards that recognize achievement and encourage future efforts to integrate research and education. Some research universities have shown leadership in developing innovative programs to broadly involve students in research and inquiry-based learning and to involve their best researchers in science and engineering education at all levels. We want to recognize their efforts and encourage them to share their ideas and experience with other institutions.

We are also in the final stages of a comprehensive examination of the current state of science, mathematics, engineering, and technology education at the undergraduate level in the nation. This project will offer an overview of the needs and opportunities for all undergraduate students and examine how science literacy for the entire country is related to undergraduate education. We hope that these efforts are responsive to the concerns of Members of this committee, who have been persistent in their focus on the need to insure the highest possible quality of undergraduate instruction in our nation's universities and colleges.

As I mentioned earlier, the education and training program function accounts for approximately 20 percent of our overall budget and will total $657 million, an increase of 5.3 percent over FY 1996. Many activities, such as Research Experiences for Undergraduates, Research in Undergraduate Institutions, and the Faculty Early Career Development program cut across our research and education functions. One could argue that all NSF programs have an education and training component, since they develop participants' knowledge and skills. Likewise, there are many cross-cutting interdisciplinary activities such as earthquake research, biotechnology, civil infrastructure systems, environment and global change, high performance computing and communication, manufacturing, and materials. These interdisciplinary activities interact with one another and also contain a coordinated, focused educational component.

A third principle guiding our budget planning is working in partnerships. Our investments directly involve 200,000 researchers, teachers, and students, and over 2,000 colleges, universities and research institutions, including almost 600 businesses. Indirectly, our programs affect literally millions of people, but this larger impact would not be possible without partnerships. In forming partnerships, we bring together the best minds in our society, sharing ideas and resources in order to improve research and education. It is particularly important that NSF build on its role as a catalyst, linking elements of society that share an interest in improving education, maintaining scientific and engineering leadership, and using scientific and engineering knowledge to our common benefit.

As one measure of the impact of our partnerships, last year NSF leveraged $1.4 billion from partners, including over $250 million from industry in support of research programs in which NSF was involved. Other major partners in these activities are academic institutions, states, and other federal agencies. For example, our Grant Opportunities for Academic Liaison with Industry (GOALI) program, which provides opportunities for a variety of industry-university linkages is slated to increase by over 40%, to $18 million.

To conclude, we have structured this budget request to allow us to sustain the momentum in science and engineering that we built over the past half century. As a result of our successes we are on the threshold, or perhaps in the midst, of a truly revolutionary era of discovery—ranging from the origins of the universe to the discovery of a new state of matter to manufacturing microscopic machines. We have at our fingertips today an array of experimental instruments, computers, and information networks that enable us to design and carry out research that would have been impossible just a few years ago. Over the next decade, the potential for rapidly increasing our understanding of both the natural world and that shaped by humans—and applying new knowledge and technologies resulting from research—is staggering.

We are in a "golden age" of scientific discovery where frequent breakthroughs are occurring in virtually every field, from astronomy to materials science to genetics to elementary particle physics. Moreover, the research often moves so seamlessly into applications that we sometimes fail to notice the transition. NSF supports research in optical and electromechanical systems that has potential applications in areas as varied as sensors that detect wear and tear in bridges and roadways, medical devices that allow doctors to conduct surgery without leaving visible scars, and new techniques for manufacturing integrated circuits.

The fact that cutting edge technologies like these are being developed at U.S. universities and laboratories is no accident. Our national capacity for education and research at the very frontiers of science remains the envy of the world. It forms the heart of a science and technology enterprise that keeps the U.S. competitive in the global economy.

Mr. Chairman, we appreciate this opportunity to present this discussion of our FY 1997 budget request and the rationale behind these proposals. We would be pleased to respond to any questions that you might have.

Thank you.

National Science Foundation

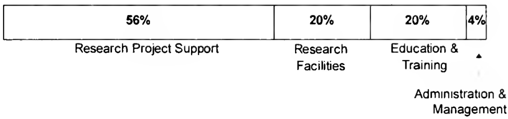
BUDGET SUMMARY

Fiscal Year 1997

NATIONAL SCIENCE FOUNDATION
OVERVIEW OF FY 1997 REQUEST

The National Science Foundation requests $3 3 billion for FY 1997 to invest in almost 20,000 research and education projects in science and engineering. Today's investments in people, in ideas, and in the exploration of the unknown will help determine the course of the United States in the 21st century Based on history, it can be said with confidence that the return on these investments will be instrumental in propelling the nation into a future of progress and prosperity

FY 1997 Request: $3.325 Billion



Embedded in this request are some of the most forward-looking activities sponsored by the Federal government. They explore the unknown, open new frontiers, and emphasize innovation in fulfilling a mission that is as appropriate today as it was when the Foundation was created in 1950. That mission, to promote progress in science and engineering in the service of the nation, gives NSF broad license to invest in research and education in science and engineering that will make a difference to the nation's future. NSF is committed to being a catalyst for progress, to addressing today's difficult questions, and to seeing that the American people get the best possible return on their investment

NSF's FY 1997 request emphasizes

- *Developing a balanced portfolio of investments that spans the frontiers of knowledge.* This requires assessing both tradeoffs and supporting connections across fields, between people and equipment and infrastructure, and between research and education. In FY 1997, certain activities, notably investments in research facilities, have been held constant in order to strike the balance necessary to extend the frontiers of science and engineering.

- *Linking the processes of learning and discovery.* Fundamental science and engineering research is enriched by the educational environment in which much of it is conducted Likewise, experimentation, inquiry, and discovery enhances and reinforces the learning process. NSF's FY 1997 request assigns high priority to activities that link the processes of learning and discovery, including new approaches in the systemic reform of precollege education, at the undergraduate and graduate levels, and in the preparation and enhancement of teachers, researchers and faculty

- *Working in partnership.* America's success in science and technology depends on the continued viability of a long-standing team effort. NSF investments, including those made in tandem with other agencies, state and local governments and the private sector, directly involve over 200,000 researchers, teachers and students, over 2,000 colleges, universities, and research institutions, including almost 600 businesses. Indirectly, they involve literally millions more NSF's FY 1997 request enhances the agency's ability to mobilize this vast resource of individuals and institutions, thereby enabling the United States to uphold a position of world leadership in science and engineering

FY 1997 Request by Account

(Millions of Dollars)

	FY 1996 Estimate	FY 1997 Request	Percent Change
Research and Related Activities	2,274	2,472	8 7%
Education and Human Resources	599	619	3 3%
Academic Research Infrastructure	100	0	-100 0%
Major Research Equipment	70	95	35 7%
Salaries and Expenses	133	134	1 4%
Office of Inspector General	4	5	4 5%
Total, National Science Foundation	$3,180	$3,325	4 6%

NSF WORKING FOR THE AMERICAN PEOPLE

Extending the Frontiers

Being a pioneer is both exciting and risky It engages the imagination and demands a high level of skill and perseverance to meet the challenges of the frontier NSF invests in today's pioneers who work on the fron ers of science and engineering, exploring an unprecedented wealth of opportunities for advancement. Sometimes their successes are small, almost imperceptible, sometimes they are spectacular and all of humankind advances.

NSF-supported science and engineering projects range from opening new windows on the universe through astronomy and gravitational physics, to exploring the world of subatomic particles They unlock the secrets of life and living systems through breakthroughs in molecular biology and biophysics. From the cold climes of the Arctic and Antarctic to the tropical oceans, NSF-supported researchers explore the dynamic processes of the Earth and the influence of local conditions on global climate Using nanoscale technologies that can trace the path of a virus and see eye to eye with an atom, scientists and engineers are developing medical devices, industrial tools, probes and detectors that will help the nation move ever farther out on the frontiers

NSF invests in tomorrow's pioneers through programs in science and engineering education that seek to improve the education available to all Americans Excellent education in science, mathematics and engineering opens new dimensions for the students, giving them new territory to explore, new ways of thinking about the world around them, and skills that prepare them to face unknown and uncertain frontiers

To remain a world leader in science and engineering, the United States must be willing and able to reach frontiers wherever they are. NSF serves as a vehicle to provide the capacity to respond when pioneering research and education are poised to offer benefits to the nation.

Delivering the Benefits

By enabling leadership across the frontiers of science and engineering, NSF's investments bolster the nation's quality of life and standard of living As noted economist Paul Romer said in a recent comment on the roots of economic growth, "If we didn't keep finding new ideas, there really would be limits to growth. It's ideas -- the whole process of discovery -- that cause growth."

NSF is alert to opportunities that might advance growth. Recent advances from NSF investments bear witness to this. Researchers using the NSF-adopted model plant *Arabadopsis* have found the genetic switch that triggers flowering in plants, creating the potential for more rapid crop development and other benefits Investigation of the most basic properties of composite materials bridges the fields of engineering, physics, chemistry, and modeling and simulation. Results are already familiar to us in recreational applications such as tennis racquets, golf clubs, and sailboats, at higher performance levels, the success of our satellite program earth-orbiting systems, and stealth aircraft depend on fundamental research in composite materials

NSF has focused its education programs on delivering benefits to the American people. Already, teachers in schools across America are discarding outdated textbooks and methods and are engaging students through hands-on, dynamic approaches to mathematics and science education. We are now moving toward unleashing the power of advanced technologies in improving the teaching of mathematics and science in the nation's schools

GOALS AND PRINCIPLES FOR FY 1997

The goals and core strategies of NSF's strategic plan, *NSF in a Changing World*, guided the development of the FY 1997 Budget Request Another influence was the second phase of the National Performance Review (NPR) NPR required NSF to reexamine its mission and functions, and whether this mission was appropriate for the Federal government From this process, the need for NSF's mission was strongly reaffirmed As a result, we have combined NSF's stated goals and strategies with an understanding of the rapid change experienced by other components of the science and technology enterprise, and established a small number of principles for developing this Request

Balanced Portfolio

NSF is the only Federal agency with responsibilities that cover research and education in all science and engineering fields Through its activities, NSF invests in specific research and education projects, facilities and instrumentation, not only for the immediate results they produce, but for the groundwork they lay for the future Maintaining a balanced investment that enables the agency to move rapidly to address the most compelling opportunities is a key principle in budget development.

Balance Across Major Fields of Science NSF's leadership role in support of research and education in colleges and universities requires both sustained, balanced support and the flexibility to move quickly into new and emerging areas

In FY 1997, NSF's Research and Related Activities Account increases by 8 7% to $2 5 billion. The major disciplinary science and engineering activities funded through that account experience comparable percentage increases Within the activities, priorities shaped by emerging scientific opportunities result in significant variation at the sub-activity and program levels

Balance Across Key Program Functions The second phase of NPR led to the organization of NSF's modes of support into a few key program functions (research project support, research facilities, education and training, and administration and management) through which NSF carries out its work

Budget by Key Program Function

(Dollars in Millions)

	FY 1996 Estimate	FY 1997 Request
Research Project Support	1,755	1,868
Research Facilities	664	661
Education and Training	624	657
Subtotal, Research and Education	$3,043	$3,186
Administration and Management	137	139
Total, NSF	$3,180	$3,325

NSF supports multi-user research facilities that are characteristically large, complicated, and expensive, requiring long-term commitments of support In FY 1997, NSF devotes particular attention to this function

- NSF will maintain funding for research facilities at approximately 20-25 percent of the total NSF program budget In FY 1997, facilities will account for 21 percent of the program budget

- In order to accommodate other priorities, NSF has eliminated support for research facilities under the Academic Research Infrastructure program This is consistent with recommendations presented in the NPR September 1995 report, *Common Sense Government Works Better and Costs Less*, that this activity might reasonably be accommodated by academic institutions, states, and the private sector

Action to Bridge across Boundaries

Nature and excellence know no boundaries, yet there are many boundaries, either real or perceived, in the funding of research and education in science and engineering NSF is undertaking positive action to eliminate organizational and other barriers to interdisciplinary research, to reinvigorate the interaction between research and education, and to draw upon the full range of perspectives and approaches for promoting progress in science and engineering

- NSF continues to sponsor cross-cutting research and education activities that relate directly to such national priorities as promoting economic prosperity, protecting the environment, rebuilding the nation's infrastructure, and strengthening the nation's schools

- In a set of activities ranging from research experiences for undergraduates through comprehensive undergraduate education reform, graduate traineeships, and awards to new investigators with both research and education objectives, NSF emphasizes the ties between research and education and moves to reinforce them

- In FY 1995, congressional appropriators provided NSF the flexibility to pursue unusually promising cross-cutting activities through creation of an Opportunity Fund NSF has used this flexibility to accelerate investment in emerging areas and will continue to do so in FY 1997

Reformulating and Promoting Partnerships

Partnerships bring together the best minds in our society as they help to share the fiscal responsibilities for research and education Promoting partnerships is a core strategy from NSF's strategic plan that is particularly relevant to today's rapidly shifting environment for science and engineering Whether it is the transformation in roles and priorities caused by the end of the Cold War or changes in scale or scope as a result of attempts to balance the Federal budget, there are substantive policy questions about how the academic, private sector, and government members of partnerships can and should interact. Difficult issues that require attention as partnerships are reformulated include: what is the role of the Federal government in support of research and education? what is an appropriate role for the private sector? what does world leadership mean? and how can we assure the American public reaps the benefit of these investments? For NSF, there is the additional question of NSF's role and the impact on NSF programs and functions of changes in activity or funding levels at other agencies.

NSF's principal partners are the institutions and individuals of academia who conduct the research and education projects in which NSF invests. Together, academia and NSF are developing new approaches to research and education activities, involving in the process the private sector, other agencies, and others with a stake in the science and engineering enterprise.

Even as NSF works to address the difficult policy issues described above, this strategy has been successfully incorporated into activities across the Foundation. Examples include: the GOALI program (Grant Opportunities for Academic Liaison with Industry); Alliances for Minority Participation, memoranda of understanding and joint program activities with approximately 20 other Federal agencies; and international partnerships that provide opportunities for collaborative research, research visits to laboratories and academic institutions in other countries, coordinated international research programs, and joint funding of major research equipment.

FY 1997 HIGHLIGHTS
PREPARING FOR THE CHALLENGES OF THE 21ST CENTURY

LEARNING

While America's system of higher education is the best and most inclusive in the world, the educational system overall traditionally does not prepare the vast majority of students for dealing with the rapidly changing, scientifically and technically challenging situations predicted for the 21st century. Through education programs, research activities that aim at better understanding the learning process, and activities that link learning and education, NSF is working to position the nation to meet the learning needs of the 21st century.

Systemic Reform: NSF's focus is on treating whole systems as the most effective way to make improvements in science and mathematics education. Building the capacity for change through the commitment and involvement of broad partnerships in the development of goals, solutions and actions can result in significant, long-lasting impact. Total system reform is based on the underlying belief that <u>all</u> students can learn and achieve in science and mathematics at much higher levels than presently attained. Investment in the systemic reform of K-12 education continues to increase in FY 1997. Funding for the Urban Systemic Initiatives increases by 20 percent to $67 million. The Rural Systemic Initiatives increase four-fold to more than $10 million. These increases will be offset by a $13 million decrease in the Statewide Systemic Initiatives, as part of the phase-out of awards planned at the program's inception.

Learning and Intelligent Systems: We are in the midst of a revolution in the interaction between human learning and technology, similar in potential impact to the revolution created by the invention of movable type and the printing press. Research is now beginning to yield tantalizing insights into how both living organisms and artificial systems process information to achieve remarkable levels of performance across a wide range of activities. Research in various fields bearing on learning and intelligent systems is at a juncture where seminal, concerted action will result in significant, even revolutionary, intellectual advances. NSF has used the Opportunity Fund to provide seed funding for this emerging area. Investments across the Foundation for these activities in FY 1997 are estimated at $23 million.

Technology for Education: The dramatic breakthroughs in information technology and communications have the potential to revolutionize the future of education Instructional methods and curricula will need to change as schools provide computers for their students and are linked to national and international information resources. Building the effective use of technology into education programs, including the systemic reform programs, will be a key component of NSF's activities aimed at preparing students for the challenges of the next century

Integration of Research and Education: This core strategy from NSF's strategic plan is a key component of the Foundation's vision for establishing a linkage between learning and discovery Educating today's students in a discovery-rich environment will better prepare them to meet tomorrow's challenges Likewise, history has shown that research in an education-rich environment yields an exceptionally dynamic and diverse enterprise

- The CAREER program (Faculty Early Career Development) enables scientists and engineers to develop their skills in both research and education. The awards provide a framework for junior-level faculty to link their research activities with their teaching and mentoring responsibilities In FY 1997, this program will almost double, to total $73 million.

- A new activity will focus on the identification and recognition of universities with significant research capabilities that have shown bold leadership, exceptional innovation, and tangible accomplishment in linking research and education. This program, which will total approximately $5 million, will be one of the activities supported through the Foundation's Opportunity Fund in FY 1997

ENVIRONMENT

NSF has had a strong presence in research on the environment for many years The focus of NSF programs has been on enhancing the understanding of complex dynamics among natural systems and humans and developing the knowledge important to preserving, managing and improving the environment

- FY 1997 sees increased emphasis on environmental research in areas such as natural hazard reduction, water, coastal and marine studies, biodiversity and its role in ecological systems, environmental technologies; and bioremediation

- Several activities will combine to establish an urban long term ecological research site, the first that focuses on a human-based ecology.

- Polar research makes significant contributions to NSF's portfolio of environmental activities The general infrastructure of the research station at the South Pole has deteriorated, and a code inspection in 1993 identified over 300 deficiencies. It is increasingly costly to maintain activities within acceptable risk bounds. To address safety and environmental concerns, specific improvements totaling $25 million in FY 1997 are proposed to address critical shortcomings

NSF also participates in the interagency Global Learning and Observations to Benefit the Environment (GLOBE) initiative.

INFORMATION FOR SCIENCE AND ENGINEERING

NSF provides state-of-the-art computing and communications capabilities essential for advanced work in all fields of science and engineering through its supercomputer centers and networking activities. Over the past decade, access to such capabilities has driven a sea change in many fields of science and engineering, providing new means for testing theories and for running different kinds of experiments. Information, always the lifeblood of science and engineering, is now being collected and analyzed in new and different ways, providing valuable tools for predicting the behavior of diverse phenomena.

- Computational biology, climate modeling, rapid prototyping for manufacturing, and digital libraries are a few among the many areas of emphasis on developing information-based resources across the Foundation.

- The Partnerships for Advanced Computational Infrastructure program builds on and replaces the current NSF Supercomputer Centers program established in 1985. It will take advantage of newly emerging opportunities in high performance computing and communications. The first awards in the program will be made in FY 1997.

- A pilot program designed to re-engineer business interactions will improve efficiency and productivity and reduce administrative burden on the research community. Over 100 institutions are participants and may conduct business with NSF electronically, including submitting proposals, performing merit reviews, requesting cash and managing awards.

CONCLUSION

America has entered an exciting, even revolutionary era for research and education in science and engineering. In just the last few months, American scientists and engineers have detected planets with the potential for sustaining life trillions of miles from earth, have accomplished genetic breakthroughs with implications for health and food supply, and observed a new state of matter at temperatures near absolute zero. Progress in computing and telecommunications has continued to accelerate. More and more schools have begun injecting the thrill of discovery into the teaching of mathematics and science.

The National Science Foundation has been at the center of these and countless other discoveries and advances that excite our imagination and secure our future. For FY 1997, NSF has established priorities for research and education investments that directly reflect this commitment to advancing learning and discovery in the nation's interest.

ACTIVITY SUMMARIES

Funding for the National Science Foundation is provided in the following Activities

Biological Sciences

The Biological Sciences (BIO) Activity fosters understanding of the underlying principles and mechanisms governing life Research ranges from the study of the structure and dynamics of biological molecules, such as proteins and nucleic acids, through cells, organs and organisms, to studies of populations and ecosystems It encompasses processes that are internal to the organism as well as those that are external, and includes temporal frameworks ranging from measurements in real time through individual life spans, to the full scope of evolutionary time The 8 6 percent increase, to a total of $326.0 million in FY 1997, will support research in microbial biology, genome sequencing, computational and theoretical biology, and ecosystem restoration and bioremediation

Computer and Information Science and Engineering

Research in the Computer and Information Science and Engineering (CISE) Activity includes theory and foundations of computing, system software design, engineering design, prototyping, testing, and deployment of cutting-edge computing and communications systems to address complex research problems The 8 6 percent increase, to a total of $277 0 million in FY 1997, is principally directed toward research pertaining to learning and intelligent systems, new technologies for scalable high performance computing and high bandwidth communications, and the convergence of computing and communications In FY 1997, the Supercomputer Centers program will transition to the new Partnerships for Advanced Computational Infrastructure program in order to facilitate continuing U S world leadership in computational science and engineering, with the new Partnerships in place and fully operational in FY 1998

Engineering

The Engineering (ENG) Activity seeks to improve the quality of life and the long-term economic strength of the nation by fostering innovation, creativity, and excellence in engineering education and research. ENG seeks to promote the natural synergy between engineering education, fundamental research, and the application of technical knowledge The ENG Activity's 12 0 percent increase, to a total of $354 33 million for FY 1997, will go to support research in areas such as learning and intelligent systems, environmental technology, and the synthesis and processing of nano-particles Funds are included to meet the mandated level for the Foundation-wide Small Business Innovation Research (SBIR) program.

Geosciences

The Geosciences (GEO) Activity supports research in the atmospheric, earth, and ocean sciences Basic research in the geosciences advances the scientific knowledge of the Earth, including resources such as water, energy, minerals, and biological diversity GEO supported research also advances the ability to predict natural phenomena of economic and human significance, such as climate changes, weather, earthquakes, fish-stock fluctuations, and disruptive events in the solar-terrestrial environment The 8.6 percent increase, to $454 0 million in FY 1997, will support fundamental research and national user facilities across the geosciences, including emphasis on the U S Weather Research Program and National Space Weather Program, the global seismic network, interdisciplinary projects in environmental geochemistry and biogeochemistry, studies on coastal ocean processes and global ocean circulation, and international activities for ocean drilling, continental drilling, and global change research

Mathematical and Physical Sciences

The Mathematical and Physical Sciences (MPS) Activity supports research in mathematics, astronomy, physics, chemistry, and materials science Major equipment and instrumentation such as particle accelerators and telescopes are provided to support the research needs of individual investigators The 8 8 percent increase, to $708 0 million in FY 1997, will support research in multidisciplinary areas such as nanoscience and engineering, optical science and engineering, biomolecular materials, undergraduate and graduate activities in education, and enhance support for instrumentation and facilities

Social, Behavioral and Economic Sciences

The Social, Behavioral and Economic Sciences (SBE) Activity supports research to build fundamental scientific knowledge about human characteristics and behavior SBE also supports the Foundation's international activities, providing U S. scientists and engineers with access to centers of excellence in science and engineering research and education throughout the world To improve understanding of the science and engineering enterprise, SBE provides informational tools for tracking the human and institutional resources that make up the nation's science and engineering infrastructure The 8 6 percent increase to $124 0 million in FY 1997 will provide increased support for: multidisciplinary research on topics including human capital, Learning and Intelligent Systems, decisionmaking related to risk, and the use of digital libraries; additional activities to provide international experiences for young researchers, and enhanced data collection and assessment activities by the Science Resources Studies Subactivity

Polar Programs

Polar Programs, which includes the U S Polar Research Programs and U S Antarctic Logistical Support Activities, supports multi-disciplinary research in Arctic and Antarctic regions Polar regions play a critical role in world weather and climate and provide unique research opportunities ranging from studies of the earth, ice and oceans to research in atmospheric sciences and astronomy In FY 1997, Polar Programs increase 4 1 percent, to $226 0 million Priority is given to increases for arctic research, including Arctic System Science which focuses on interdisciplinary approaches Increases are also provided for research on Antarctic ice sheets and oceans, and for science facilities and operations that make Antarctic research possible Critical safety issues at the South Pole are addressed though the Major Research Equipment account

Critical Technologies Institute

The Critical Technologies Institute is a Federally-Funded Research and Development Center established in 1992 by Congress to support the complex task of devising and implementing science and technology policy Specifically, the Institute provides analytical support to the Office of Science and Technology Policy to identify near-term and long-term objectives for research and development and identify options for achieving those objectives

Education and Human Resources

The FY 1997 Budget Request for Education and Human Resources (EHR) is $619.0 million, an increase of $20.0 million, or 3.3 percent, over the FY 1996 Estimate of $599.0 million. EHR supports a cohesive and comprehensive set of activities which encompass every level of education and every region of the country. EHR also plays a major role in the Foundation's long-standing commitment to developing all our nation's human resources for the science and engineering workforce of the future.

- Support at the **Pre K-12** level totals $375.39 million, an increase of $6.75. This support is focused primarily in the Systemic Reform activities ($101.85 million) in states, urban, and rural areas, and Elementary, Secondary and Informal Science activities that enable **all** students to achieve in science, mathematics, engineering and technology education.

- Support at the **Undergraduate** level increases $8.75 million to total $114.11 million. This support is focused primarily on institution-wide undergraduate education reform, improving undergraduate preparation of Pre K-12 teachers, and addressing advanced technician training. Efforts of reforming curriculum and laboratory instruction, and upgrading equipment continue to be major emphases.

- Support at the **Graduate** level is $79.20 million, an increase of $8.0 million. This support allows an increase in the institution cost-of-education allowance provided for the Graduate Research Fellowships program. The number of fellows will remain at approximately 2,400. The Graduate Research Traineeships program will be enhanced, permitting new traineeship awards for about 150 students. FY 1997 funding will also support a new Science Education Postdoctoral Fellowships program.

- **Advanced Technological Education** (ATE) established in FY 1994, is $30.85 million, an increase of $7.50 million. Support will continue to focus on improving curriculum development and program improvement at the secondary and undergraduate levels to help transition students to the increasingly technology-based workforce.

Major Research Equipment

The FY 1997 Request for Major Research Equipment (MRE) of $95.0 million represents a $25.0 million increase, or 35.7 percent, above the FY 1996 Estimate. Two projects currently comprise the Major Research Equipment Account: the Laser Interferometer Gravitational Wave Observatory (LIGO) and the South Pole Safety Project. A third project, the funding for the construction of the Gemini 8-meter telescopes, was completed in FY 1995. The $70.0 million request in FY 1997 will permit the LIGO project to progress toward completion of construction in FY 1998 and a transition to operations during FY 1999. In FY 1997, the Research and Related Account will provide support for the initial activities needed for the operational phase of the facility. Also included in the request is $25.0 million for the South Pole Safety Project to address critical health, safety and environmental concerns at the South Pole research station. Improvements are proposed for the heavy equipment maintenance facility, the power plant, and fuel storage facilities.

Salaries and Expenses

The FY 1997 Request for Salaries and Expenses (S&E) is $134 31 million, an increase of $1 80 million, or 1 4 percent, over the FY 1996 level of $132 51 million Salaries and Expenses provides funds for staff salaries and benefits, and general operating expenses necessary to manage and administer the NSF. The Request level provides for current administrative levels, and continues the investment in information technology for administrative processes

Office of Inspector General

The Office of Inspector General (OIG) was established to promote economy, efficiency, and effectiveness in administering the Foundation's programs, to detect and prevent fraud, waste, or abuse within NSF or by individuals that request or receive NSF funding, and to identify and resolve cases of misconduct in science. The FY 1997 Request for the OIG is $4 69 million, an increase of $200,000, or 4 5 percent, over the FY 1996 level.

KEY PROGRAM FUNCTIONS

In response to the Government Performance and Results Act (GPRA) of 1993, NSF has been planning for increased examination of the results of its portfolio of investments This section of the budget is organized to provide, simultaneously, a substantive justification of the FY 1997 request and a preliminary picture of how NSF will use performance in the budget process in the future

NSF's investments are expressed in terms of key program functions. Research Project Support (which includes Research Projects and Centers), Research Facilities, Education and Training, and Administration and Management. This categorization is an extension of what NSF has previously exhibited as "Modes of Support" resulting from intense examination of NSF activities through the GPRA and National Performance Review processes

Budget by Key Program Functions

(Dollars in Millions)

	FY 1995 Actual	FY 1996 Estimate	FY 1997 Request
Research Project Support			
Research Projects	1,570	1,553	1,659
Centers	196	202	209
Research Facilities	742	664	661
Education and Training	629	624	657
Subtotal, Research and Education	$3,137	$3,043	$3,186
Administration and Management	133	137	139
Total, NSF	$3,270	$3,180	$3,325

The key program functions themselves are mutually reinforcing, working in concert to support NSF's goals While the NSF budget has been divided into support for particular key functions, many activities actually cut across even this very streamlined structure For purposes of providing a more complete description of NSF activities, this section also includes a component on activites that cut across the research and education subtotal (that is the portfolio of investments NSF makes) in the table above.

Research Project Support

Support for research projects totals $1,659 million in FY 1997, an increase of $106 million, or 6 8 percent, over the FY 1996 Estimate Research projects provide support for individuals and small groups devoted both to disciplinary research in traditional fields and to cross-disciplinary fields Also included within this function is support for centers, based on the premise that some scientific questions and research problems can best be addressed through the multidisciplinary, long-term, coordinated efforts of many researchers Support for centers totals $209 million in FY 1997, an increase of $7 million, or 3 6 percent, over the FY 1996 Estimate

Research Facilities

Support for Research Facilities totals $661 million in FY 1997, a decrease of $3 million, or 0.4 percent, from the FY 1996 Estimate. NSF supports large, multi-user research facilities that are characteristically large, complicated, and expensive, requiring long-term commitments of support. The principal focus is providing access to state-of-the-art capabilities that might otherwise be unavailable to U.S. researchers.

Education and Training

Education and Training totals $657 million in FY 1997, an increase of $33 million, or 5.3 percent, over the FY 1996 Estimate. NSF's education and training component supports activities from pre-kindergarten through postdoctoral levels, including public science literacy, aimed at enabling U.S. students to become scientifically literate citizens and well-trained members of the nation's workforce.

Cross-Cutting Activities in Research and Education

Many activities cut across the key program functions described above. For example, one might argue that all NSF programs have an education and training component since they develop participants' knowledge and skills. Explicit examples of research project support activities with significant education and training components include Research Experiences for Undergraduates, Research in Undergraduate Institutions, and the Faculty Early Career Development program (CAREER). Likewise, there are cross-cutting interdisciplinary activities, many of great importance in delivering benefits to the nation, that merit attention. Examples include earthquake research, which incorporates components of all the key program functions. Other areas where NSF specifically coordinates activities across program functions and organizations include biotechnology, civil infrastructure systems, environment and global change, high performance computing and communications, manufacturing, and materials. These coordinated activities interact vigorously with one another and with a complementary focused activity on science, math, engineering and technology education.

Administration and Management

Administration and Management totals $139 million in FY 1997, an increase of $2 million or 1.5 percent above the FY 1996 Estimate. This program function provides operating funds to support NSF staff in efforts to achieve strategic goals by implementing programs in all key program areas. NSF programs require both a high-level professional workforce and an effective management and support staff.

RESEARCH PROJECT SUPPORT

Research Project Support includes funding for both Research Projects and Centers

(Millions of Dollars)

	FY 1995 Actual	FY 1996 Estimate	FY 1997 Request
Research Projects	1,570	1,553	1,659
Centers	196	202	209
Total, Research Project Support	$1,766	$1,755	$1,868

Research Projects

FY 1997 support for Research Projects totals $1,659 million, an increase of about $106 million, or 6 8 percent, over FY 1996. Research Projects develop intellectual capital through support for individuals and small groups of investigators in disciplinary and cross-disciplinary fields of research, including areas of national priority. Project support includes funding for researchers as well as postdoctoral associates and undergraduate and graduate assistants, emphasizing the discovery of new knowledge as well as contributing significantly to education and training. Funds are provided for items necessary for performing research such as instrumentation and supplies and related costs for travel and conference support. NSF seeks out and supports excellent proposals from groups and regions that traditionally have not fully participated in science, mathematics, and engineering. In addition, the Experimental Program to Stimulate Competitive Research (EPSCoR), a State-NSF partnership, will continue to support improvements in academic research competitiveness

NSF relies on merit review to guide investments within its existing programs. As current awards expire, funds are reallocated to new opportunities. The requested increment will intensify NSF-supported efforts in such areas as. genome sequencing; computational and theoretical biology, human-centered systems such as learning technologies and virtual environments; computing systems; networking, communications and the convergence of computing and communications, synthesis and processing of nano-particles, water, coastal and marine research, biodiversity; environmental technologies and bioremediation, Arctic research on ocean surface heat budget; and Antarctic studies of the West Antarctic Ice Sheet. In addition, $50 million will be used to support an NSF-wide instrumentation program.

University/industry partnerships within an integrated education/research environment will be supported through expansion of the Grant Opportunities for Academic Liaison with Industry (GOALI) program. New Focused Research Groups (FRGs) in materials science will be initiated and an Industry-University Environmental Chemistry Institute will also be initiated.

Support is targeted for young investigators and for increasing participation of women and minority researchers. The Faculty Early Career Development (CAREER) program, which was initiated in FY 1995, will increase by 48 percent to $73 million in FY 1997. CAREER supports junior faculty within the context of their overall career development and combines, in a single program, the integrated support of quality research and education.

The Small Business Innovation Research (SBIR) program is mandated to increase from 2.0 percent of extramural research to 2 5 percent in FY 1997. The program will total approximately $52 million, an increase of almost $13 million over the nearly $39 million for SBIR in the FY 1996 Estimate.

In order to move into new areas of science, some existing programs will be eliminated or phased out These include a planned phaseout of an ocean sciences postdoctoral program, and sunsetting of the Research Improvement in Minority Institutions program to accommodate enhancement of the Minority Research Centers of Excellence

Centers

NSF supports a variety of individual centers and centers programs The centers play a key role in enabling the U S to achieve its goals, particularly through their encouragement of interdisciplinary research and the integration of research in education programs While the programs are diverse, the centers share a commitment to

- Addressing scientific questions and research and technical problems with a multidisciplinary, long-term, coordinated research effort Center programs involve a number of scientists and engineers working together on fundamental research addressing the many facets of a complex problem;

- Including a strong educational component to aid the training of this nation's next generation of scientists and engineers and to encourage students of all ages to participate in science and engineering, and

- Coordinating with industry to ensure that research is relevant to national needs and that knowledge quickly migrates into the private sector

The centers and center programs are listed below

(Millions of Dollars)

	Year of Program Initiation	FY 1996 No of Centers	FY 1995 Actual	FY 1996 Estimate	FY 1997 Request
Engineering Research Centers	1985	23	$51	$51	$52
Science & Technology Centers	1987	24	$60	$61	$63
Industry/University Cooperative Research Centers	1973	54	$4	$4	$4
State Industry/University Cooperative Research Centers	1991	13	$4	$4	$3
Minority Research Centers of Excellence	1987	8	$8	$8	$10
Materials Research Science & Engineering Centers	1972	29	$44	$44	$46
Center for Ecological Analysis and Synthesis	1995	1	$2	$2	$2
Long-Term Ecological Research Sites	1980	18	$11	$11	$12
National Center for Earthquake Engineering Research	1988	1	$4	$4	$4
National Center for Environmental Decision-Making Research	1995	1	$1	$1	$1
Research Centers on the Human Dimensions of Global Change	1995	NA	$0	$5	$5
National Consortium for Research on Violence	1995	1	$0	$2	$2
National High Field FT-ICR Mass Spectrometry Center	1994	1	$1	$1	$1
National Center for Geographic Information and Analysis	1989	1	$2	$1	$1
Critical Technologies Institute	1993	1	$2	$3	$3
TOTAL		176	$196	$202	$209

The FY 1997 Request for centers is $209 million, an increase of 3 6 % over the FY 1996 Estimate NSF expects to support 176 centers by the end of FY 1996 No new center programs will be initiated in FY 1997. There will, however, be competitions within some of the existing center programs possibly leading to some turnover within the programs Funding for the Minority Research Centers of Excellence will increase by 27% to establish two additional centers Support for the National High Field FT-ICR Mass Spectrometry Center will be reduced by 20 percent, reflecting decreases in instrumentation costs Support for all other centers and centers programs is stable

1995 Estimates for Selected Centers

(Millions of Dollars)

	Number of Participating Institutions	Number of Partners	Total NSF Support	Total Leveraged Support	Number of Participants
Engineering Research Centers	100	590	$51	$96	4 648
Science & Technology Centers	83	330	$60	$45	3 710
State & Industry/University Cooperative Research Centers	100	854	$8	$79	2 291
Minority Research Centers of Excellence	8	70	$8	$5	3 765
Materials Research Science and Engineering Centers	34	190	$44	$42	2 630
National Center for Earthquake Engineering Research	23	16	$4	$8	90
Long Term Ecological Research Sites	187	34	$11	$3	1 610
National High Field FT-ICR Mass Spectrometry Center	12	1	$1	$1	30
Critical Technologies Institute	NA	NA	$2	NA	NA
TOTAL	547	2085	$189	$279	18 774

Total Number of Participating Institutions all academic institutions which participate in activities at the centers
Number of Partners the total number of non-academic participants, including industry, states, and other federal agencies, at the centers
Leveraged Support funding for centers from sources other than NSF
Number of Participants the total number of people who utilize center facilities, not just persons directly supported by NSF

RESEARCH FACILITIES

The National Science Foundation provides support for large, multi-user facilities which meet the need for access to state-of-the-art research facilities that would otherwise be unavailable Support includes funding for staff and support personnel to assist both internal and external scientists in conducting research at the facilities. Support for these unique national facilities is essential to advance U S. research capabilities required for world-class research

NSF's support of facilities, generally operated and partly supported by universities, contributes to all the goals of the NSF strategic plan by providing physical and institutional capabilities necessary

- for scientists and engineers to carry out cutting-edge research across a broad spectrum of scientific and engineering fields,
- to promote the discovery and dissemination of new knowledge in service to society as exemplified by fields such as materials science, computing and communications science, and environmental science.
- for graduate and undergraduate science, mathematics and engineering students to acquire skills to perform world class research.

The activity reflects NSF strategies by strengthening physical infrastructure for the conduct of research, developing scientific and engineering intellectual capital, integrating research and education, and promoting partnerships in the U.S. science and engineering research system

NSF supports the following facilities

(Millions of Dollars)

	FY 1995 Actual	FY 1996 Estimate	FY 1997 Request
Advanced Scientific Computing Facilities	72	69	71
NSFNET	46	44	44
National Center for Atmospheric Research	59	59	62
National Astronomy Centers	65	64	67
Laser Interferometer Gravitational Wave Observatory	85	70	70
National High Magnetic Field Laboratory	12	18	18
Gemini Observatories	41	4	5
National Nanofabrication Users Network	4	4	4
Academic Research Fleet/Ship Operations	49	47	48
Academic Research Infrastructure	59	50	0
Polar Science Operations & Logistics	167	163	168
South Pole Safety Project	-	-	25
Other Facilities[1]	83	74	80
TOTAL	$742	$664	$661

[1] Other facilities include physics, materials research, ocean sciences, atmospheric sciences, and earth sciences facilities

The FY 1997 Request for Facilities totals $661 million, a $3 million decrease from the FY 1996 Estimate and $81 million below the FY 1995 level. U.S funding for construction of the Gemini 8-meter telescopes was completed in FY 1995. Support for Gemini in FY 1996 and FY 1997 is for preliminary operations only The Academic Research Infrastructure program is terminated in FY 1997, and no further funding for this activity is requested In FY 1997, NSF plans to provide $25 million for the South Pole Safety Project

EDUCATION AND TRAINING

National Science Foundation programs support and place a high priority on efforts to improve science, mathematics, engineering, and technology education and training at all levels. pre-kindergarten through secondary, undergraduate, graduate, and public science literacy In addition, special emphasis is placed on increasing participation among groups which have been historically underrepresented in science and engineering fields Other important efforts include programs for evaluation and communication, which ensure that education programs achieve their goals and that program and project outcomes reach a wide audience. Much of NSF's support is associated with the federal interagency effort to improve science, mathematics, engineering and technology education

NSF fosters the natural connections between learning and discovery When research resides alongside education and training, the rewards of discovery are shared more quickly and disseminated more widely Support for education and training includes most activities funded through the Education and Human Resources appropriation, as well as those programs funded through the Research and Related Activities appropriation that accomplish education and training objectives through the tie to research programs

(Millions of Dollars)

	FY 1995 Actual	FY 1996 Estimate	FY 1997 Request
Pre K-12	373	369	376
Undergraduate	147	142	159
Graduate/Postdoctoral	91	95	106
Other Education and Training Support	18	18	17
TOTAL	$629	$624	$657

Pre K-12

The goal of NSF's programs at the Pre K-12 level is for **all** students to succeed in mathematics, science, and technology To accomplish this goal, NSF programs are directed at teachers, students, curriculum development, and systemic reform. NSF's systemic reform efforts aim to make lasting improvements in science, mathematics, and technology education at the state level, in urban centers, and in rural regions. The systemic approach involves broad partnerships in the development of goals, solutions, and actions. Teacher enhancement and teacher preparation programs strengthen teachers' knowledge and pedagogical skills and create a network of teachers who are better able to foster reform Pre K-12 curricula are enhanced through the instructional materials development program.

The FY 1997 Budget Request of $376 million is an increase of $7 million, or 1 8 percent, over the FY 1996 Estimate. In FY 1997, support will focus in the following activities systemic reform, particularly the urban and rural systemic initiatives; teacher preparation and enhancement, and advanced technological education Efforts integrating research and education include a new Pre K-12 math and science assessment activity and expansion of Pre K-12 education projects integrated with relevant research activities Coordinating some projects in minority student participation and informal science education through relevant systemic initiatives permits modest reductions in these areas. Funding for Statewide Systemic Initiatives will decline as part of a phase-out in awards, planned since the program's inception.

Undergraduate

NSF's programs support many facets of undergraduate education, including instrumentation and laboratory improvement, curriculum development, faculty enhancement, and undergraduate student research. In order to improve the quality of undergraduate courses and curricula in the sciences, NSF provides funds to encourage the development of multi- and interdisciplinary courses as well as to

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encourage science, mathematics, and engineering faculty members to take leadership in developing educational experiences that enhance the competence of prospective teachers

NSF programs which address undergraduate needs include.

- Advanced Technological Education projects, which focus on meeting the demands of the competitive, technology-based workplace by targeting technician education programs at the undergraduate and secondary school levels in advanced technology fields.
- Comprehensive Undergraduate Education Reform which supports institution-wide reforms of undergraduate science, engineering and mathematics education
- Alliances for Minority Participation, which support comprehensive approaches to increase the quantity and quality of underrepresented minorities who successfully earn science and engineering baccalaureate degrees, and the number who go on for graduate study in these fields
- Engineering Education Coalitions, which stimulate innovative and comprehensive models for systemic reform of undergraduate engineering education and aim to increase the retention of students

Undergraduate activities will total $159 million in FY 1997, an increase of $17 million, or 11 8 percent, over the FY 1996 Estimate FY 1997 priorities in undergraduate activities include expansion of the Comprehensive Undergraduate Education Reform program initiated in FY 1996 and enhancements to the Advanced Technological Education projects and Alliances for Minority Participation. The Model Institutions for Excellence program will remain at the FY 1996 level. Undergraduate programs also include support for Engineering Education Coalitions and interdisciplinary mentoring programs for minorities

Graduate/Postdoctoral

NSF's graduate education programs are designed to improve the human resource base of science and engineering in the United States and to increase the participation of scientists and engineers from groups that are traditionally underrepresented in advanced levels of science, mathematics, and engineering Programs include:

- Graduate Fellowships and Minority Graduate Fellowships, which are awarded across all science, mathematics, and engineering disciplines to provide financial support for outstanding students during their graduate studies,
- Graduate Research Traineeships, which are awarded competitively to institutions to provide student support in critical areas of current and anticipated national priority,
- Research Training Groups, which foster multidisciplinary, research-based training and education at the graduate level; and
- Postdoctoral study and research fellowships, which are sponsored in specific research disciplines

Graduate and postdoctoral programs will total $106 million in FY 1997, an increase of $11 million, or 11 0 percent, over the FY 1996 Estimate. In FY 1997, a new class of Graduate Research Traineeships will be funded and the Graduate Research Fellowships program will be enhanced to allow an increase in the education allowance A new science education postdoctoral program for production of K-12 and undergraduate level professionals will be initiated In addition, increases will include support for international postdoctoral fellows and for industry-based fellowships for graduate students and postdoctoral fellows A new competition is planned for Research Training Groups

Other Support for Education and Training

NSF supports programs to promote public understanding of science, mathematics, engineering, and technology (SMET), including the collection, analysis, and dissemination of data on U S and international resources devoted to science, engineering, and technology The FY 1997 Budget Request is $17 million, a decrease of $800,000, or 4 4 percent, from the FY 1996 Estimate Increases for data collection, analysis, and evaluation of selected data systems will be offset by decreases in programs promoting public interest and literacy in SMET

CROSS-CUTTING ACTIVITIES IN RESEARCH AND EDUCATION

New cross-cutting activities in research and education are always emerging within the framework of NSF's existing programs. NSF uses both formal and informal mechanisms to ensure that links are created across organizations and key program functions The examples below describe areas where NSF provides formal coordination, through a group of senior managers, due to their importance within NSF's priorities or to interest on the part of other agencies

Integration of Research and Education

One might argue that all NSF programs have an education and training component since they develop the participants' knowledge and skills Likewise, many education and training programs are linked to research activities Integrating research and education is one of NSF's core strategies for implementation of its strategic plan Coordination is provided across a broad range of relevant programs The coordinating group is currently developing a new activity that will focus on the identification and recognition of universities with significant research capabilities that have shown bold leadership, exceptional innovation, and tangible accomplishment in linking research and education

In the Research Project Support key program function, relevant programs include Faculty Early Career Development (CAREER); Research in Undergraduate Institutions, Collaborative Research in Undergraduate Institutions, Research Experiences for Undergraduates, Grant Opportunities for Academic Liaison with Industry (GOALI); and Engineering Research Centers, Science and Technology Centers, Materials Research Science and Engineering Centers and Minority Research Centers of Excellence, all of whose missions include the integration of research and education

In the Education and Training key program function, relevant programs include: Institution-Wide Reform of Undergraduate Education in Science, Mathematics, Engineering and Technology, Graduate Research Fellowships, Graduate Research Traineeships, Science Education Postdoctoral Fellowships, Research Training Groups, Undergraduate Faculty Enhancement, Undergraduate Course and Curriculum Development, Instrumentation and Laboratory Improvement, Combined Research-Curriculum Development Program, and Engineering Education Coalitions

Coordinated Interdisciplinary Research and Education in Areas of National Priority

An evolving set of interdisciplinary frontiers in areas of broad national interest also receives sustained attention and coordination. These areas emerge from NSF planning processes that take account of both (1) input from the research and education community resulting from such activities as workshops, reports, and advisory committees and (2) national goals for science and technology In identifying areas included in this set, NSF considers factors such as scientific readiness, the availability of infrastructure, NSF's role in promoting the discovery and dissemination of new knowledge in service to society, and the potential for collaboration. NSF has played an important role in nurturing research and education in areas that subsequently became the focus of interagency coordination and national efforts

Seven well-defined areas currently make up this set of opportunities for investment The coordination mechanism provides a means of establishing priorities within each area and tracking the outcomes The table below displays funding estimates for each area as if it were distinct from each of the others

Research and Education in Areas of National Priority [1]

(Millions of Dollars)

	FY 1996 Estimate	FY 1997 Estimate
Advanced Materials and Processing Program	$214	$220
Biotechnology	$166	$176
Civil Infrastructure Systems	$55	$57
Environment and Global Change	$325	$346
High Performance Computing & Communications	$291	$280 [2]
Manufacturing	$121	$125
Science, Math, Engineering & Technology Education	$662	$695

Note Figures in table rounded

1 Estimates for areas are mutually exclusive

2 HPCC program was reformulated in FY 1997. characterization is not comparable to FY 1996

As with any set of science and engineering activities, sharp distinctions between fields frequently cannot be made Research in one area may influence results in another area The table below provides a more realistic picture of NSF spending in FY 1995 in these areas which recognizes the interconnectedness of the activities

Estimates of FY 1995 Total Investment in Areas of National Priority [1]

(Millions of Dollars)

	FY 1995 Estimate
Advanced Materials and Processing Program	$260
Biotechnology	$185
Civil Infrastructure Systems	$45
Environment and Global Change	$335
High Performance Computing & Communications	$320
Manufacturing	$115
Science, Math, Engineering & Techology Education	$635

1 Estimates include contributing investments, and are not mutually exclusive.

Advanced Materials and Processing Program. The FY 1997 estimate for the Advanced Materials and Processing Program (AMPP) is $220 million, a 2 5 percent increase over the FY 1996 estimate. The goals of AMPP are to enhance the fundamental understanding of materials, develop appropriate university-industry research partnerships, and provide interdisciplinary education and training to prepare future scientists and engineers for careers in academia, government laboratories, and industry Priorities for FY 1997 include establishing Focused Research Groups (FRGs) with participants from academia, industry and national laboratories to address complex problems; nano-science and engineering, optical science and engineering, and biomolecular materials; linking research and education with an emphasis on the CAREER and Graduate Opportunities for Academic Liaison with Industry (GOALI) programs, and strengthening the physical infrastructure of materials research through facilities enhancement and acquisition and development of instrumentation for shared use

Biotechnology. The FY 1997 estimate for Biotechnology is $176 million, a 6 2 percent increase over the FY 1996 estimate The goals for this area are to increase understanding of biological systems at the most basic level and to develop the infrastructure and human resources for continued progress in biotechnology. Priorities remain environmental biotechnology, bioprocessing/ bioconversion, and plant/agriculture biotechnology Special focus areas within these priorities include building the knowledge base, the sequencing of the *Arabidopsis* genome, and interagency partnerships in multidisciplinary research on bioremediation and metabolic engineering.

Civil Infrastructure Systems. The FY 1997 estimate for Civil Infrastructure Systems (CIS) is $57 million, a 4.3 percent increase from the FY 1996 estimate. FY 1997 activities emphasize systemic research with broad-based participation and enhanced partnerships and linkages, including international interactions. Research priorities include new and improved materials, deterioration of materials and systems, life cycle performance evaluation of systems and components; recycling and retrofit/repair technologies; intelligent renewal decisions for urban infrastructure systems; mitigation of earthquakes and other hazards, and institutional effectiveness and productivity

Environment and Global Change. The FY 1997 estimate for Environment and Global Change (EGC) is $346 million, a 6.5 percent increase over the FY 1996 estimate The goals of environment and global change research are to enhance understanding of complex dynamics among natural systems and humans, to develop knowledge to preserve, manage and improve the environment, and to provide scientific background for national and international policies. In FY 1997, the overall EGC priorities reflect increased emphasis on research related to natural hazard reduction, water, coastal and marine research; biodiversity; pollution prevention technologies and bioremediation, global ocean studies and climate modeling Some large scale international programs are making a transition from data collection to data analysis

High Performance Computing and Communications. The FY 1997 estimate for High Performance Computing and Communications (HPCC) is $280 million, a 3 6 percent reduction from the FY 1996 estimate. NSF's work in the HPCC area is coordinated through the interagency High Performance Computing, Communications, and Information Technology Subcommittee on Information and Communications (CIC) of the National Science and Technology Council In keeping with National Research Council studies of the overall HPCC program, the CIC has reformulated the national effort to reflect the rapid evolution of HPCC technologies For FY 1997, NSF's goals, priorities, and funding estimates are consistent with this reformulation which emphasizes Global Scale Information Infrastructure Technologies; High Performance Scaleable Systems; High Confidence Systems, Virtual Environments, User-Centered Interfaces and Tools, and Human Resources and Education

Manufacturing. The FY 1997 estimate for Manufacturing is $125 million, a 3.6 percent increase over the FY 1996 estimate In FY 1997, increased support will be given to: developing software and hardware tools for virtual and physical rapid prototyping, advanced fabrication and processing methods that are resource and energy efficient, developing the fundamental breakthroughs in sensors, process modeling, computation and control, and in their coordinated application for next generation intelligent manufacturing systems, and research on environmentally conscious design and manufacturing, including methodologies for design for disassembly and recyclability, life cycle design/assessment and material life cycle analyses

Science, Mathematics, Engineering, and Technological Education. The FY 1997 estimate for Science, Mathematics, Engineering, and Technological Education (SMETE) is $695 million, an increase of 8 4 percent over the FY 1996 estimate NSF is working to strengthen partnerships with industry, state and local governments, and schools, colleges and universities throughout the country NSF is committed to providing the citizenry with the knowledge and skills needed to meet the demands of the high-technology jobs of the future FY 1997 SMETE priority areas include Pre K-12 systemic reform at urban, rural, and state levels, including activities that support reform, technological workforce and expanded comprehensive undergraduate reform, and expansion of activities that integrate research and education, including a new science education postdoctoral program, a new class of graduate research traineeships, integration of K-12 education projects with research activities, and Research Training Groups and System Reform of Engineering Education

Opportunity Fund

In FY 1995, Congressional appropriators provided NSF the flexibility to pursue unusually promising cross-cutting activities through the creation of an Opportunity Fund of up to $15 million NSF used this flexibility in FY 1995 to accelerate investment in emerging areas The total Opportunity Fund investment in FY 1995 was $13.3 million

In FY 1997, NSF plans to continue with its use of a similar Opportunity Fund Current plans include

- enhanced investments in learning and intelligent systems that build on seed funding for this area from the FY 1995 Opportunity Fund,
- a new activity focused on the identification and recognition of universities with significant research capabilities that have shown bold leadership, exceptional innovation, and tangible accomplishment in linking research and education, and
- developing emphases on aspects of modeling and simulation that address predictability in a variety of phenomena; and on addressing research topics and educational approaches of importance to the urban environment.

ADMINISTRATION AND MANAGEMENT

The FY 1997 Request of $139 0 million provides support for staff salaries and benefits, general operating expenses, headquarters relocation expenses, and audit and oversight functions of the agency

(Millions of Dollars)

	FY 1995 Actual	FY 1996 Estimate	FY 1997 Request
General Management and Administration	124	127	129
NSF Headquarters Relocation	5	5	5
Audit and Oversight	4	4	5
Total, Administration and Management	133	137[1]	139
FTE	1,244	1,267	1,259

[1]Detail does not add because of rounding

The FY 1997 Request is sufficient to maintain current services and provide funds for a reduced ceiling of 1,259 FTEs

The Administration and Management activity includes the following components

- Personnel Compensation and Benefits (PC&B) is the single largest component of this activity accounting for approximately two-thirds of total administrative resources Personnel Compensation and Benefits costs for FY 1997 increase $2 million over FY 1996 to provide for comparability and locality pay increases

- General Operating Expenses (GOE) funds the entire range of operating expenses necessary for the Foundation to administer its programs GOE costs for FY 1997 are slightly down from the FY 1996 estimate This GOE level maintains the FY 1996 current service levels for the Foundation's infrastructure, information systems, and administration

About 4 percent of the total NSF budget goes towards Administration and Management activities As the NSF budget almost tripled over the past fifteen years, resources for administration and management have remained fairly static, forcing the agency to become more efficient Today NSF has one of the lowest percentages of total resources used for administration and management of all agencies This includes both federal agencies and private foundations with similar missions NSF is committed to minimizing administrative costs and burden, and has successfully integrated new technologies into mission systems to improve productivity and enhance customer service

Since the 1980s, both the Foundation's budget levels and the quantity and complexity of its workload have increased dramatically. During this same period, the staffing levels available to manage this workload have remained static. In FY 1985, the Foundation's budget level was $1 5 billion and its staffing was 1,173 FTEs. A decade later, in FY 1995, NSF's budget level had doubled to more than $3 billion, while the FTE level remained relatively stable

NSF Workload Measures

	Fiscal Year			
	1985	1995	1996	1997
Competitive Proposals/FTE	20	25	27	29
Active Awards/FTE	12	16	16	16
Budget $/FTE ($M)	$1 3	$2.7	$2.6	$2.7

KEY PROGRAM FUNCTIONS AND GOALS-BASED PERFORMANCE ASSESSMENT

The Government Performance and Results Act (GPRA) requires that performance be assessed in terms of progress toward strategic goals The key program functions represent aspects of NSF's portfolio that have varied performance objectives in support of those goals

NSF's Goals and Core Strategies

The NSF Strategic Plan, *NSF in a Changing World*, identifies a course of action in keeping with the Foundation's tradition of excellence and its commitment to working in partnership with other organizations dedicated to advancing science and engineering The plan sets forth three broad goals to help guide the agency's investments

- Enable the United States to uphold a position of world leadership in science, mathematics, and engineering

- Promote the discovery, integration, dissemination, and employment of new knowledge in service to society.

- Achieve excellence in U.S science, mathematics, engineering, and technology education at all levels

The plan describes four core strategies through which the agency will address its goals These core strategies provide a touchstone against which the agency tests its priorities in planning programmatic activity

- **Develop Intellectual Capital.** NSF's investments in the Nation's intellectual capital, that is, in people and the ideas they create, are essential to meeting the agency's goals This means looking for areas that are particularly ripe for advancement, identifying and supporting the best ideas in research and education and the most capable people, and nurturing the systems that engage future generations with science and engineering.

- **Strengthen the Physical Infrastructure.** Creative, innovative ideas require resources for their pursuit The physical infrastructure is an enabling aspect of NSF's activities It helps create an environment in which effective progress is possible. NSF is promoting the intelligent development of a versatile and adaptable infrastructure for the future.

- **Integrate Research and Education.** NSF's close involvement with academic institutions gives it the ability to promote the closer coupling of research and education NSF aims to engage researchers and educators in a joint effort to infuse education with the joy of discovery and to bring an awareness of the needs of the learning process to research, creating a rich environment for both.

- **Promote Partnerships.** NSF does not itself perform research or education activities Thus, the Foundation cannot achieve its goals without partnerships Success requires collaboration with many different partners, including the academic community, industry, elementary and secondary schools, other Federal agencies, state and local governments, and other institutions involved in science and engineering.

These goals and core strategies are implemented through the investment strategies developed for the budget request, the merit review of projects that make up the portfolio of investments, and a cycle of performance assessment that addresses the effectiveness of the implementation

Plans for responding to GPRA

For all functions composing the set of investments NSF makes in research and education, NSF proposes to use descriptive performance goals based on its strategic plan, and to ask independent assessment panels to judge whether the Foundation's investments have met them The panels would assess broad areas of science, engineering and education, and cover the entire range of the Foundation's activities over a five to eight-year period The panels would include international members and members from organizations that use the science and engineering knowledge and human resource base The panels would be provided with both quantitative and qualitative performance information on which to base their assessments. During FY 1997, the Foundation will build the base of results information available from its various activities and experiment with using assessment panels effectively

The following performance highlights include some of the information that might be presented to the assessment panels. Because the purpose is to tie outcomes to goals, the highlights have been laid out in a goal-based framework

PERFORMANCE HIGHLIGHTS

GOAL: Enabling the U.S. to uphold a position of world leadership in all aspects of science, mathematics, and engineering.

Research Project Support: NSF investments in fundamental research activities provide support for the cutting edge research that characterizes world leadership in many fields They help to maintain the nation's capacity to perform in science and engineering, particularly in the U S academic research enterprise

- **Parallel Computing Systems.** Since the 1960s, NSF has supported research on various aspects of parallel computing During the past 10 years the overall investment, which has supported a broad range of related activities with impact well beyond parallel systems, has totaled approximately $285 million As a result of this investment and the investments of other agencies, there has been a paradigm shift from sequential systems with a single processor to parallel systems consisting of from a few, to thousands of processors capable of executing instructions simultaneously In addition to being the only form of computing capable of addressing the high performance needs of the science and engineering research community, parallel computing is also becoming increasingly pervasive in workstations and other less powerful systems as a cost-effective alternative to sequential computing

- **Polymers** NSF invests about $45 million annually on basic research on polymers through about 300 individual investigator grants and several centers. Past NSF support of basic research has contributed substantially to the $300 billion per year U S polymer industry It is important to find cheaper and more benign solvents to replace toxic volatile organic solvents for polymer synthesis. In research supported jointly by NSF and EPA, an environmentally benign method of polymer synthesis was discovered using liquid carbon dioxide. This research received one of *Discover* magazine's 1995 Awards for Technological Innovation, and several chemical companies are supporting its development for commercial use. Other exciting work in polymers focuses on finding ways to use plastics in place of silicon as the base material of microcircuits. NSF grantee Alan Heeger recently received the international Balzan Prize for his work in the area of Science of New Materials, where Heeger and collaborator Fred Wudl synthesized all-plastic light emitting diodes.

- **Genetic Code** Two of the major challenges in biology are to determine the genetic blueprint of organisms, as encoded in their DNA, and to decipher how this linear blueprint leads to the complicated structure of biological molecules. The Science and Technology Center for Molecular Biotechnology, with $24 million from NSF over the past seven years, has developed integrated tools and instruments to meet these challenges. A distinguishing feature of the Center's research is that it focuses the most powerful methods from chemistry, computer science, engineering, mathematics and physics on biological problems. Researchers at the Center were involved in the development of the first automated DNA sequencer, and their current research is leading to new analytical instrumentation with greater sensitivity and productivity than existing instruments Recently, the University of Washington has capitalized on the Center's success by creating a new Department of Molecular Biotechnology that will provide a multidisciplinary educational program of biology, genomics, protein chemistry, instrumentation and engineering.

Facilities: NSF support of large multi-user facilities provides physical and institutional capabilities necessary for scientists and engineers to carry out research which enables the United States to uphold world leadership across a broad spectrum of scientific and engineering fields.

- The **Academic Research Fleet** includes ships, submersibles and large shipboard equipment necessary to support NSF-funded research and the training of oceanographers The twenty-seven ships in the U.S academic fleet provide the resources necessary for the research community to explore new areas of science For example, researchers aboard the research vessel Melville accomplished the first major demonstration of the Iron Hypothesis, that "fertilizing" the oceans with iron could influence the levels of CO_2 in the atmosphere. The hypothesis is based on the theory that plant growth in large areas of the ocean is limited by the availability of dissolved iron Scientists from Moss Landing Marine Laboratories and 12 other institutions in the U.S , England and Mexico fertilized an 8x8 km patch of ocean west of the Galapagos Islands with 220 kg of iron and tracked it for 20 days as it drifted a distance of over 1100 km. The rapid growth of plankton began to reduce the concentration of carbon dioxide in the surface waters and after 10 days the concentration of CO_2 had dropped 20 percent below the initial values. The IronEx II research cruise confirmed an ocean-atmosphere linkage that may drive large scale climate change.

- **Recent Results from Radio Astronomy.** The powerful **Arecibo Observatory** discovered, through telltale radio signals, planets (roughly the mass of the earth) around a nearby neutron star. These are the first known planets outside of the solar system The radiotelescopes of the **Very Long Baseline Array** (VLBA) can study signals which have been traveling across the universe from quasars and radiogalaxies The unparalleled angular resolution of the VLBA, 100 times finer than the Hubble Space Telescope, has shown that the extraordinary luminosity of these radiogalaxies is due to gaseous material falling into massive black holes. Recent technical advances at the **National Radio Astronomy Observatory** (NRAO) have made it possible to observe carbon monoxide (CO) and molecular oxygen (O_2) in the gas clouds making up the youngest galaxies. These first galaxies are seen to be large amorphous structures that are not yet dynamically stable These observations will contribute to understanding exactly how and when heavy elements such as carbon and oxygen formed in the early universe

- In its first five and one-half years, the **National High Magnetic Field Laboratory (NHMFL)** has become a truly unique facility With a first-rate scientific and technical staff, including Robert Schriefer, Nobel Laureate, the NHMFL has already set world records for magnetic field strengths obtained in resistive magnets The NHMFL collaborates with the High Field Magnet Laboratory in Grenoble, France, the National Research Institute for Metals in Tsukuba, Japan and the European Community 100 Tesla Program At home, the NHMFL has established active collaborations with industries such as Dow Chemical, DuPont, Intermagnetics General, American Superconductors and others In addition, the NHMFL has established a masters degree program in magnet technology at Florida A&M University/Florida State University College of Engineering, undergraduate programs for women and minorities, and K-12 cooperative education programs involving regional schools The NHMFL is well on its way to ensuring the scientific and technological competitiveness of the United States in high magnetic field research

- **Polar Facilities** provide the infrastructure for research in Antarctica -- a remote, hostile environment at the end of a long logistical supply chain NSF funds the operation of three research stations, two research ships and about 30 field camps, a fleet of aircraft operated for NSF by DOD; and an icebreaker operated by the US Coast Guard The Antarctic infrastructure sustains the pursuit of unique scientific opportunities. For example, since the 1985 discovery of the "ozone hole" above Antarctica, NSF has supported research to understand the causes and dynamics of stratospheric ozone depletion in polar regions. Recent observations of ozone depletion in the Arctic and the excursions of the Antarctic ozone hole over Argentina have heightened the interest in ozone depletion research in high latitude regions, particularly in populated areas Building on the ozone research, data from the NSF Polar Ultraviolet Radiation Monitoring Network have now provided the first direct measurements of potentially harmful ultraviolet radiation occurring in a region affected by the Antarctic ozone hole. Such ongoing research has a direct impact on issues in human health as well as on understanding atmospheric structure and climate

Education and Training: NSF seeks to ensure an adequate, well-trained workforce that can maintain leadership in science and technology

- **Graduate Research Fellowships.** The Graduate Research Fellowship Program (GRF) identifies and encourages young American science, mathematics, and engineering students to develop their potential and prepares them for leadership in the nation The GRF program, initiated in 1952, is designed to ensure the vitality of the human resource base of science and engineering in the United States and to strengthen its diversity Since its inception, GRF has invested approximately $700 million in fellowships to over 31,000 outstanding graduate students in the sciences, mathematics and engineering Many of these individuals have had distinguished careers in research, academia, and industry In 1995, Dr. Eric F Wieschaus became the 13th Awardee to receive the Nobel Prize Dr. Wieschaus won an NSF Graduate Fellowship in 1969 to study genetics. He earned his Ph. D at Yale, and has been teaching and conducting research at Princeton University since 1987 His Nobel Prize in Medicine recognizes his discovery of how genes control the early structural development of the body

GOAL: Promoting the discovery, integration, dissemination, and employment of new knowledge in service to society.

Research Project Support: The discoveries produced by NSF-funded research projects provide a foundation for broad and useful applications of knowledge and the development of new technologies Researchers in the academic, government, and private sectors build upon the results of NSF-funded work

- **Advanced Storage Systems** Advanced storage systems are vital to the U S computer industry's ability to maintain its competitive edge in world markets and continue its world leadership of the information super-highway. One crucial technology involves improving recording heads as they access data at very small distances from rapidly spinning storage discs Researchers at the Data Storage Systems Engineering Research Center combined the effects of air bearing design, gas dynamics, dynamical mechanical forces between heads and discs, and surface roughness and wear to develop state-of-the-art head/disk interface simulation programs. Companies such as IBM, Hewlett Packard, and Seagate Technology have received licenses from the ERC to use this technology in the design of the next generation of storage devices NSF has provided about $9 6 million to this ERC over the past six years

- **Geographic Data Display.** With NSF support of $9 4 million over the past eight years, researchers at the National Center for Geographic Information and Analysis (NCGIA) have developed powerful methods for manipulating, correlating, analyzing, and displaying geographic data Geographic information systems are a major tool in both the public and private sectors for land use, transportation planning, and environmental management. NCGIA has developed automated support systems for spatial decision making and for processing satellite and other remote sensing data These developments provide the key framework for a multi-million dollar industry that develops geographic information systems

- **Energy Dissipation in Structural Systems.** Over the last five years, NSF has invested approximately $5 million in the area of passive energy dissipation As one part of this broader field, research on energy dissipation and large deformations of thin-walled cylinder cluster structural systems has provided extremely useful results Innovative energy absorption hardware has been used to develop new transportation safety technologies, such as the crash cushions located at the exits of many interstate highways and around temporary construction sites The Federal Highway Administration estimates that the use of these impact attenuation devices has prevented thousands of highway deaths and serious injuries each year, with an annual savings of about $400 million.

- **Medical Imaging** In keeping with its desire to fund scientific research with potentially significant societal benefits, NSF is supporting a collaboration among researchers at the Space Telescope Science Institute in Baltimore, Georgetown University's Lombardi Cancer Research Center, and Johns Hopkins University to detect signs of cancer in digitized mammograms. Sophisticated astronomical image processing techniques, the product of decades of investment by NSF and other Federal agencies, makes such research possible In this case, image-processing software developed by NASA for the Hubble Space Telescope reconstructs and filters images which, when applied to a digitized mammogram, enables researchers to distinguish suspicious areas that may indicate breast cancer from other areas With initial results showing promise, the team of researchers will work on refining and testing the detection methods.

- **Economics** Over the past decade, NSF has provided about $160 million for fundamental research in management and decision science, and economics This research has included experiments that have been used to identify strengths and weaknesses of existing and proposed policies and to test innovative alternatives. Improved policies developed by incorporating the results of such experiments can lead to substantial savings. For example, the FCC sold broadband communication licenses using a "simultaneous multiple round auction" system developed by NSF-funded researchers, and captured at least $1 billion in additional net revenue for the government. Based on NSF-funded research, EPA is using pollution permits to promote more cost effective reductions in pollution levels. This approach will save about $100 million in the Los Angeles Basin alone.

- **Composite Materials.** NSF invests about $10 million annually on basic research on composite materials. This research into new materials bridges the fields of engineering, physics, chemistry, and mathematical simulation. With NSF support of $12.6 million over the past seven years, the Science and Technology Center for High-Performance Polymeric Adhesives and Composites has developed tough new materials like the advanced composite used in the tail-section of the Boeing 777. Light as aluminum but far more durable and fatigue-resistant at high altitudes, this resin-and-fiber composite is ideal for aircraft. Composites are familiar to us in recreational applications such as tennis rackets, golf clubs, and sailboat masts. At the higher performance levels, the success of our satellites, earth-orbiting systems, and stealth aircraft depend on fundamental composite materials research.

- **Tornado Research.** Coordinated NSF sponsored research at universities, the National Center for Atmospheric Research (NCAR) and the Center for Analysis and Prediction of Storms (CAPS) is advancing fundamental knowledge of tornadoes and tornadic storms. The NSF and NOAA project VORTEX (Verification of Origins of Rotation in Tornadoes Experiment) revealed unprecedented details of tornado genesis and served as a test of short-term forecasts (up to 6 hours) of tornadic thunderstorms. Two types of advanced tools were used during VORTEX. The first was several advanced Doppler Radars developed collaboratively between university scientists, NOAA and NCAR. The second was the numerical prediction system developed at the CAPS - the Advanced Regional Prediction System, the best weather numerical model in existence for the prediction of localized severe weather events.

- **Experimental Program to Stimulate Competitive Research (EPSCoR).** EPSCoR, initiated in 1979, enhances the research competitiveness of 18 states and the Commonwealth of Puerto Rico (all called "states"). EPSCoR builds partnerships among major research universities, industry, and state governments to strengthen science and technology (S&T) research, higher education, and technology transfer. Over the period 1979-1995, EPSCoR awarded $145 million in grants matched by $300 million from participants. In FY 1995, EPSCoR supported over 240 S&T projects conducted at 62 institutions. These projects involved more than 1,000 faculty and more than 2,000 postdoctoral, graduate, undergraduate and high school students and covered all disciplines supported by NSF. EPSCoR participants have made the establishment of university/private sector partnerships a high priority. EPSCoR-sponsored R&D projects have also spawned some productive spin-off activities. For example, EPSCoR-funded research in South Dakota on the recovery of platinum from catalytic converters has provided the basis for two patents and a pilot company.

Facilities: In addition to providing capabilities which produce world class research, the facilities supported by NSF have promoted the potential uses of research results and technological breakthroughs in the instrumentation provided by facilities.

- The four NSF **Supercomputer Centers** have fostered fundamental advances in our understanding of science and engineering in areas including the application of computing, communications and information technologies to important national problems. One major accomplishment has been the dramatic expansion of the use of high end computing to explore important questions in many scientific fields. For example, research carried out at one of the Supercomputer Centers has led to a clearer understanding of the chemical and physical processes responsible for the formation of air pollution. The computational capability to perform this type of detailed modeling and scientific understanding led to changes in the Clean Air Act and is now a routine part of the design of more effective air pollution control strategies throughout the world. Projects currently underway, such as the linking of powerful supercomputers to solve complex climate simulation problems, promise to keep this nation at the forefront of science, engineering, and education in computer and networking technology well into the twenty-first century.

- Created in 1960, the **National Center for Atmospheric Research** (NCAR) serves as the world center for atmospheric research. Facilities available to university, NCAR, and other researchers include advanced computational resources and research aircraft to measure meteorological and chemical state parameters. Recent research using these facilities has ranged from the global effect of clouds on climate, to the background status of aerosols in the atmosphere, the development and testing of the next generation of climate models, from observations and simulations of tornado formation to detailed observations of the sun's corona. This research will increase our understanding of the climate and will help to improve the accuracy of weather forecasting.

- For six years NSF has supported the **University NAVSTAR Consortium** (a consortium of 30 universities) to provide equipment, technical, and logistic assistance to scientists using the Global Positioning System (GPS). GPS is a space-based radionavigation system of 24 earth-orbiting satellites. The three-dimensional positioning relative to a terrestrial reference frame with an accuracy better than a few millimeters allows direct measurements of the motions of tectonic plates, displacements along seismically active faults, and the swelling of volcanoes before eruption. These projects have led to a much improved understanding of earthquakes and earthquake hazard mitigation techniques.

Education and Training: Many of NSF's educational programs simultaneously seek to use new knowledge in service to society.

- **Engineering Education Coalitions.** The Engineering Education Coalitions link engineering programs in colleges and universities together to create and implement comprehensive, systemic models for reform of undergraduate engineering curricula. For example, the Engineering Coalition of Schools for Excellence in Education and Leadership (ECSEL), consisting of engineering schools at Howard University, City College of New York, Massachusetts Institute of Technology, Morgan State University, Pennsylvania State University, the University of Maryland, and the University of Washington, has made significant progress in institutionalizing the design experience into the core curricula. With $3 million annually from NSF, matched by contributions from the participants, these schools have worked together since 1990 to introduce engineering design all across the curriculum. The ECSEL schools use assorted projects to introduce design at the Freshman level. Howard University has focused on the design of products for the community such as portable shelters for the homeless. The University of Maryland freshman design course is now offered to all 600 incoming students and has resulted in the design, manufacture, assembly, and testing of fully realized products such as windmills to produce electricity and solar water boilers. At Penn State the introductory design course is now offered to approximately 500 students per semester. At the City College of New York (CCNY) the Engineering Freshman Design course is now required in the engineering curricula.

GOAL: Achieving excellence in U.S. science, mathematics, engineering and technology education at all levels.

Research Project Support: Research Projects contribute to the education and training of the next generation of scientists and engineers by giving them the opportunity to participate in discovery-oriented projects. NSF centers provide an alternative and enhanced environment for broad interdisciplinary education at all levels while maintaining the highest standards of intellectual excellence

- **Antarctic Research and Education: Live from Antarctica.** Modern communications technologies have enabled NSF to bring antarctic science to classrooms around the United States. In the 1994-1995 antarctic summer, the pioneering public television series, *Live from Antarctica*, offered students in middle schools and high schools four hour-long "electronic field trips." The live telecasts allowed students to see and examine Antarctica's harsh environment and its research projects (weather, biology, animal life, etc.) with the guidance of the researchers in the field, including researchers at South Pole Station Students from several sites around the country interacted with NSF funded scientists

  The programs were broadcast across the United States, on public television, and reached thousands of classrooms in 46 states There were follow-up question and answer sessions via the Internet. With a small investment, this $750,000 project -- with support from several Federal agencies and private-sector organizations in addition to NSF -- demonstrates how the combination of distant, exotic regions or phenomena, new technologies, and the expertise of NSF-funded researchers can inform and educate the public about contemporary science, as well as to motivate and inspire young people

  The father of a sixth-grader wrote, "I've never seen a science project that was more alive with the breath of what it means to do the work of science." One hearing-impaired student pointed out that using the electronic medium for learning has the effect of "equalizing" the educational playing field for hearing impaired or other physically challenged students. An early evaluation of 128 teacher responses representing 272 classrooms and 6,559 students indicated that 99 percent were able to integrate the project fully or partially into their teaching goals and objectives. The same percentage said they are likely to use the materials again with a new class of students.

- **Ocean Drilling Program (ODP).** The ODP is a multinational program of basic research in the marine geosciences supported through NSF and six international partners. Over the last twelve years, NSF has invested approximately $270 million in the ODP, 60% of the total international effort, as well as $49 million in U S. science support associated with the drilling program (which includes U.S. educational activities) The program uses a drilling vessel, the *JOIDES Resolution,* to recover sediment cores and geochemical and geophysical logs from the continental margins and deep oceans. NSF's investment in this program has led to improved understanding of plate tectonic processes, of the earth's crustal structure and composition, of conditions in ancient oceans and of changes in climate through time

  The ODP has always recognized that a strong education component is essential for maintaining the U.S.'s competitive lead in drilling research. The program has sought to incorporate educational opportunities, for students at all levels of schooling, into its research activities. Educational support has primarily been through fellowships and scholarships granted to undergraduate and graduate students. In particular, the ODP has emphasized its doctoral fellowship program which provides students an opportunity to do research, largely of their own choice, which is compatible with the research interests of the drilling program Since the fellowship program in the Geosciences began in 1987, it has awarded $20,000/year fellowships to four or five students each year Most fellows conduct their research aboard the drillship, which provides a unique opportunity to interact in the intense scientific environment of the long ocean drilling legs

In addition to the doctoral fellowship program, the ODP has sought to integrate education through several other programs For the past five years, ODP has offered a Distinguished Lecturer Series designed to bring the results of the program's research to students at both the undergraduate and graduate levels, and to the general earth sciences community In addition, ODP has developed an interactive, multimedia CD ROM which describes, and involves students in, the research activities on the drilling ship The CD, accompanied by a teachers manual, provides interactive laboratory exercises for primary education students to complete with the guidance of the scientists aboard the drilling ship NSF's total investment of almost $200,000 in these two programs has been very successful in teaching students about Earth System Science and bringing ODP science results to the general public

Facilities: The NSF supported facilities directly contribute to the education and training of science and engineering students, and enhance the public awareness of science and the goals of scientific research

- NSF's nurturing and support of **NSFNET**, now expanded into the global Internet, has had a profound impact on science, education, and communication worldwide A natural evolution of the ARPAnet, NSFNET was a Foundation-supported nationwide computer network that enabled almost instantaneous communication between researchers and educators in all fields and served as an experimental platform for high speed networking As more sites were connected to the network, better communications tools were developed, such as Mosaic (the precursor of today's websurfing software), which was created at the NSF-supported National Center for Supercomputing Applications The combination of vast stores of information available on-line and simple yet effective tools for accessing this information led to exponentially increasing demand by the public for access to Internet services The Internet has now moved beyond servicing the research and academic communities and has blossomed into an entire industry supplying an indispensable educational service to society that is used by millions daily

Education and Training: In addition to the training of the next generations of excellent scientists, NSF strives to enable U S students to become well-informed, scientifically and technologically literate citizens

- **Statewide Systemic Initiatives (SSI).** SSI is a major effort to encourage improvements in science, mathematics, and engineering (SME) education through systemic changes in the education systems of the states Initiated in FY 1991, NSF has invested over $275 million in 24 states and Puerto Rico, an investment matched by $200 million from other sources SSI has touched more than 2,900 school districts, over 13,000 schools and has involved over 100,000 teachers who instruct more than 5 million students SSIs use a wide combination of reform strategies involving broad partnerships in the development of goals, solutions, and actions For example

  The **Connecticut** SSI (Project CONNstruct) has worked for four years with communities, local school districts, state agencies, and other partners to institutionalize improvements in all students' learning of science, mathematics and technology Other Federal, foundation, and corporate sources have tripled NSF's $8 million contribution to the Connecticut SSI effort More than 130 of the state's 166 districts are now participating in this systemic initiative Course taking and test scores in SME, the proportion of high school graduates who continue their education, and the amount of teacher education that is being restructured have all increased since 1991 A vigorous public awareness and community outreach strategy has fostered continuing coverage of the reform effort by over half the state's print media and 80 percent of its electronic media

Success in math and science education reform is demonstrated in the **Louisiana** SSI (LaSIP) The heart of LaSIP is professional development, focusing on the redesign of professional development programs for mathematics and science teachers Accomplishments to date have been substantial For example, 74 mathematics and science projects, involving over 2,400 teachers throughout the state have been funded by LaSIP in the first three cycles, with approximately 25 additional projects to be funded in 1995-96, affecting 800 more teachers Almost 18 percent of the 59,400 students who took the 1994 Louisiana grade seven mathematics test were instructed by LaSIP-trained teachers In a state with high rates of illiteracy and low rates of high school graduation, the LaSIP students, ethnically and economically representative, averaged scores two to three items higher than other students This performance is directly related to the professional development of teachers over the past four years In 1995-96, approximately 200,000 students in Louisiana will be taught by LaSIP teachers

The Systemic Initiative for **Montana** Mathematics and Science (SIMMS), initiated in FY 1991 has redesigned the state's mathematics curriculum for grades 9-12 into a multidisciplinary approach that is being implemented in 106 of the state's 173 schools It currently is being taught to more than 7,000 students Through SIMMS, professional development services in FY 1995 reached about 550 of the state's 980 secondary math and science teachers, directly or indirectly affecting 31,000 students out of a total student population of 47,000

- The **Urban Systemic Initiative** (USI) program addresses both the need for systemic change in science and mathematics education at the elementary and secondary levels and for enhanced productivity for groups that traditionally have been underserved by our national education system Begun in FY 1993, the USI targets the 25 cities with the largest populations of school-age children living in poverty NSF's USI investment through FY 1995 totaled about $63 million, and although the program is relatively young, initial outcomes are encouraging For example, the Dallas Independent School District is developing and implementing a new, integrated K-12 science and math curriculum, and the school district is instituting a new management structure to improve delivery of education to its 145,000+ students Activities in Dallas have resulted in a $2.3 million match from the O'Donnell Foundation to expand USI efforts Also, the city of Dallas passed a $275 million bond issue for capital improvements, including technical applications, which is testimony to the early strength of USI efforts The Dallas school district has forged important partnerships with area corporations (Occidental Petroleum, Frito-Lay, Texas Instruments, IBM, and Mobil Oil) The school district notes that mathematics test gains have exceeded expectations in seven of eight tested grades All of this activity has occurred in just the first year of USI efforts in Dallas

- **Calculus - The Mathematical Gateway to Science** The Calculus and Bridge to Calculus activity has reformed the teaching and learning of calculus nationally NSF has invested about $22 million in this program since its inception in FY 1988 The program objectives are to reform courses and curricula so that calculus serves as a "pump" rather than a "filter," thereby expanding the academic and career options and opportunities for students These courses focus on numerical, visual, and applied interpretations of calculus. Students make extensive use of technology, engage in cooperative learning, and learn to attack the open-ended problems faced in the real world The best selling calculus text last year (over 800,000 copies sold) is a reformed text developed through the NSF funded project produced by a Harvard-led consortium of five universities, two four-year and one two-year college, and a high school The NSF support was critical to the formation of a consortium of this breadth, an essential feature of this project to develop innovative materials ready for broad adoption The impact of the NSF program can be measured in several ways, including the fact that over 35 percent of all students enrolled in calculus in the U S are now taking a "reformed" course, including those in over 1000 institutions that were not supported by NSF as pilot projects under this program, indicating exceptional leadership, dissemination, and impact

- **Research Training Groups** Since 1989, NSF has sponsored 23 integrated multidisciplinary, training programs through its biological sciences Research Training Groups (RTGs) program, for a total investment of approximately $30 million The goal has been to facilitate broadened education and research training centered on a multidisciplinary research theme RTGs include faculty from disciplines such as mathematics, chemistry and computer science in addition to the biological sciences, and students from undergraduate through postdoctoral levels Opportunities for industrial internships are included as part of the training

The programs of individual RTGs often impact students at many institutions For example the RTG for Metals in Biology at the University of Georgia offers a summer workshop in inorganic biochemistry to graduate students from across the nation Over the last 5 years, approximately 400 students from other institutions have received instruction in isolation and genetic characterization of novel bacteria, and in the purification and analysis of novel, metal-containing proteins The multidisciplinary training being provided students at Georgia and other RTGs is helping to develop a "fearless" biologist, a scientist especially well equipped to tackle the challenging multidisciplinary problems of the 21st century

PERFORMANCE HIGHLIGHTS FOR ADMINISTRATION AND MANAGEMENT

NSF manages its research and education programs through a cycle that involves choosing an appropriate portfolio of programs and activities, project selection, and project and program assessment

Portfolio Management

As described in the Budget Overview, NSF balances its portfolio of activities in a variety of ways, introducing new programs and shifting resources toward existing ones regularly The amount of funds obligated for facilities as a percentage of total obligations is one of NSF's measures of balance in its portfolio Facilities funding can grow out of balance with other activities, given the possibility of large, sudden incremental construction or operations costs NSF management and the National Science Board guard against this threat to the overall balance in the NSF investment portfolio in their continual review of facility plans This year, NSF staff recommended and the Board approved the principle that facilities funding should remain in the range of 20 to 25 percent of the total budget Achieving this goal will require continued management attention during the budget process, as well as on-time, on-budget performance from the facilities themselves

Facilities Obligations as a Percent of Program Funds

FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
23%	24%	25%	23%	21%	24%

Project Selection

- Merit review is a key investment strategy for NSF, since it maintains standards of excellence and allows flexible response to changing research opportunities NSF's goal in the merit review process is to invest available resources to yield maximum benefits for the American public Merit review activity measures indicate the level of program officer and agency effort going into this key investment process

Merit Review Activity Measures

	Fiscal Year					
Requested Reviews	1990	1991	1992	1993	1994	1995
Total Number of Reviews (1000s)	266	273	282	256	277	292
Ad Hoc Mail Reviews (100s)	120	115	119	108	107	111
Reviews Requested per Proposal	9 4	9 7	9 7	8 8	9 2	9 7
Percent of Mail Reviews Completed	66%	64%	64%	65%	63%	64%

- Applicants for grants are the major customers of NSF's administrative services NSF has adopted ambitious customer service standards, and is working to meet them. NSF's customer service standards commit us to an improvement to lead time of three months for program announcements and solicitations. They also commit NSF to be able to tell applicants whether their proposals have been declined or recommended for funding within six months for 95 percent of proposals, unless the program announcement or solicitation states otherwise

As the table indicates, this new standard requires significant improvements from current practice

Processing Time from Proposal Receipt Through Directorate Recommendation

	Fiscal Year 1990	1991	1992	1993	1994	1995
Proposal Processing Time Average (Months)	6 5	6 5	6 8	6 7	6 6	6 5
Processed within Customer Service Standard	51%	45%	45%	46%	50%	48%

Performance Assessment

Performance under NSF awards is regularly examined through the merit review process In the case of research projects, this happens when grantees apply for additional funding In the case of centers and facilities, regular site visits and recompetitions gather performance information and incorporate it into resource allocation decisions Committees of visitors, advisory committees, and the National Science Board provide oversight at program and directorate levels

As described in the introduction to the Key Program Functions section, NSF has been moving toward an even more systematic examination of goal-based performance assessment in response to the Government Performance and Results Act.

NSF proposes to set descriptive performance goals based on its strategic plan, and to ask independent assessment panels to judge whether its investments are leading toward them The panels would be provided with both quantitative and descriptive information on which to base their assessments

- The panels will be able to draw on reports of results provided by principal investigators on research projects This information will be gathered and retrieved through a new results information base scheduled for implementation early in FY 1997

- The panels will have access to reports of results provided by facility and center directors, external reviews, and the reports of site visit reviews NSF is currently testing a set of indicators of the efficiency and effectiveness of facility operations

- In judging NSF's education portfolio, the panels will have access to the Impact Database that gathers information on outcomes of activities funded through the Education and Human Resources account.

- The panels will also be able to draw on the results of special performance studies For example, an evaluation of the Science and Technology Centers program is underway and two studies of the Engineering Research Centers (ERC) program, on the impact of ERCs on industry and on ERC graduate student outcomes, are nearing completion

Other Highlights

- In order to provide the best returns on public investments in research, engineering, and education activities, NSF staff work to reduce administrative burdens on grantees as far as possible Electronic communication presents NSF with unique opportunities to reduce the administrative burden on the research community and on NSF in many parts of the proposal, review, and award process A key part of this effort is **Project FastLane**, a three year experimental program utilizing advanced information technology to explore methods to re-engineer and streamline the way NSF does business with the research community In October 1995, participation in FastLane was expanded beyond the original 16 universities and now includes over 100 institutions This group represents a broad cross section of NSF funded institutions including large universities, state colleges, community colleges, minority institutions and museums In FY 1995, the Graduate Research Fellowship module was particularly successful having over 20% of its applications submitted electronically Another notable success was that 10% of all cash requests from institutions were submitted to NSF via FastLane All requests were processed within 5 days (and 90% were processed within 3 days) The standard for processing these requests is 90% within 5 days In FY 1995, 800 reviews were submitted via FastLane. This resulted in a savings of 200 hours of processing time

- NSF has implemented a site on the World Wide Web that has drawn critical acclaim from our customers and the trade press The NSF home page (and associated sites developed by NSF research directorates and staff offices) has provided a number of benefits to NSF and to the communities we serve

  1 The NSF website serves as a very effective vehicle for communicating with the external research community The home page has expanded the overall audience for NSF information and enabled us to reach target audiences more quickly

  2. The "instant" access made possible by dissemination on the World Wide Web has helped us to make important science news and information (e g , press releases) available quickly and to a broader audience

  3 The NSF home page has given NSF the opportunity to create an unprecedented global science information network that showcases the accomplishments of NSF-sponsored research projects and centers

  4 Feedback from our external customers regarding the NSF home page has provided valuable insights on their information needs

- The NSF Information Center annually responds to over 50,000 requests for information from external audiences about NSF programmatic and operational activities In a recent pilot project, the Center worked with the Office of Polar Programs to develop a profile describing facets of the Antarctic and Arctic Research Programs The profile included frequently requested information that could be disseminated directly to customers through the Center, thereby freeing the program staff from handling numerous routine inquiries This pilot will be expanded to other program areas of NSF and should result in significant time savings from customers and program staff.

- FinanceNet is the Internet's worldwide home for public financial management. FinanceNet began as a concept at the National Performance Review in early 1994 and is now operated by NSF under memoranda of agreement with agency members of the U S Chief Financial Officers Council FinanceNet seeks to achieve its goals by (1) encouraging dialog for the sharing of ideas, best practices and successes through subscriptions to a series of 30 public

Internet mailing lists and corresponding netnews newsgroups, and (2) by providing an instantly available electronic library of financial information on gopher, ftp and World Wide Web Internet servers to empower government financial operations staff and taxpayers to make more effective decisions. FinanceNet is also the worldwide electronic "clearing house" for information on the sale of all manner of public assets from real property and loans to planes, boats, cars, jewelry, and just about anything that any government, Federal, state, local or International, will be offering for sale to the general public electronically--truly a "one-stop-shop" for such information. FinanceNet has become the largest government administrative Internet network on all service platforms in the world. FinanceNet posts an average of 75 new financial management documents every month, processes over 300 e-mail messages daily and is visited at the rate of nearly 9 million "hits" per year.

NUMBERS OF PEOPLE INVOLVED IN NSF ACTIVITIES

Over 200,000 people are directly involved in NSF programs and activities, receiving salaries, stipends, or participant support

In addition, an estimated 15 million people are indirectly impacted by NSF programs. These programs reach Pre K-12 students, Pre K-12 teachers, and researchers through activities including workshops, informal science activities such as museums, television, videos, and journals, outreach efforts, and dissemination of improved curriculum and teaching methods

	FY 1995 Estimate	FY 1996 Estimate	FY1997 Estimate
Senior Researchers	25,300	24,800	25,700
Other Professionals	9,300	9,100	9,400
Postdoctoral Associates	4,100	4,000	4,200
Graduate Students	20,100	20,000	20,800
Undergraduate Students	27,600	25,400	25,900
K-12 Students	11,200	11,600	6,100
K-12 Teachers	105,900	115,000	125,500
Total Number of People	203,500	209,900	217,600

Senior Researchers include scientists, mathematicians, engineers, and educators receiving funding through NSF awards These include both researchers who are principal or co-principal investigators on research and education projects, and researchers working at NSF-supported centers and facilities

Other Professionals are individuals who may or may not hold a doctoral degrees or its equivalent who are considered professionals, but are not reported as senior researchers, postdoctoral associates, or students Examples are technicians, systems experts, etc

Postdoctoral Associates are individuals who have received Ph D , M D , D Sc , or equivalent degrees less than five years ago, and who are not members of the faculty of the performing institution Most of these postdoctoral associates are supported through funds included in research projects, centers or facilities awards The balance of these, less than 5 percent, are recipients of postdoctoral felllowships

Graduate Students include students compensated from NSF grant funds Roughly 15 percent of these students receive support through programs such as the NSF Graduate Fellowships, Minority Graduate Fellowships, and Graduate Traineeships The balance assist senior researchers or postdoctoral associates in performing research, and are supported through funds included in research projects, centers or facilities awards

Undergraduate Students include students enrolled in technical colleges or baccalaureate programs compensated from NSF grant funds They may either be assisting senior researchers or postdoctoral associates in performing research, or participating in NSF programs specifically aimed at undergraduate students, such as Research Experiences for Undergraduates or Alliances for Minority Participation

K-12 Teachers include teachers at elementary, middle and secondary schools These teachers participate in a direct, intensive enhancement project, which includes approximately three week programs with follow-up activities

K-12 Students are those attending elementary, middle and secondary schools These students receive direct support in NSF programs, such as the Young Scholars program and the Summer Science Camps

NSF FUNDING PROFILE

Approximately half of the awards that are supported in a particular fiscal year are competitively reviewed in that year through NSF's merit review process The other awards are continuations of projects that were competitively reviewed in a prior year The funding rate is the number of competitive awards made during a year as a percentage of total proposals competitively reviewed It indicates the probability of winning an award when submitting proposals to NSF

The annualized award size displays the annual level of support provided to awardees by dividing the total dollars of each award by the number of years over which it extends Both the average and the median annualized award size for competitively reviewed awards are shown

Average duration is the length of the award in years The duration calculation is limited to research projects and excludes other categories of awards which fund infrastructure-type activities such as equipment and conference awards which do not require multi-year support

The Quantitative Data Tables, provided under a separate tab, are based on all proposals and awards, including competitive awards, contracts, cooperative agreements, supplements and amendments to existing grants and contracts

NSF FUNDING PROFILE

	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate
Total Number of Awards	19,393	19,103	19,597
Statistics for Competitive Awards			
Number	9,784	9,650	9,800
Funding Rate	30%	30%	31%
Median Annualized Award Size[1]	$58,065	$59,000	$61,000
Average Annualized Award Size[1]	$72,800	$74,250	$78,700
Average Duration (yrs) [1]	2 6	2 6	2 7

[1]Statistics for average award size and duration for Research Projects only Excludes facilities, centers, fellowships, and travel

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE [5]	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
BIOLOGICAL SCIENCES						
MOLECULAR AND CELLULAR BIOSCIENCES						
Molecular & Cellular Biosciences Research Projects	$88,552	$94,170	$87,200	$92,220	$5,020	5 8%
Total	88,552	94,170	87,200	92,220	5,020	5 8%
INTEGRATIVE BIOLOGY AND NEUROSCIENCES						
Integrative Biology & Neuroscience Research Projects	80,374	86,330	79,950	84,950	5,000	6 3%
Total	80,374	86,330	79,950	84,950	5,000	6 3%
ENVIRONMENTAL BIOLOGY						
Environmental Biology Research Projects	79,004	85,330	79,020	84,200	5,180	6 6%
Total	79,004	85,330	79,020	84,200	5,180	6 6%
BIOLOGICAL INSTRUMENTATION AND RESOURCES						
Research Resources	37,613	40,530	37,530	46,330	8,800	23 4%
Human Resources	15,300	17,600	16,300	18,300	2,000	12 3%
Total	52,913	58,130	53,830	64,630	10,800	20 1%
Total, BIO	$300,843	$323,960	$300,000	$326,000	$26,000	8 6%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE '	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING						
COMPUTER AND COMPUTATION RESEARCH						
Computer & Computation Research Project Support	$39,776	$42,910	$39,500	$43,420	$3,920	9 9%
Total	39,776	42,910	39,500	43,420	3,920	9 9%
INFORMATION ROBOTICS AND INTELLIGENT SYSTEMS						
Information, Robotics & Intelligent Systems Research Project Support	31,893	35,130	32,390	35,570	3,180	9 8%
Total	31,893	35,130	32,390	35,570	3,180	9 8%
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS						
Microelectronic Information Processing Systems Research Project Support	25,368	28,140	25,950	28,440	2,490	9 6%
Total	25,368	28 140	25,950	28,440	2,490	9 6%
ADVANCED SCIENTIFIC COMPUTING						
Advanced Computational Infrastructure	74,395	77,460	69,360	70,560	1,200	1 7%
New Technologies	5,823	6,600	9,000	10,000	1,000	11 1%
Total	80,218	84,060	78,360	80,560	2,200	2 8%
NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE						
NSFNET	45,528	46,220	44,040	44,140	100	0 2%
Networking & Communications Research Project Support	11,317	13,340	10,740	12,950	2,210	20 6%
Total	56,845	59,560	54,780	57,090	2,310	4 2%
CROSS-DISCIPLINARY ACTIVITIES						
CISE Institutional Infrastructure	20,242	22,210	21,000	22,880	1,880	9 0%
CISE Instrumentation	3,486	3,560	3,020	9,040	6,020	199 3%
Total	23,728	25,770	24,020	31,920	7,900	32 9%
Total, CISE	$257,828	$275,570	$255,000	$277,000	$22 000	8 6%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE [3]	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
ENGINEERING						
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS						
Bioengineering	$16,199	$17,940	$16,230	$17,020	$790	4 9%
Environmental and Ocean Systems	6,944	7,630	7,000	8,900	1,900	27 1%
Total	23,143	25,570	23,230	25,920	2,690	11 6%
CHEMICAL AND TRANSPORT SYSTEMS						
Chemical and Transport Systems	39,657	41,130	38,130	41,630	3,500	9 2%
Total	39,657	41,130	38,130	41,630	3,500	9 2%
CIVIL AND MECHANICAL SYSTEMS						
Hazard Mitigation	19,574	21,170	19,590	21,400	1,810	9 2%
Civil, Mechanical and Materials Engineering	28,365	30,720	28,380	30,960	2,580	9 1%
Total	47,939	51,890	47,970	52,360	4,390	9 2%
DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION						
Design and Manufacturing Systems	32,242	34,070	30,920	34,850	3,930	12 7%
Small Business Innovation Research	42,094	43,740	38,800	51,750	12,950	33 4%
Industry/University Innovation & Liaison	6,809	10,250	9,620	11,780	2,160	22 5%
Total	81,145	88,060	79,340	98,380	19,040	24 0%
ELECTRICAL AND COMMUNICATIONS SYSTEMS						
Electrical and Communications Systems	39,730	41,680	38,520	42,060	3,540	9 2%
Total	39,730	41,680	38,520	42,060	3,540	9 2%
ENGINEERING EDUCATION AND CENTERS						
Development of Human Resources	32,034	35,250	30,230	34,220	3,990	13 2%
Engineering Centers	59,273	60,580	58,950	59,760	810	1 4%
Total	91,307	95,830	89,180	93,980	4,800	5 4%
Total, ENG	$322,921	$344,160	$316,370	$354,330	$37,960	12 0%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE [5]	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
GEOSCIENCES						
ATMOSPHERIC SCIENCES						
Atmospheric Sciences Research Support	$85,774	$91,010	$83,860	$92,060	$8,200	9 8%
National Center for Atmospheric Research	58,615	64,830	58,170	61,170	3,000	5 2%
Total	144,389	155,840	142,030	153,230	11,200	7 9%
EARTH SCIENCES						
Earth Sciences Project Support	54,564	58,570	56,540	58,800	2,260	4 0%
Instrumentation and Facilities	20,458	22,150	21,200	27,700	6,500	30 7%
Continental Dynamics	7,400	9,330	7,660	9,400	1,740	22.7%
Total	82,422	90,050	85,400	95,900	10,500	12 3%
OCEAN SCIENCES						
Ocean Sciences Research Support	102,600	110,300	103,020	110,180	7,160	7 0%
Oceanographic Centers and Facilities	50,452	54,200	47,700	53,650	5,950	12.5%
Ocean Drilling Program	39,753	41,090	39,850	41,040	1,190	3.0%
Total	192,805	205,590	190,570	204,870	14,300	7.5%
Total, GEO	$419,616	$451,480	$418,000	$454,000	$36,000	8 6%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE [3]	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
MATHEMATICAL AND PHYSICAL SCIENCES						
MATHEMATICAL SCIENCES						
Research Project Support	$66,524	$70,310	$64,270	$69,560	$5,290	8 2%
Infrastructure Support	18,768	19,550	19,950	22,000	2,050	10 3%
Total	85,292	89,860	84,220	91,560	7,340	8 7%
ASTRONOMICAL SCIENCES						
Astronomy Research and Instrumentation	38,917	40,000	39,000	45,340	6,340	16 3%
Facilities	63,572	70,390	67,210	71,630	4,420	6 6%
Total	102,489	110,390	106,210	116,970	10,760	10 1%
PHYSICS						
Physics Research Project Support	93,349	98,950	94,980	102,660	7,680	8 1%
Facilities	36,659	43,250	35,900	39,600	3,700	10 3%
Total	130,008	142,200	130,880	142,260	11,380	8 7%
CHEMISTRY						
Chemistry Research Project Support	105,131	112,900	105,630	111,740	6,110	5 8%
Instrumentation & Infrastructure	17,954	20,740	20,100	24,900	4,800	23 9%
Total	123,085	133,640	125,730	136,640	10,910	8 7%
MATERIALS RESEARCH						
Materials Research Project Support	82,824	88,970	84,090	92,590	8,500	10 1%
Materials Research Science and Engineering Centers	58,738	62,320	56,590	58,590	2,000	3 5%
National Facilities and Instrumentation	33,277	39,630	33,280	37,890	4,610	13 9%
Total	174,839	190,920	173,960	189,070	15,110	8 7%
OFFICE OF MULTIDISCIPLINARY ACTIVITIES						
Research Project Support	29,529	31,270	30,000	31,500	1,500	5 0%
Total	29,529	31,270	30,000	31,500	1,500	5 0%
Total, MPS	$645,242	$698,280	$651,000	$708,000	57,000	8 8%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE [5]	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES						
SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH						
Social, Behavioral and Economic Research	$81,850 [1]	$91,690	$85,000	$93,000	$8,000	9.4%
Total	81,850	91,690	85,000	93,000	8,000	9.4%
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES						
International Cooperative Scientific Activities	16,588	18,750	17,000	18,000	1,000	5.9%
Total	16,588	18,750	17,000	18,000	1,000	5.9%
SCIENCE RESOURCES STUDIES						
Science Resource Studies	11,925	12,430	12,000	13,000	1,000	8.3%
Total	11,925	12,430	12,000	13,000	1,000	8.3%
Total, SBE	$110,363	$122,870	$114,000	$124,000	$10,000	8.6%
UNITED STATES POLAR RESEARCH PROGRAMS	$160,049 [2]	$172,280	$154,400	$163,400	$9,000	5.8%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$62,600	$62,600	$62,600	$62,600	$0	0.0%
CRITICAL TECHNOLOGIES INSTITUTE	$2,000	$2,800	$2,630	$2,670	$40	1.5%
Subtotal, RESEARCH AND RELATED ACTIVITIES	$2,281,462	$2,454,000	$2,274,000	$2,472,000	$198,000	8.7%
Carryover			$3,098		($3,098)	N/A
Total, RESEARCH AND RELATED ACTIVITIES	$2,281,462	$2,454,000	$2,277,098	$2,472,000	$194,902	8.6%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
EDUCATION AND HUMAN RESOURCES						
EDUCATIONAL SYSTEM REFORM						
Educational System Reform	$94,217	$95,350	$95,350	$101,850	$6,500	6.8%
Total	$94,217	$95,350	$95,350	$101,850	$6,500	6.8%
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR)						
Experimental Program to Stimulate Competitive Research	36,339	35,910	35,910	35,910	0	0.0%
Total	36,339	35,910	35,910	35,910	0	0.0%
ELEMENTARY, SECONDARY, AND INFORMAL EDUCATION						
Curriculum and Assessment Development	49,678	48,180	48,180	53,680	5,500	11.4%
Teacher & Student Development	113,889	109,970	109,970	110,470	500	0.5%
Informal Science Education	35,645	36,000	36,000	26,000	(10,000)	-27.8%
Total	199,212	194,150	194,150	190,150	(4,000)	-2.1%
UNDERGRADUATE EDUCATION						
Curriculum & Laboratory Development	60,676	58,600	58,600	66,260	7,660	13.1%
Teacher and Faculty Development	25,899	24,830	24,830	26,170	1,340	5.4%
Total	86,575	83,430	83,430	92,430	9,000	10.8%
GRADUATE EDUCATION						
Graduate Student Support	66,789	66,790	66,790	74,290	7,500	11.2%
Total	66,789	66,790	66,790	74,290	7,500	11.2%
HUMAN RESOURCE DEVELOPMENT						
Precollege Education (ACCESS)	15,800	15,830	15,830	13,830	(2,000)	-12.6%
Undergraduate Student Support	26,759	26,410	26,410	27,410	1,000	3.8%
Research & Education Infrastructure	18,043	14,540	14,540	12,540	(2,000)	-13.8%
Opportunities for Women and Persons with Disabilities	19,178	18,020	18,020	20,020	2,000	11.1%
Total	79,780	74,800	74,800	73,800	(1,000)	-1.3%
RESEARCH, EVALUATION AND COMMUNICATION						
Research	14,552	13,030	13,030	13,030	0	0.0%
Evaluation	8,414	10,270	10,270	13,270	3,000	29.2%
Technology	26,002	25,270	25,270	24,270	(1,000)	-4.0%
Total	48,968	48,570	48,570	50,570	2,000	4.1%
Subtotal, EHR	611,880	599,000	599,000	619,000	20,000	3.3%
Carryover			2,224		(2,224)	N/A
Total, EHR	$611,880	$599,000	$601,224	$619,000	$17,776	3.0%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1995 ACTUAL	FY 1996 REQUEST	FY 1996 ESTIMATE [5]	FY 1997 REQUEST	CHANGE FY 97 Req/FY 96 Est AMOUNT	PERCENT
ACADEMIC RESEARCH INFRASTRUCTURE	$117,458	$100,000	$100,000	$0	($100,000)	-100.0%
Carryover			$917		(917)	N A
Total, ARI	$117,458	$100,000	$100,917	$0	($100,917)	-100.0%
MAJOR RESEARCH EQUIPMENT [4]	$126,000	$70,000	$70,000	$95,000	$25,000	35.7%
SALARIES AND EXPENSES						
Salaries & Expenses	$123,814	$127,310	$127,310	$129,110	$1,800	1.4%
NSF Headquarters Relocation [3]	$5,200	$5,200	$5,200	$5,200	$0	0.0%
Total	$129,014	$132,510	$132,510	$134,310	$1,800	1.4%
OFFICE OF INSPECTOR GENERAL	$4,460	$4,490	$4,490	$4,690	$200	4.5%
Total	$4,460	$4,490	$4,490	$4,690	$200	4.5%
Subtotal, NATIONAL SCIENCE FOUNDATION [4]	$3,270,274	$3,360,000	$3,180,000	$3,325,000	$145,000	4.6%
Carryover			$6,239		(6,239)	N A
TOTAL, NATIONAL SCIENCE FOUNDATION	$3,270,274	$3,360,000	$3,186,239	$3,325,000	$138,761	4.4%

[1] FY 1995 Actual for Social, Behavioral, and Economic Science excludes $2.9 million carried over into FY 1996

[2] FY 1995 Actual for the U.S. Polar Research Programs includes $1.15 million in recoveries

[3] NSF Headquarters Relocation was funded through a separate appropriation heading in FY 1995 and FY 1996. For comparability, this has been included within the Salaries and Expenses appropriation headin

[4] $35 million available for LIGO in FY 1994 within R&RA was rescinded and restored in FY 1995

[5] FY 1996 Estimate does not include $40 million in adjustments proposed in budget negotiations

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About the National Science Foundation

NSF is an independent federal agency created by the National Science Foundation Act of 1950 (P L 81-507) Its aim is to promote and advance scientific progress in the United States. The idea of such a foundation was an outgrowth of the important contributions made by science and technology during World War II. From those first days, NSF has had a unique place in the Federal government it is responsible for the overall health of science and engineering across all disciplines In contrast, other federal agencies support research focused on specific missions, such as health or defense The Foundation is also committed to ensuring the Nation's supply of scientists, engineers, and science educators

NSF funds research and education in science and engineering It does this through grants and contracts to more that 2,000 colleges, universities, and other research institutions in all parts of the United States The Foundation accounts for about 25 percent of Federal support to academic institutions for basic research

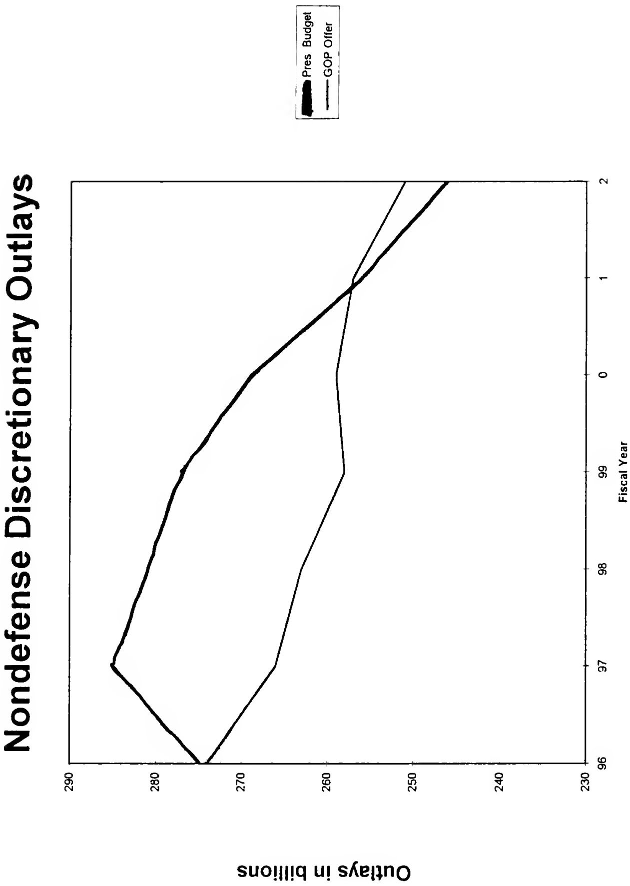
NSF receives approximately 30,000 proposals each year for research and education and training projects, and several thousand applications for graduate and postdoctoral fellowships, it makes approximately 20,000 awards These typically go to universities, colleges, academic consortia, nonprofit institutions, and small businesses The agency operates no laboratories itself but does support National Research Centers, certain oceanographic vessels, and Antarctic research stations The Foundation also supports cooperative research between universities and industry and U S participation in international scientific efforts

The Foundation is led by a presidentially appointed director and governed by the National Science Board (NSB) The Board is composed of 24 members, representing a cross section of American leadership in science and engineering research and education; appointed by the President to 6-year terms, with one third appointed every 2 years, and selected solely on the basis of established records of distinguished service. The NSF Director is a member ex officio of the Board In addition to governance of the Foundation, the Board serves the President and the Congress as an independent advisory body on policies affecting the health of U S science and engineering and education in science and engineering

NSF is structured much like a university, with grants-making divisions for the various disciplines and fields of science and engineering and science education. NSF also uses a formal management process to coordinate research in strategic areas that cross traditional disciplinary boundaries The Foundation is helped by advisors from the scientific community and from industry who serve on formal committees or as ad hoc reviewers of proposals This advisory system, which focuses on both program direction and specific proposals, involves more than 59,000 scientists and engineers a year NSF staff members who are experts in a certain field or area make award recommendations, applicants get anonymous verbatim copies of peer reviews

Awardees are wholly responsible for doing their research and preparing the results for publication; the Foundation does not assume responsibility for such findings or their interpretation

NSF welcomes proposals on behalf of all qualified scientists and engineers and strongly encourages women, minorities, and people with disabilities to compete fully in its programs In accordance with federal statutes and regulations and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from NSF.


Nondefense Discretionary Outlays
Pres Budget
GOP Offer
Outlays in billions
290
280
270
260
250
240
230
96
97
98
99
0
1
2
Fiscal Year

Mr. SCHIFF. Dr. Lane, I want to say a couple of things first, just so there is no mistake between you and me; and I am sure there would not be, but those watching us today:

The first is, I believe the National Science Foundation is a very well-run organization. I said that in my prepared remarks, and I want to say it again. When you are on a committee with jurisdiction over any agency, the dirty laundry starts to come over. You know, people with some kind of complaint come in to see you to say, "Well, what about this?"

I can tell you that what I have seen—and by the way, there are even complaints about how Congress is run sometimes; I know none of you in the room believe that, but on occasion I have heard it——

[Laughter.]

Mr. SCHIFF. (continuing) the things I have heard about, and some of which we have discussed. Things like how many directorates there ought to be, and so forth. Although these are reasonable questions, they do not amount to serious criticism of the agency, and I want you to know that. I want no mistake in any portion of this hearing if I raise something to misconstrue what I feel about your agency.

Dr. LANE. Thank you, Mr. Chairman.

Mr. SCHIFF. The second is, I want to assure you that, speaking for myself and Mr. Cramer and other members of the Subcommittee, all of us are committed to the idea of funding basic research to the absolute extent possible.

I can assure you—I believe in both of our cases, and on behalf of the other Subcommittee members—that in the budget process, whether it is internal with the Congress or internal with the Administration, or between the two as that comes up, that we will all do our best for scientific research funding within the mutually agreed goal of balancing the budget.

However, I have to say that we cannot totally eliminate all references to sides of the aisle, and Administration, and Congress, and so forth because it is part of how the legislative process works.

Way over there on your right, the Science Committee staff has prepared a chart. I don't know if you have a copy of that—you do, do you not?—and Congressman Cramer has a copy, but essentially I don't know if the members can see it all the way on the other side—they have copies also—but in essence it is the Science Committee's analysis of the proposals for nondefense discretionary funding.

The red line is their analysis of the President's proposals as scored by the CBO, and the blue line is their analysis of presently the Congress's proposal.

Now of course proposals are "proposals." I mean, if and when we reach an agreement between the Congress and the President—and I hope we do—then there would presumably be a whole new set of numbers there.

But as you can see, as we analyzed the Administration's proposals, the proposal is for an increase in nondefense discretionary spending for fiscal year 1997, which it just so happens we have to vote on in 1996, which I think is a presidential election year—I might have that wrong, but I am pretty sure I am right about that—and then it starts to go down from there; and it goes down so much that at the very end it falls. The total figures fall below what Congress is recommending at this time.

Again, we have talked about this privately, so you know what I am going to ask you, I trust. That is, what I would like to know is where does NSF fit into the Administration's budget for the full seven years through the Year 2002, if you know?

I wonder if you could tell us about that?

Dr. LANE. Well, Mr. Chairman, we certainly recognize that, in an effort to get hold of the deficit, there is pressure on many budget categories and certainly on the nondefense discretionary budget.

The outyear numbers that have been published for the National Science Foundation, the bottom-line numbers, over the period that you have mentioned are essentially flat from 1997.

So the President has made a very good request for us in 1997, as has been remarked on here; and the budget authority in those outyear projects is roughly constant in current dollars through that period.

It is also the case, though, that the outlays for at least several of those years increase in recognition of earlier budget authority on major construction projects that will be spent out over a number of years.

So I guess I would conclude by saying two things:

The outyear numbers that have been provided for NSF do, in fact, show the President's strong commitment for science and for NSF.

It is also the case that we understand that the outyear numbers are not locked, and that the situation will be re-examined every year.

We would expect to continue to make the strong case for NSF's budget because we believe that this is an important investment in the nation's future.

Mr. SCHIFF. Dr. Lane, I cannot resist telling you, looking at that chart, that there is kind of a Republican joke that goes: "Does Vice-President Al Gore know what President Clinton is proposing for his presidency four years from now?"

[Laughter.]

Mr. SCHIFF. I am not seeing too many chuckles, so maybe it tells me the political division out there, I don't know.

But I have a couple of follow-up questions.

My first follow-up question is on the flat NSF budget that you have referred to. In the President's budget submission that we received a few days ago, the President had total figures printed twice. One is CBO-scored, which is our mutual agreement between the President and Congress; and the President had a separate set of numbers—and I have no idea why that was in the budget since we have all agreed to use the CBO numbers—but the President has a separate set of numbers of total spending, not CBO scored; I assume, OMB scored.

The chart you see there is using CBO scoring for both the Administration's proposals and Congress's proposals.

The question is this. Do you know whether the proposal you have just stated for the outyears for NSF is under CBO scoring, or under OMB scoring?

Dr. LANE. I am sorry, Mr. Chairman, I do not know the answer to that question.

Mr. SCHIFF. All right, Dr. Lane, I regard that as an extremely important question. In fact, I think it was nothing less than misleading for the Administration to put in a budget spending figures that are not related to the Congressional Budget Office verifications after the President has agreed with the Congress that we would all use Congressional Budget Office figures.

I think to introduce a separate set of figures for total spending is nothing less than providing a lot of confusion. That is why I would like to be certain which set of figures your testimony applies to. I would be grateful if you would get back to me on that.

[The following information was received for the record:]

SCORING OF NSF BUDGET

The budget proposals presented in the President's budget for NSF were developed using outlay rates that have been agreed upon by NSF, OMB, and CBO. It is our understanding that OMB and CBO do not differ on the scoring issue. Therefore, the outlay proposals displayed for all years are consistent with both OMB and CBO scoring. However, OMB and CBO disagree on certain economic assumptions for Fiscal Years 2001 and 2002. As a result, the budget presents two sets of tables, one of which displays proposed budget authority and outlays through FY 2002 using the Administration's economic assumptions, and one which displays outlays through FY 2002 using only the CBO assumptions.

Mr. SCHIFF. I would like to also ask if you have the breakdown within your separate accounts within the NSF as to how the funds in the next six fiscal years will be spent.

For example, I believe that the Congressional proposal is for a 3 percent real growth in the Research and Related Activities Account for each year for the next six fiscal years.

Can you tell me within the Research and Related Activities Account what the breakdown is in those fiscal years in the figures you have referred to?

Dr. LANE. Well, Mr. Chairman, one thing I would like to say is I think the Research and Related Account does not correctly project NSF's investment in research. Let me be more specific.

In the NPR process we identified a different way of describing our activities. I don't mean that we changed the account structure, but we felt it was appropriate to try to look more carefully at the activities that we are funding and identify what all goes into research activity and what goes into education.

So we have broken out and given examples in our 1997 budget of what we spend on so-called "research projects" which I refer to in my testimony—that's grants, and centers, and other such activities—and a "research facilities" line, critically important in supporting the research projects, and "education" and "training."

These do not correspond one-to-one with the accounts. "Research and Related" includes many activities that, quite properly, can be called "education and training," and the EHR account includes some activities that, in fact, are almost entirely research.

So that is why we have—not to try to obfuscate the situation at all, but to try to clarify how our money really is invested—we have moved to talking also about these key programs.

Mr. SCHIFF. Well——

Dr. LANE. The reason for me—I am sorry. I will try to finish very quickly.

Mr. SCHIFF. Please.

Dr. LANE. The reason I am going into that is to say that our priorities now both in developing the 1997 budget and also we would anticipate to apply to the outyears, would be to keep the balance between what we call research projects and research facilities and education and training.

So that is our expectation under these budget scenarios over the next several years.

Mr. SCHIFF. Dr. Lane, you have every right to give further explanation, and the points you have made are very important, but I respectfully point out you did not answer my question, which was: Do you have a breakdown, over the next fiscal years, of projected spending in the Research and Related Activities Account (RR&A)?

Dr. LANE. Yes, Mr. Chairman.

The R&RA is roughly flat for 1996 through the Year 2000. It goes up somewhat for the last two years, 2001 and 2002.

Mr. SCHIFF. Could I ask you, in addition to the question I asked earlier about relating the numbers to which figures in the President's budget, could you get me those figures also at your convenience?

Dr. LANE. Yes, Mr. Chairman.

[The following information was received for the record:]

RESEARCH AND RELATED ACTIVITIES ACCOUNT BUDGET

The following table displays budget authority numbers for the Research and Related Activities account, FY 1996 through FY 2002.

Budget Authority	Millions of Dollars						
	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
Research and Related Activities	2,314	2,472	2,473	2,474	2,475	2,549	2,628

Mr. SCHIFF. And I just have a couple more questions—and I have gone a bit over five minutes, and of course I will allow every Member the same prerogative, but I only have a couple of more questions.

In the fiscal year 1997 request, the line item for Academic Research Infrastructure which was estimated at $100 million in fiscal year 1996, and which I believe Congress estimates at $50 million for fiscal year 1997, has been zeroed-out in the Administration's proposal.

I believe that $50 million, if I have the correct figure, was placed in the fiscal year 1997 request for Research and Related Activities, which of course made the percent change proposed for this next fiscal year in Research and Related Activities an increase of 8.7 percent, which appears to me to be at least in part due to a shift in line items.

I wonder if you can explain why the Academic Research and Infrastructure Account was zeroed-out in the next fiscal year in your proposal.

Dr. LANE. Mr. Chairman, I would like to start by saying I think our investments in academic research and infrastructure have been well-made and have addressed important needs. So we have no disagreement that our investigators need the very best instrumentation at all levels that we can provide, and also that universities have had difficulty keeping their laboratory facilities, their spaces, their air conditioning and air handling systems up to modern standards.

So we believe that the investment has been made properly and the best projects have been supported.

The problem is simply that under constrained budgets, we have to set priorities and make tough decisions. Our first priority is on the people and the research activities. If we do not have the money to support the grants for the researchers, then it is very difficult for EPSCOR scientists to graduate to a competitive position, for example, or in any case to have the scientists funded to use the laboratories on campuses.

So it is simply the case that we believe the institutions are in a better position, working in partnership with the private sector and with other sources, to handle the bricks-and-mortar needs of the laboratories.

The removal of the $100 million does, as you point out, correspond to $100 million moving into the Research and Related Account. $50 million of that money is going to be used to support instrumentation of the same scale of multi- user instrumentation as we supported previously under the ARI account.

So that money will still be invested in competitive, merit-reviewed programs to buy large-scale equipment for the researchers in institutions across the country. So that will be a competition as we have had before. The only difference is that the money now resides for that instrumentation, now resides in the various research directorates.

Mr. SCHIFF. I understand that, but I just want to make the point—and I don't question your administrative decision to do that, but the budget shows an 8.7 percent increase in the proposal for the Research and Related Activities Account, and that is now not the same account as it was in the fiscal year 1996 account.

Is that right? Because you have now included the Academic Research and Infrastructure Account with the Research and Related Activities Account.

Dr. LANE. I am not quite sure I know what you mean, Mr. Chairman, by saying it is not the same account. The account does include this additional responsibility to handle the——

Mr. SCHIFF. Which it did not before?

Dr. LANE. Which it did not before; yes, sir, that is correct.

Mr. SCHIFF. Two more things, Dr. Lane.

One is, in previous budgets I have seen, "Analysis and Proposals" for the National Science Foundation, in the category "Salaries and Expenses," there was usually a separate breakout of about $5.2 million-a-year representing a payment of expenses for relocation of the NSF.

It is my understanding that in a period of time, that is expected to be eliminated as the expenses of moving have been paid.

I am just noticing that in "Salaries and Expenses" in your proposed budget, that is not broken out. I wonder if there is any reason why that has been changed?

Dr. LANE. Mr. Chairman, I think the reason is simply to simplify the accounting. We still have the $5.2 million to pay on the relocation, and we can provide you the detail. We have simply tried to simplify the account structure.

Mr. SCHIFF. One last thing, Dr. Lane, and this is a matter I hope you were told I was going to ask about before. Timing I guess is everything in government. Just a couple of days ago I happened to be shown an article from *The Wall Street Journal* which talks about some researchers putting together a proposal for a TV series funded by a grant from the Department of Energy and the National Science Foundation.

I just kind of wonder if you have any familiarity with a grant that was to produce a TV series funded by the National Science Foundation?

Dr. LANE. Mr. Chairman, my understanding is we do—we have planned to provide some funding for the development of the concept. I believe this is handled in our Informal Education activity within the EHR directorate. If you would like more details on it, Dr. Luther Williams, is here and would be happy to comment.

Mr. SCHIFF. Well I think the article explains what this is all about. I guess it is a TV drama like some of the police dramas, if you will, or medical dramas to show the life of scientists. I would sure be interested to know who the casting is going to be.

I would just conclude with this observation, and then I am going to recognize Congressman Cramer.

I think I can understand what someone is trying to get at, you know, in funding the idea of funding a TV program is intended to provide education; but I would, with respect, offer a caution.

It is easy for that to go awry. I think that is really on the edge, if not over the edge, of what is appropriate for NSF to be funding, particularly when I am hearing from so many universities about how strapped they are for direct research funds, which is your primary mission, as you know.

I just want to say, again with respect, there are some grant-giving agencies funded by the Congress that have not been careful over the years about what kinds of projects they have been funding, and in my opinion those agencies are heading towards a very serious problem with the Congress—that they have had one already, and are running into one in the future to the point where I think one or more of them may be de-funded before the process is all over.

I would not want to see NSF get into that kind of controversy and debate. So I just respectfully point out. It is necessary to be looking in all directions at once. I know that is hard to do, but I think you understand what I am saying.

Mr. BOEHLERT. Will the Chairman yield to me on that subject?

Mr. SCHIFF. I certainly do yield, Mr. Boehlert.

Mr. BOEHLERT. You bring up a legitimate concern. I would think, then, that the Chairman might be enticed to work with me to provide adequate funding for Public Broadcasting, because quite frankly as we look across the country, we are hard-pressed to find any decent programming for young people to simulate their interest in the sciences. Public Broadcasting is trying valiantly, but there are some people in this Congress that would eliminate all funding for it, which I think is absolutely ridiculous.

But I share the Chairman's concern, and I think his caveat is well taken.

Mr. SCHIFF. I thank the gentleman.

I did not time my own questions here.

Mr. CRAMER. I did.

Mr. SCHIFF. So whatever——

[Laughter.]

Mr. CRAMER. I will get 30 minutes.

Mr. SCHIFF. Dr. Lane, we are all watched somewhere. I just want to make that very clear.

[Laughter.]

Mr. SCHIFF. Whatever time I took as chair, I happily grant to Mr. Cramer.

Mr. CRAMER. That is only fair, and I knew you would be, Mr. Chairman. But just in case, I was keeping up with it.

No, I do not have that much. You have in fact emphasized at least some of the issues that I wanted to bring up.

I do want to start with an overall budget issue. Your NSF budget request for fiscal year 1997 I said in my opening statement provides real growth.

Would you tell me how much growth over the expected appropriations level for the current fiscal year?

Dr. LANE. I think—do you mean growth in the year just between 1996 and 1997?

Mr. CRAMER. Yes.

Dr. LANE. Well if the inflator is—if you take 3 percent, then I would say 2.6 percent real growth. It is probably a little more. It depends on what inflation turns out to be.

Mr. CRAMER. In projecting down-the-line over the next six years, what kind of growth will you experience there in your budget?

Dr. LANE. I think if one measures it from 1997 onward, then our current outyear numbers would not project any growth over that period of time. In fact, they would be flat in current dollars, or relatively flat, which would mean we would lose to inflation over that period.

Mr. CRAMER. Dr. Lane, you have had to make tough choices during a very confusing budget time, to say the least; and I want to congratulate you on the progress the agency has made, and on having to make those tough choices.

Let me come back to a program that I talked about again in my opening statement, EPSCOR, which I think is a wonderful partnership arrangement with states like mine.

Would you talk about EPSCOR's budget and NSF's commitment to EPSCOR as we look currently and down-the-line?

Dr. LANE. Well, Mr. Cramer, EPSCOR has I think been a model success story. As I think I may have mentioned to you before in our conversations, EPSCOR was not an idea that I thought sounded terrific back when I was a university professor hearing about it offhand; but when I had my first opportunity to make a site visit and be involved in the review process, I of course was immediately reminded of the high standards NSF applies to everything it does, including the EPSCOR program, and also the tremendous impact that it had on the states involved.

It brought together all the key players in a state to help that state become more competitive in funding, and more recently, to better link the research activities with education activities and economic development activities.

So I think it has been a tremendous success story.

The budget request we have in 1997 is similar to 1996. It does not show growth. I think that is, though, quite a good request for EPSCOR given the current set of situations. So EPSCOR remains an important program to us in making these decisions, and we felt this would be the appropriate level.

Mr. CRAMER. Would you expect your funding commitment to be the same as we look down the next six years?

Dr. LANE. I would certainly expect, unless something unanticipated occurs in the evaluation which then would cause us to look at the nature of the program, as we do with all our programs, that this properly reflects our priorities.

Mr. CRAMER. NSF has also been studying the need for a research icebreaker to support the Arctic Research Projects. What is the status of that proposed project?

Dr. LANE. Well that is one area in which our fleet of research vessels has an identified need. It is clear that we need some infrastructure to help Arctic research scientists.

There have been a number of reports, a GAO report, though, questioning the need for a new ship to do this. A National Academy of Sciences study more specifically suggested that the new Coast Guard Icebreaker, the HEALEY, I believe, could in fact play this role with some appropriate consideration to design needs, more space for scientists, for example, and attention to schedules that would better accommodate scientific research.

So our staff is working with the Coast Guard on this to simply see whether, in fact, that vessel would meet the needs of the scientists working in the Arctic.

Mr. CRAMER. I want to come back to the comments that I believe I heard you make about the situation with research infrastructure.

As I pointed out again in my opening statement, the Academic Research Facilities was zeroed-out. That part of your budget was zeroed-out.

You made some reference to how it would be picked up. Would you talk to me about that again?

Dr. LANE. Yes, Mr. Cramer. We believe that, of the activities that previously were supported within that account, and there are two such activities—one is to support larger scale instrumentation, large spectrometers, computational equipment, nuclear magnetic resonance instrumentation—instrumentation that is at a level too large for single grants, and that perhaps would be at the departmental level shared by many people in a department or on a campus, that level of instrumentation was provided by a competitive, peer-reviewed process using half of the money in the account. That has been the case in recent years.

We would continue to make that same amount of money available—$50 million—but we would do it within the Research and Related Account.

The part that we are eliminating is the other $50 million that was supporting the modernization of laboratories—the replacement of air handling equipment, the moving of walls, the refurbishment, the bricks and mortar, to put it simply. It is not that that is not important or that the universities do not need it. It is simply that in setting priorities in constrained budgets, our feeling was that, given the magnitude of that problem across the nation and the relatively small impact of the NSF's part of that, that our funds would be best spent in these other areas.

Mr. CRAMER. All right.

Mr. Chairman, in spite of the fact that I believe I have additional time, that is all the questions I have. I will yield back.

Thank you, Dr. Lane.

Mr. SCHIFF. I thank the gentleman.

Now I have to be in the situation of saying do as we say and not as we do, because both I and our Ranking Member took over five minutes, but just because we have several Members here now, which I am very pleased to see and I am glad there is interest, I am going to ask Members to try to stay within five minutes.

If Dr. Lane and Dr. Petersen can stay, I will offer a second round. I will not take a second round to make up for the extra time.

With that, Mr. Gordon, you are recognized for five minutes—oh, I am sorry, Mr. Luther, you are recognized for five minutes.

Mr. LUTHER. No questions.

Mr. SCHIFF. Mr. Luther has no questions.

Mr. Boehlert, I believe you are next. You are recognized for five minutes.

Mr. BOEHLERT. Thank you very much, Mr. Chairman.

Welcome, Dr. Lane and Dr. Petersen. I admit at the outset that I am captain of the cheerleading squad for NSF, so maybe this is going to be some of your easier questions.

A couple of things come to mind.

First of all, let me compliment whoever wrote this document, because on page 6 I read something that really sort of warms my heart. It says:

"Educating today's students in a discovery-rich environment will better prepare them to meet tomorrow's challenges. Likewise, history has shown that research in an education-rich environment yields an exceptionally dynamic and diverse enterprise."

At long last we are beginning to realize there is a linkage between research and education, and I compliment you for beginning to focus on this and for that initiative in the integration of research and education.

Too often I have found from my experience—and this is my fourteenth year on this Committee—that the research universities really do magnificent work and I applaud their outstanding work, and sometimes forget about the educational component of their mission.

So let me just compliment you and encourage you. I know Dr. Ehlers probably will share that view, too.

Now as I look at the long-range projections, I am not particularly happy with either side. Because what we are looking at, it seems to me, throughout the beginning of the next century is sort of level funding for NSF when we factor in inflation.

Quite frankly, I plead guilty. I would like to be a bigger spender, because I think we have got to establish some realistic priorities, and I am concerned when you have to zero-out the Facilities account. I am concerned about the inadequacy of funding for instrumentation.

I am concerned, for example, as I look at this budget presentation to see that the Supercomputer Centers account is not doing particularly well, all things considered. As I view it, its projected growth really is about 2 percent.

Then we hear the possibility that we are going from four magnificent centers that make us preeminent in the world to the possibility of only two centers.

Can you address that subject, please?

Dr. LANE. Mr. Boehlert, I thank you for your comments about our efforts to do more to emphasize the importance of integration of research and education. We feel very strongly about it. We put it down as one of our four core strategies in the strategic plan.

It largely describes our priorities in this budget. As I indicated earlier, those priorities reflect our priorities for the next several years.

We appreciate your strong encouragement through the years for us to look harder at how our programs can, in fact, help the universities make the changes that are needed.

On the issue of the budget for the Supercomputer Centers and the change in the program, the budget reflects tough times and hard decisions. We realize that there are risks involved in all of these things.

We know that there are outstanding people working in this area, and we are confident that the new program will be an exciting program and that we will be able to move seamlessly from the current one to the new one with the budget that is provided.

But there is not a lot of room in there.

What do I think about this?

I believe that, were our budget situation better, a more conservative approach perhaps would have been to stay with the original program and extend from there at least for some period of time in the future, because it has been an outstanding success story.

It has revolutionized the way science is done, the way scientists interact with one another and, unexpectedly, through the development of the NSF Net and the Internet, the way everybody interacts not only in this country but around the world.

We are very proud of our involvement and our role in that partnership with other agencies and institutions. We think it has been extraordinarily successful.

The centers themselves have played a key role. The development of Mosiac at the Illinois Center by students really led to—really gave us the trick in being able to handle the Internet where all this complex information is available and is hard to find.

So we believe it is a tremendous success story.

There have been changes, however, through the years. New technologies have come along. Many, many other kinds of centers have developed around the country that have unique capabilities that we feel we can take advantage of for the scientists and engineers, researchers and educators.

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So we think that—I thought, I should say, that it was important to have a group of experts have a look at this. So we asked Ed Hayes, Vice President Chemist at Ohio State University, to chair a panel which we put together to help us with realistic budgets over the next several years and tell us how best to set up this program.

I think it was an outstanding report. I had people tell me it was a model of what future task forces dealing with these complex problems really ought to look like.

We followed their recommendations really quite closely. We took to the Board the recommendation of a new program, which anybody can compete for, that spreads out a little bit the base, that takes advantage of this broader capability now out around the country, which in fact was caused by NSF's efforts in advanced scientific computing for the past decade.

We want to take advantage of that. We want to build that into the partnerships. So the new program will do that.

We are very optimistic about it. We think it is an excellent program. We simply want to ensure that, while we go through this transition, that the science, in fact, remains as exciting and that the scientists are as well-supported as they ever have been. So we are optimistic and we are very excited about it.

Mr. BOEHLERT. Dr. Lane, that is a very diplomatic response, and I would expect that from someone as skilled as you, but it seems to me we are diminishing the commitment to our centers of excellence, and sort of diversifying more. I like the idea of diversification, but if I could draw an analogy.

The baseball season is starting shortly. I can recall from history, not from first-hand experience but from history, reading about the famous "murders row" for the New York Yankees back in the late 1920s, and I'll tell you what. Nobody thought in terms of sitting Ruth or Gehrig down because we wanted to bring up some rookies from the Minor Leagues.

The point is, I think we should build upon it. As we are looking at priorities, it seems to me you are lessening the commitment to the Supercomputer Center initiative by virtue of the commitment of dollars at a time when probably we should think in terms of expanding the commitment.

I know that dollars are tight. Believe me I know that. I stand ready to vote for more dollars for some of the programs that have a high priority, just as I am willing to say to some people, sorry, you cannot have as much as you want, and I am willing to cut other programs.

Thank you very much. I know my time is up.

Dr. LANE. Thank you, Mr. Boehlert.

Mr. SCHIFF. Thank you, sir, for your fine questions.

Mr. Baker?

Mr. BAKER. Thank you very much, Mr. Chairman. Thank you for holding the hearing, and thank you for the Doctors being here to explain their budget.

This is probably one of the least partisan committees both under Mr. Brown and now under Mr. Walker, but the commitment to a balanced budget has been universal.

In each of Bill Clinton's speeches he talks about it.

We intend to do it.

So you have in front of you a chart, not withstanding the nonpartisanship, which explains the difference. I am going to ask for your cooperation here.

In the first line, the top line, is what I would politely call an election year blip. You mentioned that you are going to have more money to spend next year, and increasingly less in future years.

This, shall I say, election year blip line—and I will not mention whose budget it is, but it does happen to come from the Administration—you go along high, and then start dropping. Then after four years, magically you really go into the toilette.

The second line is a more level line. It says, yes, we realize our commitment to live within our means and we will slowly work with all of the agencies to try and get there.

In the two outyears, we are better off. So what the top line says is. Well, we hope these people go away and we hope we can go back to deficit financing. The bottom line says. We know that the whole world forces us to live within our means, and we are going to have to get there in a patient, slow way. But in the end we will be a lot better off.

I am asking you if you will cooperate with the Committee to take that blip out and begin the tough job this year so that in five years we are going to be better off from then on. Because, just like Sheri said, there are those of us who believe in Supercomputing. We believe in the fact that we want to have education in the schools by scientists.

In my area, the Livermore Lab spends a lot of their time, personnel time, out in the schools and it is very, very helpful. So none of us wants to cut these budgets. But the numbers we get from the Appropriations Committee are inflexible.

We are not. Despite Sheri's willingness to vote for more spending, the rest of the House is not going to let us do it. So we have to get there in a patient way, and we will end up better off if we take a slow, patient way to do it.

Are you willing to work with this Committee and help us achieve this end?

Dr. LANE. Well, Mr. Baker, there is no question that I am willing to work with this Committee.

I cannot comment on all the competing priorities—it would not be appropriate for me to do so—of all the things that appear under the nondefense discretionary spending profile.

It would, however—and I understand that as we balance the budget we will have to find the money some place. However, I really do not think it is self-serving if I say that it would be irresponsible for me to say that this nation should, in fact, cut its investment in the future of its children and its grandchildren.

That future is in science.

That future is in technology.

That future is in education.

NSF is an agency that integrates those things and that holds to the very high standards all the decisions we make by using expert opinion to make those decisions.

I just feel that it would be irresponsible on my part to say that that is the place we should go to find the money.

Mr. BAKER. Dr. Lane, the people in the Entitlements Committee and the Education Committee, and the Welfare Committee, and every committee we talk to, have the same feeling. We are here because we care about science, not because we came to cut it.

Dr. LANE. Right.

Mr. BAKER. Okay? We agree with you.

But that feeling is throughout Congress. We did not get to $5 trillion overnight. We added $200 billion a year. They have told us. No more. So we have to do our part.

My question again is. Will you help us get there in a painless way? Or are we going to go a partisan way?

The partisan way is, we take your TV program and wave it like a bloody shirt and show that, beyond a reasonable doubt, you are wasting all your money. That is the partisan way—the election year blip way. We do not want to do it the other way.

By golly, we are going to spend more on you, and you can count on us.

Dr. LANE. Well, Mr. Baker, I am here to defend the President's budget. I think it is an appropriate budget for NSF. It is not a large increase that has been presented, but certainly a very good budget in difficult times.

Mr. BAKER. I will conclude my questioning by saying. To raise people up to drop them farther down is not probably a good thing in physics. It is probably not a good thing in budget.

Dr. LANE. Well, Mr. Baker, I certainly will tell you that we will do everything we can to ensure that the planning that we have in place, especially for things that have long, long playouts, implications for many years down the road, will certainly take into consideration the uncertainty of the budget and that these are difficult times.

Mr. BAKER. You hit the key word.

In Livermore Lab they are going to cut their budget. I know that. Everybody knows that. It was recommended by the Department of Energy—not the mean-spirited Republicans in Congress.

The only thing I asked the Department of Energy was, no, not that I'll vote for more money for the labs—of course I will, and Sheri will join me—but we are not going to get away with it—so I asked them, please give us a certainty. Tell us what the budget is going to be next year, and the year after, and the year after.

They promised to do that by next week.

What does that do? That allows me and the Department of Energy to go to those employees and say. This is what it is going to look like over five years. These are the retraining programs that are available. These are the other science slots that are available. Let's help us help you get through that.

By artificially raising your expenditures and then dropping you on your head, you are not being fair to your employees, and you are not being fair to the science budget.

That is all I am asking. Cooperate with us. We are not after you. We are on your side.

Mr. SCHIFF. The gentleman's time has expired.

Mr. Ehlers?

Mr. EHLERS. Thank you, Mr. Chairman.

First of all I would like to assure Mr. Baker that he is absolutely correct that physicists do not like to lift people up and drop them.

[Laughter.]

Mr. EHLERS. However, I also assure you that if it does happen, we can help you calculate how soon they will hit the ground, and how fast——

[Laughter.]

Mr. EHLERS. (continuing) and what their velocity will be when they hit.

I would like to associate myself also with the comments of my comrade from New York, Mr. Boehlert, who made some very wise observations.

They key issue here, and one we have to communicate to the public and, to a certain extent, to our colleagues is that the future economic base of this country two, three, and four decades from now rests on the decisions we make this year about supporting science because of the economic engine we have today that is a result of the sacrifices our parents and grandparents made in funding science research 30, 40, and 50 years ago. The same now holds true.

I believe if we do not provide the funds for basic, fundamental research and science that is going to fuel the economic engine of the future, we are doing just as good a disservice to our children and grandchildren as we are when we do not balance the budget.

So this leads to very difficult decisions. But I will join my colleagues certainly in trying to do what we can to maintain effective science research programs in this country.

I will not go into detail on the budget. I have discussed this privately with both of the witnesses. I think it is very important for us to proceed with some of our major projects, such as the millimeter array radio telescope, also the superconducting cyclotron, and there are a number of other areas—the NSF's participation in the large Hedron Collider at CERN—all of these are important projects, and I encourage their continuation and their funding.

But in addition to those, the essence of NSF is thousands and thousands of individual investigators across the Nation doing outstanding research on behalf of our country. That is the unique role of NSF that they perform very, very well, and that we have to support and communicate to our colleagues and to our country.

I hope we can do that effectively.

On a point related to that, I have circulated a letter trying to ensure full-year funding for NSF as soon as possible, if we continue to drag along with continuing resolutions.

Because of the nature of NSF and their grant-making mechanism, this has jeopardized a great deal of scientific research in this nation because they simply cannot make grants without an assurance of their funding for the year. So we have many investigators and scientists across the country who are unable to receive funding from NSF.

They will not receive their grants because Dr. Lane cannot promise money that he doesn't know that he has. I think it is incumbent upon all of us on the Science Committee to work toward assuring full-year funding for NSF, as well as NOAA, their scientific enterprises in NOAA, NASA, and so forth, as soon as we can.

I am hopeful that next week we will produce a budget that the President can sign. But if we cannot, I hope we can at least in the next Continuing Resolution provide full-year funding for these scientific enterprises because it is really starting to hamper and hurt the scientific enterprise in this country.

Having made that impassioned plea, Mr. Chairman, I will not ask any questions, since you are anxious to cut short the time, and I yield back the remainder of my time.

Mr. SCHIFF. I am not that anxious, Mr. Ehlers.

Mr. EHLERS. That is fine.

Mr. SCHIFF. Mr. Barton?

Mr. BARTON. Thank you, Mr. Chairman.

I have only got one question. I am not going to talk about the numbers. You have been asked about that a number of times, I am sure.

I want to read a few statements from your budget summary and then ask one question.

The first sentence in the statement says: "The National Science Foundation requests $3.3 billion for fiscal year 1997 to invest in almost 20,000 research and education projects in science and engineering."

I want to skip down to the second paragraph. "That mission, to promote progress in science and engineering."

I want to skip down to the third program. ", ... certain activities, notably investments in research facilities, have been held constant in order to strike the balance necessary to extend the frontiers of science and engineering."

The fourth paragraph. "Fundamental science and engineering".

The fifth paragraph. "Providing ... the United States to uphold a position of world leadership in science and engineering".

So that on the first page, the words "science and engineering" is mentioned in every paragraph. I offered an amendment to change the name of the National Science Foundation to National Science and Engineering Foundation. Chairman Walker called you and said that you opposed the name change.

In the first page of your statement, everywhere you mention the word "science" you also mention the word "engineering."

I am a registered professional engineer. The National Society of Professional Engineers very much wants to have the name changed. My Texas Society of Professional Engineers very much wants to have the name changed. We will raise the money to change the letterhead.

[Laughter.]

Mr. BARTON. We will raise the money to change the name on the building.

So, Mr. Director, I would like for you to seriously consider next year, or this year I guess, when I offer the amendment again to think about being supportive. And if you have got some comments, I would be happy to hear your comments.

Dr. LANE. Thank you, Mr. Barton.

We clearly take engineering as an important part of our charge, and that is why it is in there and all the places that it is.

The reason I opposed the change is not the cost of the letterhead, but I do appreciate your offer on that one. It is because NSF is also very much about learning. It is about education.

The research we support in engineering is primarily fundamental engineering. "Engineering" is a much broader area, a much broader enterprise than "science" is. Pretty quickly we would, I think if we wanted the title to really represent the kind of things NSF does, we would need "education" in the title as well as, and then maybe "research," and it starts to become cumbersome.

Mr. BARTON. But we have a Department of Education. Engineering is a profession. I did not offer the amendment in a trivial attitude. I offered it because the engineering societies of our nation, which I happen to think are the greatest engineers in the world, strongly feel that they are the stepchild of an agency in which the charter very specifically names engineering as a separate function of the Foundation.

Now I do not want to belabor this because the Chairman has been very kind, and you have been here for two hours, but I do want you to know this a serious effort.

We had a fairly close vote. It would have passed, I think, if you had indicated support, which you did not. So I just wanted to take this opportunity to make you aware that we are going to keep trying and hope that we can work together and get you to change your mind.

Dr. LANE. Thank you, Mr. Barton.

Mr. BARTON. And with that I will yield back to the chairman.

Mr. SCHIFF. I thank the gentleman.

Dr. Lane and Dr. Petersen, I am going to have to go in a moment because I am due on the House Floor. In a moment I am going to ask the Vice Chairman of the Full Committee, Congressman Ehlers, to chair in my place, but then recognize Mr. Olver and any Members for a second round if they choose.

Two things.

Just so we are clear on the two matters I have asked you about, I am asking whether the extended figures for the year 2002 that you told us about are connected to the CBO-scored budget or to any other budget.

And second, whatever figures you have been given from the Administration, that you provide them to all the members of the Subcommittee, if you would.

Also, I have some more technical questions that I wonder if you would be willing to answer in writing. Therefore, I presume there would be no objection to that?

Dr. LANE. I would be happy to do that, Mr. Chairman.

Mr. SCHIFF. I know that, Dr. Lane.

So I am going to give all Members one week to send whatever questions in writing that they might want to ask, and would ask you to respond in two weeks, if you could.

Without objection, the record of the hearing will remain open for 30 days so that we can get these questions and answers back and forth on the record.

[The following information was received for the record:]

SCORING OF NSF BUDGET

The NSF budget out-year figures FY 1996 to FY 2002 are from the President's FY 1997 budget and are consistent with CBO scoring.
The figures for major NSF accounts are presented in the table below.

PRESIDENTIAL POLICY BUDGET AUTHORITY

	Millions of Dollars						
	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
Research and Related Activities	2,314	2,472	2,473	2,474	2,475	2,549	2,628
Education and Human Resources	599	619	619	619	619	636	654
All other accounts	306	234	223	211	200	217	236
Total, NSF Discretionary	3,219	3,325	3,315	3,304	3,294	3,402	3,518

Mr. SCHIFF. With that, I am going to ask Congressman Ehlers—I am going to recognize Mr. Olver for five minutes, and then ask Congressman Ehlers to chair.

Mr. OLVER. Thank you, Mr. Lane.

I am sorry that my colleague from Texas has left. I was just going to say that I don't think that you should be particularly responsible for the inferiority complex from which engineers suffer while basking in the scientific-reflected light.

In any case, I wanted to ask you, because we had a panel a few days ago—I seem to return to this on a number of occasions—but we had a panel a few days ago of key advisory panel, a Presidential Advisory Panel, that suggested that we should attempt to be preeminent in many scientific areas, but certainly world-class in all scientific areas.

We had a little bit of a discussion about what being "world-class" meant and, while I do not think that we necessarily all agreed in the four-member panel at that time, I think there would be general agreement that being world-class meant that in a major scientific area we were one of the handful, five, plus or minus one or two, something like that, of the best programs in the world in that scientific area.

I am wondering, in the areas that you cover, the scientific and research areas, are there any in which you would say we are not world class?

You can take this in a very narrow sense, I suppose, or you can take it in a rather broad sense. Broadly, you can talk about geology, or neuroscience, or you could take it down to fairly narrow issues like high-speed computational capacities which we got to in a hearing a day or so ago, and where the panelists at that time said we are absolutely preeminent, and there is only one other place, it seemed, that was world-class and in danger of making us—that might be in danger—from which our preeminence might be in danger.

So I guess I could ask you to answer the question with sort of a broad brush.

Dr. LANE. Mr. Olver, I have some difficulty with this distinction that is being talked about. I entirely agree that, given the advancement of science across the world, that all the major discoveries are not made in this country. In fact, it was never the case that they were, and that will not be the case in the future, and we should feel good about that.

Much of that advancement of science across the world is due to leadership this country has played in making the world a better, more secure place.

I would find it difficult to decide that the United States was going to sort of be second in some field or other, was not going to be preeminent but be world class. I think that is a distinction that is difficult to make.

What I would have real trouble with is if the United States found that it was, in fact, not making some of the major discoveries in all the important fields of science.

There may be subfields where that is not happening right now, but I am not aware what they would be. My belief is that in all the important areas of science this country, scientists, researchers in this country, are making breakthroughs and important advancements all the time.

So I am not sure it is easy, and you did not indicate it was necessarily easy, but I am not sure it is such a good strategy to try to draw the distinction too sharply.

Where I think we are at great risk——

Mr. OLVER. You are the one that is drawing it sharply. I think you said you would find it difficult to even contemplate the U.S. not being, I think, almost preeminent. I think I don't find it difficult with drawing the distinction so that we are never less than world-class, and I don't know how we could expect to be preeminent in all scientific fields. That is a measure that is probably beyond our capacities, nor even beyond our arrogance.

Dr. LANE. Yes. Mr. Olver, I miscommunicated and I apologize. I do not, by any means, believe we can or should expect to be preeminent in every field of science. But unless we push as hard as we can, then we are not going to be world-class. I do not see any evidence for that in the past, and I certainly would not believe it would occur in the future.

We do not ask our scientists to sort of be very good but not excellent. We do not ask our institutions to push pretty hard, but not try to be the best. This country does not try to be good, but not the very best.

So that is all I really meant to imply; that somehow the motivation there, the incentive, has to stay there because this is tough stuff and it is not going to happen unless we are very, very aggressive.

Mr. OLVER. How do you think this relates to our interest in cooperation in major scientific areas, major what you might call "big science projects" that we have on the table or that we might have on the table in the future?

Does our need to be world-class or preeminent somehow make it—have any implications for the capacity for cooperation in broad fields, which obviously means that there is a great deal of openness in who is able to use, and what the data are available for.

Dr. LANE. I think there is no conflict between cooperation and competition in this regard. And I believe for large, expensive facilities, international cooperation makes a lot of sense.

We hope that we will, in fact, be doing more of that. Certainly in the case of high-energy physics where the Large Hadron Collider

(HC) is a facility that our scientists want to use, we certainly should make it possible for them to do that.

In the meantime, and probably for all time, we will be building facilities that scientists from all over the world will want to use, as we are now.

Mr. OLVER. Should these cooperative efforts be proportionate? Are we going to allow that one be the first among equals, that someone else may be the first among equals in some projects? Is there any problem with that?

Dr. LANE. That is a very tough question. I wish I knew the answer.

My feeling is that there is some problem with that, but it is a very difficult question.

Right now, for example, our telescopes that we have made substantial investment in are available for the world. There is a peer-review process where the best ideas and the best people can work at these facilities.

Many of our other large facilities are available to the world of scientists in that same way. That reciprocity is very good for science. It means the best science gets funded, as opposed to the best science within some subcategory of more deserving folks.

Science is going to prosper if we can keep peer-review of the way in which the decisions are made.

So I think there is a problem, but it is a very important question and a very difficult one in dealing with these large, expensive projects. I don't have the answer.

Mr. OLVER. Is there enough money——

Mr. EHLERS [presiding]. The gentleman's time has expired. I will let you ask this one final question.

Mr. OLVER. Do we have enough money investing—are we investing, or is there a proposal to invest enough money to make certain that the general principles that you have put forward are going to be met?

Are the proposals in the budgets by the President, or those which have been under discussion for this year and the planned expenditures there for the next few years, are those enough to do what you are suggesting I think in broad form?

Dr. LANE. I don't believe that the analysis across all of the investment, federal investment, has been done to the extent that I could answer that question confidently in the affirmative, but it is an issue for the fundamental Science Committee.

We talk about this all the time. NSF, I can say——

Mr. OLVER. You cannot answer confidently in the affirmative? That is a fairly circumspect statement.

Dr. LANE. Well, my feeling is that the plans of the individual agencies do appropriately take into account the need for international cooperation and making available to our scientists access to these facilities.

The LHC is a good example where that planning is underway. But what I simply do not know is when you add all the pieces together with all of the programs of all of the federal agencies that support science, I think you were asking about the totality, and that is what I do not know the answer to.

Mr. OLVER. Is there enough in the NSF, in the programs under NSF that you support, to foster at least world-class, if not preeminence, in that rather broad combination of things as we have talked about?

Dr. LANE. I am worried about it.

Mr. OLVER. You are worried about it.

Dr. LANE. I cannot assure you. That is why I answered the question the way I did earlier, that with decreasing real buying power in the NSF budget we are going to be able to remain world-class in all the important fields of science. I would not be able to tell you that I thought that was the case.

Mr. OLVER. Well, recognizing that you cannot ever be absolutely certain about what will be the right number, your worry concerns me. I wish it were possible to quantify with some degree of understanding of what the margins of error are on a quantification, you know, what the limits are and whether we are doing it or not doing it, and what the dangers are that we may not be doing it. Because we should not be not doing it.

Mr. EHLERS. The gentleman's time has expired.

Mr. Cramer had some additional questions.

Mr. CRAMER. Yes, and I will try to be brief.

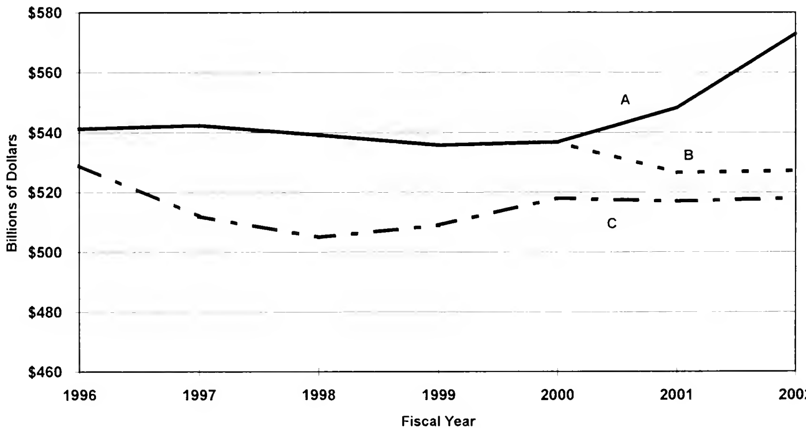
I am confused a bit by the chart, and rather than belaboring this point I have been looking at the budget figures myself, and I certainly would not chart it out that way.

The Chairman has indicated that he would leave the record open for 30 days, I think he said, and I would like to, as well—and he made reference to the fact that we could submit additional questions to you, Dr. Lane. I would like to request of the Chair that the record be left open so that I and other Members can submit additional material, as well.

Mr. EHLERS. Without objection, so ordered.

[The following information was received for the record:]

DISCRETIONARY OUTLAY ESTIMATES



A/ The Budget of the United States Government, Fiscal Year 1997; Budget Supplement; Table S-1, Outlays, Receipts, and Deficit Summary; pg. 141

B/ The Budget of the United States Government, Fiscal Year 1997; Budget Supplement; Table S-12, Budget Summary Under CBO Assumptions; pg. 159

C/ Fiscal Year 1996 Balanced Budget Resolution, Chairman's Mark

Mr. CRAMER. Again, Dr. Lane, I do not see these budget figures being plotted the way they are plotted on this chart here.

I would ask you, as well, during that time to submit to us a plotting of these figures, as well, so that we can make sure we have an opportunity to clear that up.

Dr. LANE. For the NSF, Mr. Cramer?

Mr. CRAMER. Yes, for the NSF.

Dr. LANE. Surely we will do that.

Mr. CRAMER. Now I would like to jump into two other questions.

It is my understanding that the size of the NSF's work force has been fairly constant over the past several years while the programs have in fact grown.

Do you, in fact, have a staffing level and the resources needed to administer the various activities that you have carried on? And what has improved your productivity, which is what occurs to me would have had to have been improved.

Would you comment about that?

Dr. LANE. I think I would like to offer an opening comment, and then if I could ask my colleague, Dr. Petersen, to add to that it is correct that our staffing level has been roughly constant for a decade or more, while the budget has gone up substantially and the workload has gone up, as well.

We have found many efficiencies during that period in how we do work, and information technology has had a tremendous impact, as it has on other organizations in doing their work.

But there is no question. I can just give you an anecdote comparing my own experience of 1979-1980 when I was in the Physics Division to my observation now.

People are working much harder, and it is a much more complex work environment. It is a good story because there is lots of interaction across interdisciplinary lines with other agencies, all good kinds of things, but the workload is very heavy.

We continue to look for how to get more with the resources available by streamlining our activities and also by making use of new technologies.

May I ask Dr. Petersen to add to my comments, if you would?

Mr. CRAMER. Sure. Briefly, if you would.

Dr. PETERSEN. Thank you, Congressman Cramer.

I would be happy to just add that the reason that we've been able to do this at NSF, in addition to using good information technology and looking to every possible source of efficiency, is that we have a very remarkable staff.

The fact that we have increased our budget over the past 10, 12 years from about a billion to $3 billion, with increases in workload and programs with a level staff, I think is truly remarkable.

This is a very dedicated work force. We are stretched very thin at this point, and we are very worried about future cuts if we have a similar workload.

I think we have explored every possible efficiency, and it may not be possible to stretch further.

Mr. CRAMER. If I could then, quickly, according to my notes your NSF budget request provides $5 million for an increase in the Advanced Technology Education Program.

Now that supports a curriculum and faculty development at two-year colleges, which are very important in at least my area.

Would you give us a progress report on this? I understand that is a relatively new program. Describe how the increased funding will be used.

Dr. LANE. Could I ask Dr. Williams to respond to that?

Mr. CRAMER. And if my time has expired, Mr. Chairman, perhaps they could provide me with that information.

Mr. EHLERS. It has not.

Dr. Williams?

STATEMENT OF DR. LUTHER WILLIAMS

Dr. LUTHER WILLIAMS. As you indicated, Congressman Cramer, this program was started several fiscal years ago with the particular purpose of ensuring from a science and math base, adequate preparation in terms of work force.

The program essentially has three components. It combines the last two years in high school, 11th and 12th grade, with the first two years in a community college.

So it requires a partnership between a collection of school districts and two-year colleges.

Occasionally four-year institutions are affiliated with them also.

The other obligatory partner is a local industry. A variety of those, for example, are in your state in the Huntsville area. But that is how we create this triumvirate between the three players.

The program has been really quite successful. It has resulted in—I would argue that at least from a scientific and technical perspective it is serving to revitalize community colleges, because it has given them really a very challenging agenda that is yielding very high returns.

The returns are measured by the rate at which the graduates of the program are being employed in the local industries, and of course that information is being communicated to the colleges.

The program has grown over the three years, and we are now requesting—as it is one of our highest priorities within the education and human resources directorate——

Mr. CRAMER. Would you use the additional monies then to expand the program?

Dr. LUTHER WILLIAMS. It will be to expand the program. As you know, we have six or seven large comprehensive centers around the country.

These monies will be used to expand the program, but in particular they will be used to bridge the linkage between the community colleges and the industries.

For a very modest amount of money, we can leverage a major contribution from the participating industries.

Mr. CRAMER. I congratulate you on that program.

I think it makes a lot of sense and accomplishes a lot of things that I would like to see accomplished.

Thank you for that information. Thank you, Mr. Chairman, I yield back.

Mr. EHLERS. Thank you, Mr. Cramer.

I believe we have completed all the questions that anyone wishes to ask.

Thank you, Dr. Lane and Dr. Petersen, and your staff, for being here.

Dr. LANE. Thank you, Mr. Chairman.

Mr. EHLERS. We appreciate your work at the Foundation. We wish you well in the future, and we will certainly do whatever we can to make your path smooth, even though not paved with gold. Thank you very much.

Dr. LANE. Thank you.

Mr. EHLERS. With that, the meeting is adjourned.

[Whereupon, at 11:07 a.m., Friday, March 22, 1996, the hearing was adjourned.]

[The following material was received for the record:]

RESPONSES OF DR. NEAL LANE TO QUESTIONS FOR THE RECORD

BACKLOG OF FACILITIES MODERNIZATION

QUESTION: Since 1990, NSF has spent about a half billion dollars for the modernization of the research facilities at colleges and universities. Current reports document $8- $10 billion worth of needs. With the FY 97 request, NSF is proposing to terminate the facilities modernization program. How is the Administration handling the backlog? Is this problem under control? Why is NSF proposing elimination of this program?

ANSWER: Since passage of the Research Facilities Modernization Act of 1988, NSF's Academic Research Infrastructure Program has awarded a total of $253 million for facilities renovation. The NSF investment over the past seven fiscal years represents less than 3% of the estimated current needs. Recipients of these awards have provided cost sharing at approximately this level, bringing the total impact of the NSF investment to approximately 5% of the estimated current need. NSF's last two surveys of facilities needs suggest that the level of need is stable at approximately $10 billion. These surveys also showed that state sources of support and the resources of the institutions themselves provide the largest portion of support for facilities modernization, totaling 76% of the total investment. Private donations from foundations, industry, and other sources accounted for another 10%. NSF support represented a small portion of the resource pool available to meet these needs. It therefore appears that sources of support other than NSF have stabilized the facilities modernization backlog at the $10 billion level. For these reasons, NSF believes that construction of specialized research facilities are a higher priority within the NSF investment portfolio.

Appropriations for ARI Facilities Modernization

[Millions of Dollars]

FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
$20.0	$20.0	$16.5	$37.5	$52.5	$56.5	$50.0

NON-FEDERAL FUNDING FOR FACILITIES

QUESTION: You state in your written testimony that no funding is requested for the NSF academic research facilities program because you have concluded that funding for facilities renewal can be found from non-federal sources.

a. Is it not the case that federal funding has never been the sole source of support for facilities modernization but has provided an important component of support, which has successfully leveraged non-federal contributions?

ANSWER: NSF support for facilities modernization from FY 1990 to 1996 represents an investment of $253 million. Awardee institutions provided a roughly equal amount in cost sharing, bringing the seven-year total to approximately $500 million. In contrast, a recent NSF survey indicated that non-Federal sources contributed approximately $3.1 billion toward renewal of facilities in just a two-year period

(1992-93). These data suggest that NSF funding is a relatively minor source of support for facilities modernization.

b. Why do you now believe that no federal role is appropriate for addressing the facilities problem, which NSF has documented? Why do you believe that the states and private sector will suddenly step in to solve the problem?

ANSWER: In proposing elimination of the ARI Facilities activity, NSF is not asserting that there is no federal role for addressing the facilities problems on the Nation's campuses. Rather, this decision reflects the realities of the current budget climate and NSF's belief that its limited resources will have a much greater impact through investments in specialized research facilities. The ongoing need for state-of-the-art platforms for cutting-edge research is another aspect of the facilities problem—one in which NSF can take a leadership role and have a major impact. Based on their past commitments to and investments in construction and renovation projects, NSF considers state governments, educational institutions, and private donors to be appropriate leaders for modernization of research facilities.

ESTIMATES OF NEED FOR FACILITIES AND INSTRUMENTATION

QUESTION: Last March, the Committee on Fundamental Science of the National Science and Technology Council released a report entitled: "Academic Research Infrastructure: A Federal Plan for Renewal." In the section on needs for and support of research infrastructure, the report recommends that federal support for instrumentation and facilities be increased by the amount of inflation—defined as increases of 3% each year—plus $300 million over the five year period of FY 1997 through FY 2001.

a. What has changed since last March? Are NSF's past estimates of facility needs inaccurate?

ANSWER: During the past year, NSF, like all federal agencies, has re-examined its priorities and has focused on those activities for which it is uniquely equipped to take a leadership role. This effort to ensure a balanced and highly effective investment portfolio has involved a careful reappraisal of the Nation's needs for academic research facilities. NSF stands by its past estimates for the needs of research facilities on university and college campuses. However, specialized one-of-a-kind research platforms represent another component of 'the facilities problem.' American leadership in research and education will require a new generation of specialized research facilities, and NSF is uniquely qualified to act as the federal steward for this effort.

b. For the long-term health of the academic research enterprise, is it prudent to continue to under-invest in infrastructure?

ANSWER: One of the core strategies articulated in NSF's 1995 strategic plan, "NSF In a Changing World," is strengthening the physical infrastructure for research and education in science and engineering. Several recent NSF surveys have estimated a roughly $10 billion need for modernization at academic research facilities and a total rate of investment of approximately $1.5 billion per year from all sources. NSF support is an extremely small portion of the current rate of investment in facilities modernization by states, institutions, and other sources of funding. In contrast, NSF support for specialized research facilities is a large and critical component of funding. Underinvesting in these world-class research facilities would erode U.S. leadership in many important research areas.

FY 1997 INSTRUMENTATION PROGRAM

QUESTION: Although the NSF Academic Infrastructure program has been terminated in the proposed FY 1997 budget, funds have been made available within the research directorate budgets to continue support for the acquisition of large scientific instruments by universities.

a. What is the rationale for eliminating the centralized instrumentation program? How will instrument awards be made? Will each directorate operate a separate solicitation?

ANSWER: NSF intends to continue a centralized instrumentation program despite the proposed elimination of the Academic Research Infrastructure program. Most of the instrumentation support provided by NSF has come from the Research and Related Activities account, either as part of research grants or as awards from instrumentation programs administered by divisions and directorates. For this reason, NSF believes that support for instrumentation is most appropriately managed as part of the research directorates' budgets. The instrumentation funds previously managed through the ARI account will support an NSF-wide competition for instruments that are generally more expensive than those supported through other programs. The management plan for this Foundation-wide activity is in the development phase but there will certainly be a high level of coordination across organizational units.

b: How did you determine the allocation of funds for instrumentation among the directorates?

ANSWER: While funds for the centralized instrumentation program were budgeted across the NSF research directorates according to the directorates' relative shares of the NSF budget, the funded allocations will be based on the quality of the proposals received.

REVIEW OF U.S. ANTARCTIC PROGRAM

QUESTION: The Congress asked the Administration to undertake a comprehensive policy review of the U.S. Antarctic program. Can you give the Subcommittee some sense of your preliminary findings? Further, the FY 97 budget requests $25 million for the South Pole Safety project. What exactly will this request provide? How important is this proposed investment? How does it tie into the long term plans for South Pole Station's redevelopment?

ANSWER:

Review of the U.S. Antarctic Program

Responsibility for the review of the U.S. Antarctic program was given to the NSTC Committee on Fundamental Science. The Committee completed its report and forwarded it to Congress on April 26, 1996.

The policy review concluded that essential elements of U.S. national and scientific interests are well-served by continued involvement in scientific activity in the Antarctic as carried out by the U.S. Antarctic Program. In particular, the Administration found that "maintaining an active and influential presence in Antarctica, including year-round operation of South Pole Station, is essential to U.S. interests." The influential presence of the U.S. in Antarctica helps maintain the existing state of international peace and stability on the continent. The science carried out in Antarctica, by researchers from 43 states, is of great interest and provides unique and crucial information in several disciplines. The report concludes that present U.S. policy and practice with respect to the USAP are well-justified.

A major recommendation by the Committee was that an external panel should be convened by NSF to explore options for sustaining the high level of USAP science activity under realistic constrained funding levels. The panel should be free to examine a full range of infrastructure, management, and scientific options, including reductions in scope commensurate with a range of budgetary scenarios.

Additional specific findings include the following:

- The National Science Foundation has implemented U.S. policy in an effective manner, especially by substantially improving environmental stewardship, by broadening the science program, and by privatizing some operational elements of the Program to reduce costs.
- The USAP research program is of very high quality and of great interest to a broad scientific community.
- At the current level of investment, the USAP is cost effective in advancing American scientific and geopolitical objectives and, from a science perspective, supports the continuation of three stations with year-round presence.

The USAP should give highest priority to correcting critical health, safety, and environmental issues at the current station at the South Pole.

South Pole Safety Project

The existing research station at the South Pole has exceeded its designed duration. The station's general infrastructure has deteriorated, and it is increasingly costly to maintain activities within acceptable risk bounds. The $25 million requested for FY 1997 for the South Pole Safety Project would provide specific upgrades to address critical shortcomings in the heavy equipment maintenance facility and associated work shops, the power plant, and the fuel storage facilities:

- Heavy Equipment Maintenance Facility and Shops ($7.96 million): Specific concerns to be addressed include (1) the absence of exhaust ventilation systems capable of maintaining hazardous airborne contaminants to within acceptable levels, (2) lack of fire suppression systems in an area where presence of fuels, lubricants and other flammable materials is required, and where ignition sources are present, and (3) minimal facilities and equipment for working on the large, heavy industrial vehicles used at South Pole Station.

- Power Plant ($12.49 million): The current power plant is operating at capacity, resulting in brown-outs and restricted operations. The existing generators are relatively fuel inefficient, the 20-25 year old power plant structure is severely overcrowded, and power distribution systems are past their intended life. The requested funds will provide new power plant structure, new generators, renewable energy equipment, water treatment and storage, and associated equipment.
- Fuel Storage Facilities ($4.55 million): Storage for up to 300,000 gallons of fuel is required at the South Pole. Fuel is currently stored in fuel bladders that have risk of leakage or major spills. Steel storage tanks are needed to meet minimum environmental standards. The fuel storage upgrade includes 10,000-gallon steel tanks with secondary containment for all tanks and fuel piping and pumping system. Their capacity will sustain the station for the eight months of winter isolation and through a possible emergency disruption to the annual fuel resupply.

The project costs include materials, labor, logistics for transportation of all material and personnel to the South Pole, construction support, inspection, and removal of construction debris. The location at the South Pole requires significant lead time for construction projects because of the lengthy procurement cycle, the shipping constraints (one vessel per year to deliver materials), and the shortened period for construction at the South Pole (100 days per year). All three upgrades will be completed by 2002.

The proposed investment is critical to address current safety, health, and environmental hazards. All three components of this request are "stand-alone," that is, they are independent of future decisions made on the station at the South Pole.

TRANSFER OF LOGISTICAL SUPPORT TO AIR NATIONAL GUARD

QUESTION: Please update the Subcommittee on the plans to transfer logistical support from the Navy to the Air National Guard. What are the rationale and advantages that accrue with the transfer? What is the current status of that effort and what is the current timeline NSF and DOD are working under to complete this transition?

ANSWER: NSF, the Navy, and the Air National Guard have developed a three-year transition to phase-in support by the Air National Guard and phase-out Navy's support. The Navy will be completely withdrawn by March 31, 1999.

The transition allows the Air National Guard to hire additional personnel—56 in FY 96; 115 in FY 97; and 68 in FY 98. NSF will provide $1.5 million in FY 96 for reimbursement of the first increment of transition costs. This will support the initial 56 personnel to the 109th airlift wing.

Appropriate memoranda of understanding for operation and maintenance of NSF's aircraft are being drafted, and the transition plan is being implemented. Many advantages result from the fact that the Air National Guard has a military mission in the Arctic in the Northern Hemisphere summer. Consolidation of the nation's fleet of ski-equipped C-130 aircraft will more effectively support Arctic and Antarctic logistics needs. Consolidation will result in more efficient operations and reduced costs: fewer total aircraft; fewer personnel; reduced training and maintenance costs.

REPLACEMENT OF SOUTH POLE STATION

QUESTION: NSF has been studying options for replacement of the U.S. Antarctic Program's South Pole Station. The current budget request includes funding for upgrades to certain facilities at the station. Is the proposed construction consistent with plans for an eventual rebuild of the station, or does it involve temporary fixes to facilities which will be replaced by a new station? What is the status of plans for rebuilding the station?

ANSWER: The proposed South Pole Safety Project reflects NSF priority for ensuring that our facilities at the South Pole are, to the extent possible, free of safety, health, or environmental hazards. All three components of this request are "stand-alone," that is, they are independent of future decisions made on the station at the South Pole. They are not temporary fixes, nor would they be replaced by a new station.

The current station is nearing the end of its useful life. Planning for rebuilding the station has been ongoing for over five years. A range of alternatives has been considered for station size and science support. One alternative examined for replacing the present station, while retaining cost-effective options for further expansion, costed-out at $181 million. Additional planning will take place based on the recommendation of the NSTC report for further cost-benefit analysis that examines the trade-offs between the size, lifetime, and capability of the station vs. the anticipated requirements of the science program.

PRIORITY OF U.S. ANTARCTIC RESEARCH ACTIVITIES

QUESTION: Congress has asked for the Administration to provide an analysis of the priority of the U.S. Antarctic research activities and the pros and cons of maintaining an Antarctic program at the current scale. Will this report address the need for a new, permanent South Pole Station? What process is NSF using to set priorities between infrastructure support for Antarctic and Arctic research activities and what is the timeline for decisions to proceed with construction?

ANSWER: To quote from the Administration's report: *"The NSTC reaffirmation of U.S. policy, including the need for a continuing U.S. presence at the South Pole, implies that by the time the Amundsen-Scott Station at the South Pole reaches the end of its useful life, it will need to have been rebuilt or replaced."*

The current station is nearing the end of its useful life. Plans for rebuilding the station continue to be discussed within the Foundation's long-range planning, and the timeline for decisions to request funding follows the planning process that is taking place through the spring and summer. Due to the present budget environment, NSF will conduct further cost-benefit analyses that examine the trade-offs between the size, lifetime, and capability of the station vs. the anticipated requirements of the science program.

Arctic and Antarctic infrastructure support are currently sized appropriately to meet the science needs in each area, which are very different in scope. Although NSF's FY 1997 Budget requests equal funding for research programs in the Arctic and Antarctic, ($29.10 million each), NSF's responsibilities and support of the infrastructure necessary to conduct Arctic and Antarctic research is fundamentally different. NSF alone serves as the Nation's manager of the USAP. The Foundation also supports a program of scientific research in the Arctic, as do 11 other Federal agencies. The scientific activities supported by NSF in these two regions are related, as reflected in the agency's decision to manage both programs in a single office, but NSF's mandated responsibility is broader in the Antarctic than it is in the Arctic. The differing responsibilities reflect geographical and jurisdictional differences between the two polar regions. The Arctic centers on an ocean covered by sea ice and includes land areas of populated sovereign nations (including the United States), whereas the Antarctic is a continent covered by thick glacial ice, isolated from any sovereign nation, governed by international Treaty, and lacking an indigenous population and infrastructure.

Because the United States has territory in the Arctic, its administration of arctic research is similar to its administration of research in other parts of the country, where Federal agencies perform or support research relevant to their missions. Twelve Federal agencies supported arctic research and associated activities in FY 95 at a combined level of $175 million; NASA and NSF were the largest funders at more than $40 million each. These figures do not include arctic research supported by the State of Alaska and the private sector. The National Science Foundation, in addition to its primary role of supporting fundamental research and education in science and engineering, has a special assignment under the Arctic Research & Policy Act of chairing the Interagency Arctic Research Policy Committee to promote interagency coordination.

Because the principal expression of U.S. interest in the Antarctic is scientific research, the National Science Foundation is tasked by the President to budget for and manage the entire U.S. national program there, including operational support, so that the program can be managed as a single package by a single agency.

UPDATE ON LIGO

QUESTION: Would you please provide the Subcommittee with an update on the Laser Interferometer Gravitational Wave Observatory (LIGO) program? Last year, the funding plan suggested that $55 million should be requested for FY 97. However, the new budget is proposing $70 million. Does this reflect some increasing cost beyond last year's estimates. What is the rationale for this increase request? Are you satisfied with the progress made over the past year?

ANSWER: NSF recently conducted an in-depth panel review of the cost, schedule and management of the LIGO project. The panel review concluded that LIGO construction will be completed within the estimated cost, schedule and scope and that the project is on track. Contracts for two of the three high-cost parts of the facilities have been awarded as planned and are within the expected estimates. The civil construction remains to be contracted.

The total cost of construction will remain at $272.1 million. The increased funding in FY 1997, from $55 million to $70 million, will preserve contract flexibility and reduce the risk of delays in the construction schedule. First, the increase will enable the civil construction to be offered in large packages which will provide optimal efficiency. Second, prompt initiation and funding of contractor activities will reduce costs and schedule risks arising from contractor delays which limit performance on other contractors. The current funding schedule has the estimated FY 1998 costs at $11.2 million, reduced from $26.2 million. The $15 million reduction offsets the increase in FY 1997.

PROGRESS OF GEMINI TELESCOPE PROJECT

QUESTION: How is the GEMINI telescope project moving ahead? What is the status of the international cost-sharing issue? Does NSF have any concerns about the international partners not being able to meet their financial obligations?

ANSWER: Construction of Gemini telescopes is proceeding according to schedule and cost estimates. The first primary mirror blank was shipped to the polisher in France in November 1995. The second blank was successfully fused at Corning in February 1996. Civil construction is well under way at both the Mauna Kea, Hawaii and Cerro Pachon, Chile sites.

Contributions from Brazil, Canada, and the U.K. are up to date. As of April 1, 1996, Chile and Argentina are technically in default of the Gemini Agreement with respect to their 1995 contribution. However, in both cases, we are optimistic that they will continue to participate and meet their obligations:

- In Chile, legislation to satisfy conditions placed on the 1995 and 1996 appropriations by the Chilean Congress is currently under discussion. While there has been no sign from that body of any ill will towards Gemini, there are complex issues—such as mining rights—connected with other projects that have slowed passage. The President of CONICYT (NSF's Chilean equivalent) has been given personal assurances by President Frei of Chile that commitment will be honored.
- In Argentina, there is also a great deal of enthusiasm for the project. Payment of the 1995 Argentine contribution has been held up by an internal discussion between the office of the Secretary of Science and Technology and CONICET (NSF's Argentine equivalent) as to how the payments should be handled between the two offices. We expect that this will be clarified within the next month.

SUPPORT FOR LARGE-SCALE RESEARCH FACILITIES

QUESTION: With these tight budget times and as we look at NSF's budget we find about 20-25% of the budget goes to large-scale research facilities—telescopes, research vessels, university-based physics facilities—these large-scale facilities could represent some pretty significant fixed cost for the Foundation as budgets get tighter. How do you plan to deal with the issue? Do you anticipate having to terminate support for some of these facilities and if so, what process will you use to help make these decisions?

ANSWER: NSF recognizes the challenges ahead and places a high priority on maintaining support for both individual and small groups of researchers and for large user facilities. Each is a critical component for ensuring the health of the U.S. science and engineering enterprise.

NSF has scrutinized its major research facilities very carefully during the past year. We have put in place a process, involving NSF senior management and the National Science Board, for dealing both with existing research facilities and with requests for development of new or refurbished facilities.

As noted in the FY 1997 Budget Request, we expect to keep research facilities at approximately 20-25 percent of the total NSF program budget. This will be done to maintain an appropriate balance across NSF's key program functions and to enable the construction of new world-class facilities that will advance human knowledge further. Individual programs are dealing with the research facilities they support. Some are being upgraded or reoriented now so that operating costs will be lower in the future. Others may be terminated or funding reduced. The facilities to be closed will be those of lower priority, as determined by the quality of research being done at the facilities, their role in keeping the U.S. at the forefront in science, the opportunities they provide for educating and training the next generation of scientists and engineers, and the overall benefits which accrue from the investment to the American people. NSF carefully tracks when funding expires for a given research facility so that rigorous examination of its efficiency, effectiveness and importance to the community can be undertaken in an appropriate time frame.

INDUSTRIAL SUPPORT FOR BASIC RESEARCH

QUESTION: Industrial support for basic research has been declining in recent years, particularly as large industrial labs, like the Bell labs, have been downsized, reoriented or closed. Is NSF concerned about these changes; does it place new pressures on NSF in its attempt to ensure the strength of U.S. research in the major fields of science and engineering?

ANSWER: NSF collects and disseminates data on industry R&D through the Science Resource Studies Division (SRS). SRS data show that over the past decade, industry's share of basic research has fluctuated between 24 and 30 percent. Industry activity in 1995 was within this range—25 percent ($7.2 billion). Industry shares of academic and nonprofit basic research support have also been roughly steady over the past decade.

NSF is very concerned about this issue and tracks the funding data carefully. NSF sponsors forums to discuss the implications of these data such as the recent American Enterprise Institute-Brookings Institution conference on the economic returns to research. NSF is also working with the National Science and Technology Council's Committee on Fundamental Science to understand better the needs of the industrial sector for fundamental research in various areas.

While NSF data do not show a substantial decline in overall industry funding for basic research, funding has declined in certain industries and in some of the large industrial labs. This can have a major impact on research in specific fields of science and engineering. For example, industry has made major investments in fundamental research in communications which has contributed to revolutionizing several fields. Over 80 percent of this industry's R&D expenditures come from AT&T and Bellcore, both of which are at risk because of major organizational changes triggered by deregulation. These changes form the backdrop for NSF's activities in networking and communications research.

Some studies indicate that Federal and private sector investments are directly correlated. Reductions in federal funding for basic research could trigger reductions in related industry-funded research which builds upon fundamental research. For example, the biotechnology industry has reported that it has almost completely mined the existing biological knowledge base. NSF plays a key role in creating this knowledge base and has responsibility for several areas of basic biology not covered by other federal agencies.

Reductions in industry-funded research can affect NSF in several ways. There can be increased competition for NSF grants as some exceptional industrial scientists move to universities. There can also be pressure for NSF to assume the activities of some of the large company R&D labs. In most cases, this is not appropriate since the research was targeted to goals focused on the companies' market sectors. NSF's research activities must be consistent with the agency's mission and goals and NSF's role as public steward of the nation's science and engineering enterprise.

COOPERATION WITH INDUSTRY

QUESTION: Are there ways in which NSF can work closely with industry to maximize the investment in R&D and, if so, what do you believe are the appropriate ways for the Foundation and industry to come together?

ANSWER: NSF is examining how it can best work with the private sector to maximize national benefits from the investment in science and engineering research and education. In areas in which industry and NSF have shared goals, partnerships may help to enhance research productivity and offset funding reductions. Cooperation can also facilitate efforts to develop world class research facilities and a world class work force. NSF encourages private sector participation in a number of its activities, particularly large-scale efforts such as centers, groups, and systemic education reform. NSF also works closely with industry to define educational needs and to provide students with hands-on science experiences.

NSF has developed many mechanisms for industry participation including:

- Industry/University Cooperative Research Centers;
- Small Business Innovation Research Program;
- Engineering Research Centers;
- Science and Technology Centers;
- Grant Opportunities for Academic Liaison with Industry; and

• the NSF/Private Sector Research Opportunities Initiative

These programs provide a wide range of opportunities for industry-NSF cooperation. In cooperative efforts NSF remains focused on its mission of supporting fundamental discovery and on the integration of research and education.

NSF and industry also engage in other collaborative efforts such as shared funding for instrumentation, geological drilling, and research on transformations to quality organizations. An important mechanism for enabling partnerships and collaborations has been the NSF cooperative agreement authority. NSF cooperative agreements have enabled relatively small amounts of Federal government support to attract and retain large industrial commitments and collaborations with universities, non-profits, and state governments. This is the mechanism that was used to develop several successful NSF programs including the Supercomputer Centers, NSFNET-Internet, and the Science and Technology Centers.

We expect cooperative efforts to increase as industry becomes more reliant upon universities for long term research and education. NSF's activities are focused in the academic sector. We believe that the agency can work most effectively with industry by developing university/industry partnerships, possibly with catalytic funding from NSF.

NATIONAL PERFORMANCE REVIEW

QUESTION: Last year NSF went through a self-examination process as part of the National Performance Review (NPR). Could you give the Subcommittee some sense of how the NPR exercise affected the priorities we see in your FY 97 budget?

ANSWER: The National Performance Review (NPR2) required all agencies to look at their programs and functions from the point of view of appropriateness for the federal government. In this context, NSF asked questions about whether other organizations might be better suited to carrying out similar activities. NSF looked broadly at issues of efficiency and effectiveness.

The key program functions described in the NSF FY 1997 Budget Request—Research Project Support; Research Facilities; Education and Training; and Administration and Management—grew out of the NPR2 focus on functions and earlier NSF use of "modes of support" as a way to describe how NSF spends appropriated funds.

Since NSF spends approximately 4 percent of its total budget on administration and management, it became apparent that NSF could not achieve the budget savings that were incorporated into the NPR2 effort only by increasing efficiency of its operations. NSF would need to cut into its program effort. The following budget impacts were determined:

- Targeted reductions were proposed for lower priority efforts in modernization and renovation of research facilities (i.e., "bricks and mortar") at academic institutions. The elimination of the facilities portion of the Academic Research Infrastructure (ARI) account is the most visible NPR2 outcome discussed in the FY 1997 Budget Request.
- The decision to maintain expenditures for construction and operation of large research user-facilities at 20-25 percent of the total NSF program budget also grew out of the NPR2 process.
- Reductions in buying power due to constraints on future budgets will affect NSF's research and education programs broadly. For example, in the Education and Human Resources account, NSF placed priority on activities related to educational systemic reform. A reduction in the request for informal science education activities is one consequence.

TASK FORCE ON GRADUATE AND POSTDOCTORAL EDUCATION

QUESTION: In response to the Committee's written questions following a hearing last July on graduate education, you indicated that the National Science Board had established a task force on graduate and postdoctoral education to look at the mix of support NSF provides to postdoctorate and graduate students, through fellowships, traineeships and assistantships. What have been the findings of the task force? Have any recommendations been made to change the proportion of funding for these different modes of support?

ANSWER: The NSB Task Force presented its recommendations on February 22, 1996. These recommendations state:

The Task Force recommends that limited studies be conducted on alternative modes of graduate support, with defined goals and assessment criteria. Among these might be programs for:

- Traineeships for programs encouraging breadth and interdisciplinary studies, and including specific attention to ethics and the responsible conduct of research.
- Fellowships for professional technical masters degrees.
- Fellowships for interdisciplinary research for students who have advanced to Ph.D. candidacy in a traditional discipline.
- Fellowships or other support modes permitting internships in industry, government agencies, and/or the public schools as part of the graduate education experience.
- Devising new means to provide incentives for attracting U.S. citizens (particularly from underrepresented groups) to graduate programs in science and engineering.

The Task Force recommends that NSF, possibly through SRS and/or the SBE directorate, should support data collection and/or research on the effects of funding mechanisms on the number, retention, programmatic quality, time-to-degree, and demographic and institutional distribution of students being supported.

The Task Force has recommend limited studies because, despite extensive study, we find inadequate data to compel a recommendation of a major shift in funding mode among fellowship, research assistantships, teaching assistantships, and traineeships for supporting graduate education in science and engineering. We have found:

- Major institutional and disciplinary variation in time-to-degree.
- Shorter time-to-degree for students who are supported than those who are not.

Specific attention should be paid to the role of foreign students in the SME enterprise. This should include collection of data on the number, support mode, and placement of foreign students.

We recommend the implementation of these changes in FY 97. We urge the EHR Committee to monitor the collection of these data and to review the issues involved at the appropriate time. (February 22, 1996, Report from the Task Force on Graduate and Postdoctoral Education, NSB/GE-96-2)

NSF's Senior Management Integration Group is overseeing implementation of the recommendations and has established two committees. One committee will propose 'pilot' projects in response to the NSB Task Force Report. One committee will consider how best to address the 'data needs' that are requested in the Task Force Recommendations.

TRACKING OF CAREER PATHS

QUESTION: One recommendation of the National Academy of Sciences committee that developed the report on reshaping graduate education was for NSF and NIH to establish tracking of career paths of graduate students they support. Does NSF have any plans to do this?

ANSWER: The National Science Board (NSB) Task Force on Graduate and Postdoctoral Education has also recommended that data be collected on tracking the career paths of graduate students. Even before the NAS committee report, NSF had undertaken studies of the National Science Foundation Graduate Fellows and Minority Graduate Fellows programs: *Career Paths of the National Science Foundation Graduate Fellows of 1972-1981,* National Research Council (National Academy Press, 1994) and *Minority Science Paths: National Science Foundation Minority Graduate Fellows of 1979-1981,* National Research Council (National Academy Press, 1995).

NSF's Senior Management Integration Group has established a committee to consider how best to address the data needs that are recommended by the NSB's Task Force.

HIGH CAPACITY CONNECTIONS

QUESTION: The new NSF Supercomputer Centers Program will involve partnerships among many institutions which will require establishing high-speed communication links. Will the new Centers program provide the resources needed for these high-speed network connections or will the partnering institutions compete for awards under NSF's networking connections program to accommodate academic research groups which need high speed Internet connections for their research, but are not part of the Centers partnerships?

ANSWER: When these questions have arisen from potential proposers in the Partnerships for Advanced Computational Infrastructure (PACI) program, NSF has encouraged proposers both to look at the networking infrastructure support programs of the Networking and Communications Research and Infrastructure (NCRI)

Division and to include networking support in their PACI proposals. Our intent is to work closely with NCRI to optimize the effect of both programs on high speed networking infrastructure, not only for the PACI sites, but also for the entire science and engineering research community. NCRI resources will be available for meritorious projects not associated with the PACI program.

EFFECT OF SHUTDOWNS

QUESTION: NSF has been operating without a permanent appropriation this fiscal year and has undergone shutdowns. What have been the problems caused by these shutdowns and by the continuing uncertainties about this year's budget? Do you see any adverse effects?

ANSWER: Budget uncertainties and attendant disruptions to normal business operations have placed substantial burdens on staff at all levels of the agency. NSF employees were furloughed for a total of 17 working days (November 14-17, 1995, and December 18 through January 6, 1996) as a result of the budget impasse. During the second furlough, more than 40,000 pieces of mail, including 2,860 proposals, accumulated in the NSF mail room. To handle the processing of this backlog, the mailroom staff was put on 12-hour shifts and paid approximately $24,000 in overtime. An additional $1,200 was authorized for overtime for warehouse workers to respond to a backlog of 1,500 requests for forms and publications. Proposal processing came to a halt during the furlough and 21 review panels were canceled, most of which were eventually rescheduled. Six special competitions were canceled and 15 were delayed.

The cancellation of a National Science Board meeting during this period also resulted in the delay of decisions on major awards and the submission of *Science and Engineering Indicators 1996.*

The lack of a permanent appropriation made it difficult for program officers to operate, given uncertainty about the amount of funding for their programs. The agency honored funding commitments on active awards to the extent possible. However, decisions on new awards have been delayed.

STATUS OF MILLIMETER ARRAY FACILITY

QUESTION: NSF has also been considering construction of a new astronomy facility—the Millimeter Array. What is the status of planning for this facility? Clearly not all of the projects which are being explored at this time can be accommodated in NSF's budget. Overall, how does NSF set priorities among competing construction within the Major Research Equipment Account?

ANSWER: In November 1994, the National Science Board approved a Project Development Plan for the Millimeter Array (MMA), endorsing further planning. This has resulted in a proposal that the MMA be included in the Major Research Equipment (MRE) account. The MMA will be one of the candidates considered for future funding within the MRE account.

An NSF-wide task force developed the criteria and implementation procedures that guide operation of the Major Research Equipment (MRE) account. Candidates for inclusion in the MRE account must meet the following criteria:

- Represent an exceptional research opportunity essential to the U.S., with broad community support;
- Support the goals of the NSF Strategic Plan;
- Be an activity requiring a period of years for proper planning and construction;
- Have undergone thorough peer review based on scientific merit, feasibility, management capability, and partnership opportunities;
- Be too large to be accommodated in the relevant disciplinary organization; and
- Be cost-shared by the relevant disciplinary organization.

In examining candidates for construction within the MRE account, NSF takes into account items such as the potential impact on the relevant scientific communities; appropriateness of the scientific plans; balance in the Foundation's portfolio of research facilities; appropriateness of the construction plans, including detailed cost estimates and construction schedule; plan for operating the facility in the future from within existing funds, including phase-out of existing facilities as necessary and impact on other activities in the relevant directorate(s); and potential for cost sharing, particularly international cost sharing.

VALUE OF THE SBIR PROGRAM

QUESTION: The SBIR program has a statutory increase for FY 1997 that brings the NSF SBIR program to $52 million. For NSF, this means that 6.6% of the increased funding available for research accounts must be designated for SBIR. What are your views on the value of this program and on the requirement for a fixed percentage of the research budget to go to the program? Do you believe there are higher priority areas for use of these resources in a time of constrained budgets?

ANSWER: NSF strongly believes in the value of the Small Business Innovation Research (SBIR) Program, which was conceived over a decade ago as a means for facilitating the transition of fundamental research results into useful products to benefit society. NSF-funded SBIR projects have resulted in new products, private investment, sales and a significant increase in jobs in SBIR companies. Experience has demonstrated that the commercial concepts in SBIR proposals are often based on new knowledge and ideas that result from previously funded fundamental research grants. It is important to recognize that success in this endeavor has a multiplier effect in making university-based researchers aware of the advantages of working with small business, encouraging small business owners to look to universities for ideas and expertise, and in making challenging, high technology jobs available to new graduates.

NSF believes that the FY 1997 allocation of 2.5 percent of the NSF external research budget to SBIR activities is sufficient to carry out the objectives of the SBIR Program. However, we believe that the future growth of the program should keep pace with, but not outstrip, the growth of NSF's research activities. This will allow NSF to carry out the objectives of the SBIR program without negatively impacting its ability to support fundamental research and education. The value of the SBIR investment would also be enhanced if the program provided greater flexibility to award grants to universities. This would provide greater continuity in the commercialization of NSF-funded research, most of which is conducted by universities.

REDUCTION IN INFORMAL SCIENCE EDUCATION PROGRAM

QUESTION: The Informal Science Education program in the education directorate is targeted for a reduction of $10 million for FY 1997, which is a decrease of 28%. This will reduce support for science museums and media activities. NSF's budget explanation indicates that the reduction can be recovered by leveraging additional funds from corporate and other sponsors.

a) Why are you confident that NSF can attract increased non-federal support for these informal science education activities?

b) Will resources be restored to this area if additional funding from non-federal sources does not materialize?

ANSWER: The Informal Science Education (ISE) program is effective in promoting public understanding of science, mathematics, and technology (SMT) and remains an integral part of the agenda for the Education and Human Resources Directorate. In FY 1997, the ISE budget reduction reflects NSF's strategic planning priorities and the realities of the current budget environment. Reductions in buying power due to constraints on future budgets will affect NSF's research and education programs broadly. In the Education and Human Resources account, as part of the National Performance Review (NPR2) process, NSF placed priority on activities related to educational systemic reform. A reduction in the request for informal science education activities was one consequence.

NSF support for informal science activities has been highly effective in leveraging support from outside sources. NSF funding of $36 million in FY 1995 leveraged about $20 million from other sources. Typically, NSF provides about one-third of total media project costs and two-thirds of museum project costs. NSF support guarantees involvement of both researchers and educators in development of projects to ensure scientific accuracy, balance, and effective educational strategies. Collaboration with NSF also opens opportunities for other sources of support. The NSF strategic planning process is rigorous and its programming dynamic. NSF will evaluate future ISE program funding in the context of the program's relative contribution in supporting NSF's strategic goals vis-a-vis the availability of funds.

ADVANCED TECHNOLOGY EDUCATION

QUESTION: The NSF budget request provides for a $5 million increase for the Advanced Technology Education Program which supports curriculum and faculty development at 2-year colleges in order to improve edu-

cation of technicians for the high-performance workplace. Please give us a progress report on this relatively new program and describe how the increasing funding will be used.

ANSWER: The Advanced Technological Education (ATE) Program was established in FY 1994 to promote exemplary improvement in advanced technological education at the national and regional level through support of curriculum development, enhancement of instructional workforces, and program improvement for technicians being educated for the high performance workplace. The ATE program has provided support for Centers of Excellence in Advanced Technological Education and model projects. Six Centers of Excellence of national scope have been established in manufacturing (Ohio); natural resource development (Oregon); information technology (Washington); mechanical, telecommunications, and electronics technology (New Jersey); environmental technology (Iowa); and engineering technology via distance education (Texas).

- All of the Centers involve industry in substantial ways. For example, both Boeing and Microsoft, and numerous other software firms, are working with the Washington Center in information technology by providing industry personnel and significant financial resources. Other large industries such as General Motors and Weyerhauser as well as many small and medium sized firms are supporting other Centers.
- All are cooperative efforts which build on leadership from 2-year colleges acting in partnership with 4-year colleges and universities, secondary schools, business, industry, and government.
- The impact of the Centers is large. For example, the Washington Center involves over 5,000 ATE college students, 350 ATE faculty and high school teachers, and 2,700 high school students. The Environmental Technology Center (Iowa) involves over 500 community colleges and 10,000 faculty and teachers in their dissemination efforts. They are directly reaching 300 community college teachers, 300 pre-college teachers, and 5,500 students.

In addition to the six Centers of Excellence, the ATE program supported 30 projects in advanced technological education in FY 1994 and 37 projects in FY 1995.

- These include projects in biotechnology, chemical technology, manufacturing, electronics, geographical information systems, environmental technology, telecommunications and other engineering technologies, computer and information technology, as well as science and mathematics core subjects for technicians, such as mathematics and physics that undergird a highly educated workforce.
- In addition, the ATE project supports leadership activities that examine national issues in technological fields.
- The first year projects initiated in FY 1995 have engaged approximately 2,340 teachers and faculty and 234,000 students. The three year impact is projected to be over 7,000 teachers and almost 700,000 students in two-year colleges and secondary schools.
- Large industries such as Nynex, Siemens, and Intel as well as numerous other large, medium, and small companies are integrally involved in projects.

Project Examples:

- Prince George's Community College in Maryland is leading a consortium of 12 community colleges each linked to a NASA Center to conduct faculty enhancement workshops in remote sensing, image processing, and geographic information systems. They are also developing an earth systems science course and interdisciplinary modules which can be infused into science and technology courses.
- Miami University-Middletown in Ohio is leading a consortium of two-year colleges and secondary schools along with many chemical manufacturing companies to develop curriculum, instructional materials, and new chemical technology programs as well as faculty and teacher enhancement programs and student outreach to improve chemical technician education.
- Johns Hopkins University is leading a consortium which represents 5 different consortia of community colleges (including over 130 community colleges directly) to develop instructional modules in science, mathematics, manufacturing technology, and technical communications to infuse into courses that comprise a broadly accepted, portable associate's degree in manufacturing.
- Texas State Technical College at Waco is leading a multi-state effort to develop curricula and laboratory materials for student learning in advanced technologies for 15 occupational areas supporting American machining and machine tool industries.

In FY 1996 NSF received 120 proposals requesting $186 million. Most of the new projects and centers requests received have been of very high quality and involve all partners—two-year colleges, industries, business, government, secondary schools, four-year colleges and universities, professional societies, etc.—required to improve education for an increasingly technology-based workforce. Coordination at the collegiate and school levels is achieved through close cooperation between the Undergraduate Education (DUE) Division and the Elementary, Secondary, and Informal Education (ESIE) Division. The requested FY 1997 budget increase of $7.5 million, including $5.0 million in DUE and $2.5 million in ESIE, is expected to result in three new ATE multi-organization projects and 30 new individual projects funded directly or cofunded with other programs.

REVIEW OF SYSTEMIC REFORM PROGRAMS

QUESTION: In the Education and Human Resources Directorate, NSF has been undergoing a review of the systemic reform programs. What is the status of this review and what have you learned in this program?

ANSWER: The NSF's Division of Educational System Reform conducts a series of activities to continually assess the progress of the systemic initiative programs. Among these are: periodic monitoring site visits by program officers; submission of Midpoint Progress Reports by each Initiative, followed by reverse-site visits at NSF and Midpoint Review on-site visits to review progress and concerns; submission of an Annual Progress Report by each Initiative, Data Collection Report, and an updated Strategic Plan. On an annual basis, program officers conduct an analysis of these data and review all documentation to determine if appropriate progress has been made to justify a recommendation for continued funding from NSF. In addition, a number of periodic meetings are held with superintendents, principal investigators and project directors to discuss critical issues related to technical assistance, accountability, reporting, data collection and formative evaluation processes.

In addition, third party program evaluations of the initiatives are being conducted. A recently released NSF Report entitled: Evaluation of the National Science Foundation's Statewide Systemic Initiatives (SSI) Program: Second Year Report, December 1995 reports current information on the progress and findings for the SSI program. The report findings indicate that the SSI program has motivated and supported thousands of talented individuals and many different agencies and institutions to work to improve education in mathematics and science in new ways. There has been greater attention to development of standards and learning goals. Moreover, a number of states are making substantial progress, including development and implementation of new curricula, new professional development programs, innovative public outreach strategies, and comprehensive school change strategies. At the same time, it is evident that systemic reform is very difficult, slow work. Although the SSI's as a whole have made substantial progress in meeting these challenges, progress is not uniform either across states or within them. Currently, program evaluations are being designed for the Urban and Rural Systemic Initiatives.

STATUS OF REPORTS REQUESTED BY HOUSE MEMBERS

QUESTION: The NSF authorization passed by the House has not yet been signed into law. However, the House Members did request several reports from the NSF for their decision making process.

The Committee asked for reports on the reorganization of the NSF Research and Related account Directorates, an OSTP Indirect Cost Report, a Facilities Plan, and an Educational Impact Study. What is the status of providing this information?

ANSWER: *Reorganization:* NSF gives continuing attention to issues of organizational structure because they are important in managing the agency. NSF is committed to an organization that is driven by the substance of the Foundation's work and that is responsive to planned outcomes. NSF is exploring organizational options, including the House and Senate recommendations, as part of the planning process.

The Director and Chairman Walker have had lengthy discussions and have agreed upon NSF's approach. These discussions will continue as part of NSF's ongoing consideration of organizational issues. NSF focused attention on broad issues of organization in a senior management retreat in December but progress has been stalled by shutdowns and protracted FY 1996 and 1997 budget discussions. NSF has given highest priority to planning balanced, forward-looking activities for FY 1996 and 1997. NSF intends to return to the issue of reorganization and will keep the Congress informed on this matter.

Facilities Plan: The NSF plan for proposed facilities construction projects within the Major Research Equipment (MRE) account is detailed in NSF's FY 1997 Budget

Request. Current plans in FY 1997 are for continued funding of the Laser Interferometer Gravitational Wave Observatory ($70 million) and initiation of the South Pole Safety Project ($25 million).

NSF has scrutinized its major research facilities very carefully during the past year. We have put in place a process, involving NSF senior management and the National Science Board, for dealing both with existing research facilities and with requests for development of new or refurbished facilities. As noted in the FY 1997 Budget Request, we expect to keep research facilities at approximately 20-25 percent of the total NSF program budget. This will be done to maintain an appropriate balance across NSF's key program functions and to enable the construction of new world-class facilities that will advance human knowledge further.

NSF's procedures for developing and approving major facilities projects involve substantial planning efforts prior to the initiation of construction, including extensive discussion within the science and engineering community, external studies and reports, and internal NSF review and study. Following these efforts, NSF requires that a detailed project development plan be drafted to provide information on the project costs and schedule, as well as on project management and operations. The project development plan must be reviewed and publicly approved by the National Science Board in order for further work on the project to proceed. NSB approval is required prior to a project's inclusion in NSF's budget request to OMB and subsequently to the Congress. It is important to note, however, that not all planning efforts or projects which receive approval from the NSB are included in the Foundation's budget or actually proceed to the construction phase.

In examining candidates for construction within the MRE account, NSF takes into consideration items such as the potential impact on the relevant scientific communities; appropriateness of the scientific plans; balance in the Foundation's portfolio of research facilities; appropriateness of the construction plans, including detailed cost estimates and construction schedule; plan for operating the facility in the future from within existing funds, including phase-out of existing facilities as necessary and impact on other activities in the relevant directorate(s); and potential for cost sharing, particularly international cost sharing.

Educational Impact: In attempting to address the educational impact of each individual grant as a way of improving undergraduate education, NSF has undertaken a broader examination of the current issues in undergraduate pedagogy and how to provide incentives to researchers and institutions to improve the quality of undergraduate teaching. In FY 1997, NSF will expand its initiative for Institution-Wide Reform of Undergraduate Education in Science and Engineering and will establish a new Recognition Awards for the Integration of Research and Education activity. The Undergraduate Reform initiative focuses on prior accomplishments by undergraduate institutions with the goal of promoting activities that spread the reform effort institutionwide. The goal of the recognition awards will be to identify and recognize research intensive universities that have shown bold leadership, innovation, and tangible accomplishments in linking research and education. The awards will focus on institutions where NSF has made the largest investments and therefore where NSF has the greatest potential influence in correcting any imbalances between research and education.

RESPONSES TO H.R. 2405

QUESTION: What is NSF doing in regards to four other provisions in the House passed bill: the financial disclosure requirement of temporary NSF employees under the Ethics and Government Act; universities to support educational leave of reservists recalled to active duty; incorporation of Important Notice Number 91 in Grant General Conditions; and prohibition of lobbying activities.

ANSWER: The "Omnibus Civilian Science Authorization Act of 1995" (H.R. 2405) as passed by the House of Representatives contains the following provisions:

SEC. 126. RESEARCH INSTRUMENTATION AND FACILITIES.

The Foundation shall incorporate the guidelines set forth in Important Notice No. 91, dated March 11, 1983 (48 Fed. Reg. 15754, April 12, 1983), relating to the use and operation of Foundation-supported research instrumentation and facilities, in its notice of Grant General Conditions, and shall examine more closely the adherence of grantee organizations to such guidelines.

SEC. 127. FINANCIAL DISCLOSURE.

Persons temporarily employed by or at the Foundation shall be subject to the same financial disclosure requirements and related sanctions under the Ethics in Government Act of 1978 as are permanent employees of the Foundation in equivalent positions.

SEC. 128. EDUCATIONAL LEAVE OF ABSENCE FOR ACTIVE DUTY.

In order to be eligible to receive funds from the Foundation after September 30, 1995, an institution of higher education must provide that whenever any student of the institution who is a member of the National Guard, or other reserve component of the Armed Forces of the United States, is called or ordered to active duty, other than active duty for training, the institution shall grant the member a military leave of absence from their education. Persons on military leave of absence from their institution shall be entitled, upon release from military duty, to be restored to the educational status they had attained prior to their being ordered to military duty without loss of academic credits earned, scholarships or grants awarded, or tuition and other fees paid prior to the commencement of the military duty. It shall be the duty of the institution to refund tuition or fees paid or to credit the tuition and fees to the next semester or term after the termination of the educational military leave of absence at the option of the student.

SEC. 129. PROHIBITION OF LOBBYING ACTIVITIES.

None of the funds authorized by this title shall be available for any activity whose purpose is to influence legislation pending before the Congress, except that this shall not prevent officers or employees of the United States or of its departments or agencies from communicating to Members of Congress on the request of any Member or to Congress, through the proper channels, requests for legislation or appropriations which they deem necessary for the efficient conduct of the public business.

In response to these provisions, NSF has taken the following actions:

- NSF has included a reference to NSF Important Notice No. 91, "Principles Related to NSF-Supported Research Instrumentation and Facilities" in the Foundation's *Grant General Conditions,* (GC-1) as was recommended by the NSF Inspector General. The Foundation added the following language into the October 1995 edition of our *Grant General Conditions* (paragraph 7b8):

Use of NSF-Supported Research Instrumentation and Facilities. Grantees should follow the guidelines contained in GPM 544 regarding use of NSF-supported research instrumentation and facilities.

Section 544 of the NSF *Grant Policy Manual* (NSF 95-26) states:

In March 1983, the National Science Board adopted *Principles Related to NSF-Supported Research Instrumentation and Facilities* (Important Notice 91) and approved guidelines to aid grantees in their implementation. (See Exhibit V-1.) Those principles and guidelines address the use of NSF-supported research instrumentation and facilities in providing services for a fee in direct competition with private companies that provide equivalent services. Grantees should implement those principles and guidelines in a reasonable manner and provide fair and adequate consideration of any complaints about use of instrumentation and facilities.

The Foundation remains alert to any indication that its grantees are not complying with the principles and guidelines of Important Notice No. 91.

- NSF is now requiring incoming Intergovernmental Personal Act (IPA) employees to agree to be bound by the Ethics and Government Act (EGA) financial disclosure regulations and the Standards of Ethical Conduct to the same extent as regular NSF employees.
- Issues related to the "reservists" and "lobbying" provisions are under review by the Foundation.

OUTYEAR PROJECTIONS OF NSF'S MAJOR ACCOUNTS

QUESTION: As I requested at the hearing, please provide to the Subcommittee the outyear projections for NSF's major accounts between FY 97 and FY 2002 in CBO scored numbers.

ANSWER: The budget proposals presented in the President's budget for NSF were developed using outlay rates that have been agreed upon by NSF, OMB, and CBO. It is our understanding that OMB and CBO do not differ on the scoring issue. Therefore, the outlay proposals displayed for all years are consistent with both OMB and CBO scoring. However, OMB and CBO disagree on certain economic assumptions for Fiscal Years 2001 and 2002. As a result, the budget presents two sets of tables, one of which displays proposed budget authority and outlays through FY 2002 using the Administration's economic assumptions, and one which displays outlays through FY 2002 using only the CBO assumptions.

The projections for NSF's major research and education accounts are presented in the table below.

PRESIDENTIAL POLICY BUDGET AUTHORITY

[Millions of Dollars]

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
Research and Related Activities	$2,314	$2,472	$2,473	$2,474	$2,475	$2,549	$2,628
Education and Human Resources	$599	$619	$619	$619	$619	$636	$654

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