DOCUMENT RESUME

ED 348 226 SE 052 873

TITLE	Federal Efforts in Science and Mathematics Education. Hearing before a Subcommittee of the Committee on Appropriations, United States Senate, One Hundred Second Congress, First Session. Special Hearing.
INSTITUTION	Congress of the U.S., Washington, D.C. Senate.
REPORT NO	ISBN-0-16-037320-4; Senate-Hrg-102-414
PUB DATE	92
NOTE	80p.; For the Second Session report, see ED 340 586.
AVAILABLE FROM	U.S. Government Printing Office, Superintendent of Documents, Congressional Sales Office, Washington, DC 20402.
PUB TYPE	Legal/Legislative/Regulatory Materials (090)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	Computer Uses in Education; Curriculum Development; Elementary Secondary Education; Federal Legislation; *Federal Programs; Financial Policy; *Financial Support; Grants; Hearings; Higher Education; *Mathematics Education; Parent Participation; Program Evaluation; *Science Education; Scientific Literacy; Scientific Personnel; State Programs; Teacher Recruitment; Teacher Shortage
IDENTIFIERS	Congress 102nd; *Dwight D Eisenhower Math and Science Educ Program; *Project 2000

ABSTRACT

This report contains the transcript of a hearing that addressed federal efforts in school science and mathematics education. Included are prepared statements from the subcommittee members and spokespersons for the Office of Science and Technology Policy within the Executive Office of the President, the National Science Foundation, and the Department of Education. Topics and issues discussed in the prepared statements, as well as the accompanying questions and answers, centered on: the goals, strategic objectives, and budget plans of the America 2000 Project; the role and strategy of the National Science Foundation in education activities and human resource utilization; and the status of and support for the Eisenhower Mathematics and Science Program. (JJK)

S. HRG. 102–414

FEDERAL EFFORTS IN SCIENCE AND MATHEMATICS EDUCATION

HEARING

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

UNITED STATES SENATE

ONE HUNDRED SECOND CONGRESS

FIRST SESSION

SPECIAL HEARING

Printed for the use of the Committee on Appropriations

U.S. GOVERNMENT PRINTING OFFICE

51–474 cc WASHINGTON : 1992

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-037320-4

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FEDERAL EFFORTS IN SCIENCE AND MATHEMATICS EDUCATION

TUESDAY, APRIL 23, 1991

U.S. SENATE,
SUBCOMMITTEE ON VETERANS AFFAIRS, HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES,
COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 10:20 a.m., in room SD–138, Dirksen Senate Office Building, Hon. Barbara A. Mikulski (chair) presiding.
Present: Senators Mikulski, Kerrey, and D'Amato.

EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

STATEMENT OF DR. D. ALLAN BROMLEY, DIRECTOR

OPENING STATEMENT OF SENATOR MIKULSKI

Senator MIKULSKI. Good morning everybody. The subcommittee will come to order.

The Chair apologizes for the delay.

Today we are here to continue the dialog we started 1 year ago on how we can make sure the United States of America is scientifically literate and that we meet our national goal of improving science and math education by the year 2000.

I feel a sense of urgency about our need to get the next generation ready for the enormous challenges they face for the 21st century because we are far from being ready. While the United States wins most of the Nobel prizes, not even one-half of its students know that the Earth revolves around the Sun once a year. We do not have a lot of time. There are only 3,174 days left before the new century, and the clock is ticking.

Yesterday Dr. Massey and I visited the Maryland Science Center in Baltimore and the Owens Science Center in Prince George's County to find out about programs in our State that are stimulating students with hands-on experience in math and science. The enthusiasm, commitment, and excitement that I saw was most encouraging. I want to see the same energy and motivation in our nationwide strategy for math and science education.

Last year the President and the Governors developed national education goals for America. Last week the President reiterated them, outlining them in his education plan. Setting those goals was an important first step. Goal No. 4 particularly emphasizes the

math and science agenda. We are pleased to see the new initiatives on math and science education in the President's budget for fiscal year 1992.

In looking at the issues we find that the National Science Foundation estimates that by the year 2000 we will be short 300,000 math and science teachers. We will be short 1 million teachers, generally. Teachers are one of our most vital links to the next generation. We need to improve our teaching. We need to improve our coordination. We need to do a lot of things.

We are looking forward to hearing today from those people charged with helping to make it happen. We are proud of the subcommittee's record in encouraging, first, that a strategy be developed through the Office of the President's Science Advisor. And we thank you for this report. We are pleased that the hearings we have held have helped. Second, we are proud of the way we have increased the funding in math and science, particularly in the science and education mission agencies.

Having said that, though, this is not a hearing for me to talk, it is a hearing for you to testify and for us to participate in a very important dialog.

Senator Kerrey, did you have an opening statement?

Senator KERREY. Madam Chair, I do have an opening statement that I would like to have made a part of the record.

In summary, I would like to congratulate you for following through and having this second hearing on what I consider to be one of the most important subjects, at least on my short agenda.

I have read the FCCSET report and view it as an awfully good inventory, in fact, a very alarming inventory as you look at the shortages of math and science teachers in the United States today. It just confirms what we viewed in Nebraska as well, that it is extremely difficult to recruit and even more difficult to retain, given the appeal of the marketplace, the attraction of the marketplace for people that have gifts in math and science.

I point out that I believe we have gotten the American people's attention. In particular, I applaud the President's decision to announce very aggressive strategy for public education. I believe that will assist.

I want to point out further that one of the things that the President posed to do is to solve the problem that was described by him as the other 91 percent, which is that 91 percent of the children are not in the schools. And it is perhaps one of the most compelling of all problems that we have—that is either a decline or, I do not know where it came from—but a lack of scientific literacy on the part of that other 91 percent where the adult population themselves are struggling to try to provide the resource needed where you have an intact family, trying to provide the resources needed for young people to be encouraged to pursue an interest in mathematics and science.

I applaud the effort of pulling together this inventory. What it does for me is simply reinforces an urgency to act. And that urgency is increased when one looks at at-risk children of minorities and women where we are doing an even poorer job than in the rest of the population, if that is possible. I find myself saying that I need to challenge it. It is perhaps the most worthwhile thing we

can do inside of public education. But it is going to require a great deal of work.

I happen to believe it is also going to require more resources than even the generous resources that the President has included in his budget. I appreciate the increase that is there. I think it is very important that it was put there, but it will take more public and private resources dedicated to the task. Otherwise we simply are not going to get it done. I would never prescribe a simple one program top-down approach to it. I believe it is going to take thousands of individual responses nationwide.

But I do believe that power necessarily will follow resources that are provided to get the job done. And I hope that we are able to make the case. There is going to be a lot of fighting done. And what you presented with the FCCSET report, I think, is a foundation upon which we can begin to conduct the fight.

But we, indeed, are going to have to go to the public and say, if you want your standard of living higher, if you want to continue to make discoveries in the 21st century that will enable us to be competitive in the world marketplace, if you want your workplace, if you want your children to be able to work in tomorrow's jobs, they have got to put this fourth goal at the top of our list. And what that will necessitate is a whole range of responses on the part of both Government and the private sector, I think, in a rather emergency fashion if we are going to be able to get it done.

PREPARED STATEMENT

So, Madam Chair, again, for emphasis, I thank you for holding this second hearing. I think it is awfully important and I look forward to the testimony of all three individuals here. I will submit my statement for the record.

[The statement follows:]

STATEMENT OF SENATOR KERREY

First, I want to commend the chair of the subcommittee for scheduling this hearing which is the second hearing to be held by the subcommittee on science and math education. It is not only appropriate but also important for this subcommittee to continue to monitor the federal government's march toward the year 2000 and the goals in math and science which have been established for that time. The subcommittee has jurisdiction over the National Science Foundation, which has major responsibilities in math and science education, as well as over HUD, the VA, NASA, EPA and OSTP which are represented on the Federal Coordinating Council for Science, Engineering and Technology, (FCCSET) Committee on Education and Human Resources. And, the subcommittee has both a chair and a ranking member who have demonstrated a commitment to science and math education and who have strong records of support for NSF and for the educational activities of the other departments and agencies which come before the subcommittee.

Second, I want to commend the efforts of the Committee on Education and Human Resources for the report which you have produced. What you have, in my opinion, is a good summary of what is now being done. It is a needed summary—a good background.

But, it is—as I think you would probably agree—just that, a summary. It is a little like a Sears catalog without an index. Or a AAA tour guide without the road map. If I were a teacher or administrator looking at this report, I would, see some ambitious goals—very ambitious goals—for the year 2000: first in the world in science and mathematics achievement. I would see some of the problems in reaching those goals. I would see a list of programs which I might pursue, some perhaps with success, more probably without. I might spend a lot of time, trying to fill up my tank with a little gas from this program and that. I might get a little acceleration from Star schools here or Eisenhower there, but I really don't find direction to the

year 2000 and I don't find any guidance for what I do if I have major engine problems on the way.

Moreover, I'm on this road, not just with other teachers and curricula and approaches which I understand, but I am also on this road with the Japanese, the French, the Canadians, the Mexicans, the Koreans. And, I have every reason to believe—in—fact, I have been told a number of times—that those other people are ahead of me.

So, I think your challenge now is to move beyond this catalog and to pursue more directly your own goal of developing a coordinated Federal budget strategy—which also supports a coordinated policy, which tells me how we are going to reach our destination of achievement in 2000.

As you do that, I would urge you to bear in mind several things:

(1) One is that the focus has to be teachers. NSF is putting great emphasis on teacher preparation and enhancement. That is where it belongs. Even when we talk about technology and distance learning—and I am a strong proponent of both—I believe the success of technology in the classroom depends upon teachers who understand and are willing to use it for what it can do.

(2) A second is that federal efforts have to be nationwide. Traditional means of attracting and retaining scientists, mathematicians, and engineers to the profession and teachers to these subjects are not meeting need. We have to branch out. I don't begrudge Illinois its Argonne or Fermi or Tennessee its Oak Ridge. But, where is Nebraska's? Why should my Westinghouse finalist not have access to the benefits which schools near those facilities have? The answer is geography—and I don't think that's an acceptable answer when you expect U.S. students to be first in the world in achievement by the year 2000 and when traditional sources are not producing the trained personnel we need.

(3) Finally, I think you need to keep public attention focused on and committed to the efforts to improve math and science capabilities. If people don't think the goals are important then they won't be. If students, parents, the public at large does not consider this a priority, it won't be.

I am reminded of the battery advertisement where all the toys start together and one by one they drop off until you have this one little rabbit running around all by itself beating its drum. Yes, it's still running but it has lost the crowd on the way. And, we can't afford to lose the crowd if we are to meet the very ambitious goals which have been set out.

PREPARED STATEMENTS

Senator MIKULSKI. Thank you very much, Senator Kerrey. We now want to turn to the President's Science Advisor, Dr. Bromley. And then we will pursue, we will ask all three of our panelists to give their testimony. Then we will engage in some questions and some dialog.

The Chair wants to note that Senator D'Amato was here and had to leave for his banking committee. Our ranking minority, Senator Garn, is literally stranded at an airport with other Senators. Senator Hatfield had submitted his statement and questions and without objection they are entered into the record.

[The statements follow:]

STATEMENT OF SENATOR D'AMATO

Madam Chair, I commend you for convening this hearing on math and science education, and I welcome our witnesses from OSTP, NSF, and the Department of Education.

The widening gap between the performance of our nation's school children in math and science, and that of their foreign counterparts is more than alarming. An educational system in which our students rank next to last among 15 countries in science knowledge is a threat to our future domestic prosperity and our position of world leadership.

As a Nation, we have wasted more than enough time coming to grips with this problem. While the coordinated Federal budget strategy to improve math and science education being presented today by our witnesses is probably long overdue, it is nevertheless an important step in the right direction.

I applaud our witnesses for their leadership in this effort, and look forward to their testimony.

STATEMENT OF SENATOR HATFIELD

Madam Chairwoman, it is with deep regret that I am unable to be with you this morning to participate in the Subcommittee's hearing on science education. As you know, I have a strong interest in this subject and have devoted much of my time in Congress to furthering student achievement in this critical area.

I was pleased to have your support for Public Law 101–589, the Excellence in Mathematics, Science and Engineering Act, which Congress enacted last year. As you know, the Appropriations Committee provided over $20 million in new funding for various components of this bill in FY 1991, and I intend to continue to work to see that additional funding is directed towards the tools which will improve the outlook for our future scientific pool.

I know you join me in the firm belief that we must develop an inclusive strategy to expand the pipeline of potential scientists and engineers to include vastly increased numbers of students, particularly women and minorities. While some people continue to think of mathematics and science as isolated and removed subjects, they literally have an effect on everything: from our productivity at home to our competitiveness abroad—as well as on the quality of life we enjoy in this country. Yet, in the absence of dramatic and immediate change, the Office of Technology Assessment predicts a shortfall of 700,000 trained scientists and engineers within the next decade. Clearly, we must act now.

I am particularly pleased that finally, both the Congress and the Administration stand in agreement on this point. Not only do we now have a national goal related to mathematics and science achievement, but we have "By the Year 2000: First in the World," a report by the Federal Coordinating Council for Science, Engineering and Technology on coordinating federal strategy in these areas. I highly commend Dr. Bromley, Admiral Watkins, Ted Sanders, Luther Williams and all the members of the FCCSET Committee for their diligence in this project. This report provides the first comprehensive look at the action being taken government-wide in math and science and it will be used as the baseline for change. Most importantly, however, this report provides an inventory of the various programs already in place throughout the federal government. In this, it assists me in answering a basic question which I have grappled with over and over again—what is the level of coordination in mathematics and science education across the federal government and how can Congress leverage resources to capitalize on these working partnerships? I look forward to reviewing the testimony of today's witnesses on this subject.

Madam Chairwoman, we always talk a great deal about expenditures for education—some of money, others of time and energy. I have little patience with those who say we cannot afford these expenditures. Frankly, we cannot afford to continue without them. We must never lose sight of the fact that our children hold tomorrow in their hands. A young science student in Missouri once said "Science class is where we learn how tomorrow happens." Indeed it is, and our investment in all education is, very literally, our investment in the future.

STATEMENT OF DR. BROMLEY

Senator MIKULSKI. Dr. Bromley, please proceed. Again, I apologize for the delay.

Dr. BROMLEY. Thank you, Madam Chair. I welcome this opportunity to appear with my colleagues, Walter Massey and Ted Sanders to present the President's new initiative in mathematics and science education.

With your permission, Madam Chair, I would ask that my formal testimony be included in the record and I will simply summarize it here.

Senator MIKULSKI. Without objection.

Dr. BROMLEY. This hearing, Madam Chair, represents a real milestone for the Federal Coordinating Council for Science, Engineering, and Technology in this area. And I would like to begin by complimenting you, Madam Chair, both personally and on behalf

of your subcommittee for the leadership that you have provided in this very vitally important area of mathematics and science education.

I know that you are very much aware of the importance of having the Department of Education, the National Science Foundation, and a whole spectrum of the Nation's science and technology mission agencies working together in a coordinated way to achieve the national education goals and to implement the national education strategy.

I look forward to working together with you and your colleagues. I believe that together we can, in fact, reach these very ambitious goals that have been established for us for the end of this millennium.

DEVELOPMENT OF THE INITIATIVE

If I may, I would like to begin by briefly describing the process whereby this Presidential initiative, which appeared in the 1992 budget, was developed. Following the 1989 Education Summit, as you have noted, President Bush and the Governors established the six national goals for improving education in the United States. Three of these are directly relevant to mathematics and science, and they include what most would view as the most ambitious goal of all—No. 4—which says that by the year 2000 U.S. students will be first in the world in science and mathematics achievement.

At about this time, the Committee on Education and Human Resources was being formed under the newly restructured Federal Coordinating Council. I was particularly pleased that Adm. James Watkins, Secretary of Energy, agreed to be chairman of that committee. He has been ably assisted in the work undertaken by his vice chairmen, Ted Sanders of the Department of Education and Luther Williams of the National Science Foundation. In addition, 16 departments and agencies are members of that committee and have participated very actively in the preparation of the report that we submitted to you, Madam Chair.

The committee's initial challenge was to develop an inventory of what the Federal Government actually had underway. That simply was not known when we began this study. I compliment all members of this committee for the aggressive and effective work they have done under tight time pressures to bring together a comprehensive collection of information about the full range of Federal activities in mathematics and science education.

From this baseline inventory that we have provided for you, we learned a number of specific things. I will mention just a few of them. The first is that all of the agencies represented on the committee, all 16, actually carry out mathematics, science, and technology education activities to some degree. That was not recognized previously.

Second, the baseline level of effort in these agencies was far higher than any of us had anticipated.

Third, the Federal Government's unparalleled collection of unique scientific and technical facilities, located in every State of the Union, the District of Columbia, Puerto Rico, and the territories, can clearly be used more effectively than they are being

used now to serve mathematics and science education, resulting in increased benefit at very little, if any, additional cost.

STRATEGIC OBJECTIVES

In parallel with the development of this baseline inventory, the committee established what I think are four very important strategic objectives. In decreasing order of priority, they are:

First, to improve science and mathematics performance and, of course, to develop methods of measuring that performance.

Second, to develop a strong precollege teacher work force.

Third, to develop an adequate pipeline for the science and technology work force, including increased participation of underrepresented groups. This third point, in my view, is one that has been greatly neglected in the years gone by. We simply have not put adequate effort into training the technical work force, nor have we paid appropriate attention to the role of women and minority group members, particularly in science and mathematics where our record is little short of scandalous.

The fourth and final of these strategic objectives is simply to improve public science literacy.

BUDGET PLANNING PRIORITIES

Using these objectives as guides, the committee established the budget planning priorities that are reflected in President Bush's 1992 budget, which was submitted to you a few months ago. Before I touch on those budget priorities, I would like to make two points.

First, the 1992 budget request that we are discussing at this hearing, Madam Chair, includes only two categories of programs, those for which the Congress appropriates funds expressly for science, mathematics, and engineering/technology education, and those funded under other agency accounts that are expressly managed as science, mathematics, and engineering education activities. These are the programs over which the member agencies have most immediate and direct control, and they will be the focus of our discussion here this morning.

Second, the principal emphasis in my remarks and those of my colleagues today will be on precollege and undergraduate education. But I want to emphasize, Madam Chair, that by emphasizing those aspects, I do not want for a moment to forget the fact that graduate education in the United States is something of which we can all be extremely proud. It is a true success story. In many ways it is one of our most important exports. We want to be very careful that, as we focus on the other aspects of our education problem, we do not do anything to reduce the quality of our graduate education.

We are focusing particularly on precollege education because we and essentially everyone who has looked at this problem agree that the precollege area is the one most in need of attention. In that area we have identified the following planning priorities.

The most important is teacher enhancement and preparation; then, curriculum development; organizational and systemic reform of schools; and last, student incentives, opportunities, and motivation. Motivation is exceedingly important.

Later this morning, my colleague, Walter Massey, will be discussing in more detail this aspect of the committee's work.

PRESIDENT'S BUDGET REQUEST

Let me then, if I may, Madam Chair, turn briefly to the budget request itself. The President's request is for $1.94 billion in fiscal year 1992. This represents a 13-percent increase over Federal spending in fiscal year 1991. In conformance with the national education goals, the largest single increase is in the precollege education area, where we have requested a 28-percent increase. The next largest goes to undergraduate education, where we have requested a 14-percent increase. Finally, in graduate education, which is, after all, the single largest component, we have requested a 2-percent increase. But it should be emphasized that a very large fraction of the support of graduate education does not appear in this category at all, but appears rather in the research category, which is treated separately.

The President's request for fiscal year 1992 marks the second year of significant increases for Federal mathematics and science education, with the most notable increases at the precollege level. The 92-percent growth in precollege funding between fiscal years 1990 and 1992 is the direct result of the heightened attention to elementary and secondary education brought about by activities such as your own, Madam Chair, and those of the President. I think that this represents an excellent example of what we can begin to accomplish by working together on problems of very real national importance.

NATIONAL EDUCATION STRATEGY

Last week the President announced his new National Education Strategy. I am pleased to tell you a little about the Strategy and to emphasize that the 1992 budget request for science and mathematics education is a key part of the Strategy outlined in the booklet, "America 2000." The objectives, the priorities, that were developed in the FCCSET Committee align very well with the new program that Secretary Alexander has been enunciating.

In mathematics and science education the Federal programs in the 1992 initiative address the four groups of students that President Bush highlighted in his April 18 remarks:

Today's students will be the first to benefit from teacher enhancement, new curricula material, and student opportunities.

Second, tomorrow's students will benefit from the full flowering of the efforts that are now being initiated.

Third, the general public will gain from improved scientific literacy.

Fourth, and perhaps most important of all, our communities will be changed through the design of new schools, new programs, for the year 2000 and beyond.

The President has made precollege education his highest priority, focusing resources and attention on the crucial elementary and secondary years and, indeed, on the preschool years, which also are very important.

In "America 2000," the booklet that you have in front of you, Madam Chair, and that will be sent formally to the Congress in the very near future, the President proposes a number of initiatives to improve and restructure college and precollege education, including the defining of new world-class standards for schools, teachers, and students in five core disciplines—English, mathematics, science, history, and geography. In his testimony this morning, Ted Sanders will provide a more complete summary of the President's proposals in this new initiative.

In concluding my remarks, I would like to point out that, despite the fact that education remains a primary responsibility of the States and localities, the Federal Government still has a vitally important role to play in achieving the national education goals and in implementing the National Education Strategy. But it is important for us all to keep in mind that education in this country is a partnership, a partnership that involves Federal, State, and local governments, educators and parents, business and industry, professional associations, and community-based organizations.

Federal sources provide only about 6 percent of the total U.S. spending for elementary and secondary education. But I would emphasize that the amount of money spent is no significant measure of the success of Federal programs. The Federal Government can play a leadership role by highlighting national problems, by mobilizing national support, and by funding programs that offer unique national solutions. By coordinating our own efforts in mathematics and science, the Federal Government can provide the localities and the States with greater access to well-organized and effectively run Federal programs and other resources, such as personnel, educational materials, facilities, and equipment.

Before turning to my two colleagues, Madam Chair, I would again like to emphasize the debt that all of us in the Nation owe to you and to your colleagues on this subcommittee for the leadership that you have consistently supplied in this area. I congratulate you that. I have enjoyed working with you.

PREPARED STATEMENT

Senator MIKULSKI. Thank you very much, Dr. Bromley and for the extraordinary effort that went into producing this report that would not have occurred had you not followed the request of the committee. We appreciate it and the wealth of data that it provides and also your commitment to science education. Your complete statement will be inserted in the record.

[The statement follows:]

STATEMENT OF D. ALLAN BROMLEY

Madam Chair and members of the committee, I am very happy to appear before this Subcommittee to present, together with my colleagues Walter Massey and Ted Sanders, the President's initiative on mathematics and science education. This hearing represents a milestone in this area for the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). I know that you, too, are keenly aware of the importance of having the Department of Education, the National Science Foundation (NSF), and the science and technology mission agencies working together in a coordinated way to achieve the National Education Goals and implement the National Education Strategy.

THE CRISIS IN AMERICAN EDUCATION

In previous appearances before this Subcommittee, I have called attention to the urgent need for improvement in U.S. science and mathematics education. We are all familiar with the litany of problems:

American student performance has declined relative to performance in other countries; many American teachers are inadequately prepared and lack current scientific knowledge; science and engineering fields are attracting a declining number of students; women, most minorities, and persons with disabilities are underrepresented in science and engineering courses and careers; and there are low levels of scientific literacy among the American public.

NATIONAL EDUCATION GOALS

Following the 1989 Education Summit, President Bush and the Governors established a national goals for improving education in the United States. All these goals are critical to ensuring America's future international competitiveness. The goals have won strong support. Goal #4 captures the spirit of the challenge that faces us in its clear charge: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement."

NATIONAL EDUCATION STRATEGY

On April 18, President Bush announced the National Education Strategy. I am pleased to be able to tell you that the President's FY 1992 Budget initiative for mathematics and science education will be supportive of the National Education Strategy. I and my colleagues will call attention to ways that Federal efforts for mathematics and science education will contribute to the transformation of America's schools and colleges.

THE FEDERAL ROLE

The Federal government has a vitally important role to play in achieving the National Education Goals and in implementing the National Education Strategy. We should never forget, however, that education in this country is a partnership effort involving Federal, State, and local governments, educators and parents, business and industry, professional associations, and community-based organizations. Although Federal sources provide only 6 percent of the total U.S. spending for elementary and secondary education, the Federal government can play a leadership role by highlighting national problems, mobilizing national support, and funding programs that offer unique national solutions. Indeed, the measure of the success of Federal programs is not the amount of money that we are spending.

COORDINATING FEDERAL EFFORTS: THE FCCSET PROCESS

Before I provide an overview of the President's FY 1992 mathematics and science education program, I would like to describe briefly the process through which we coordinated the interagency effort to develop that initiative. When I became Director of the Office of Science and Technology Policy (OSTP), one of my early actions was to restructure and revitalize the FCCSET. The level of membership was elevated to department secretaries or deputy secretaries and heads of independent agencies to ensure that when decisions were made, they would stay made. I established a new committee structure with seven standing committees. The FCCSET membership and the names of the seven umbrella committees are listed in Appendix A.

FCCSET COMMITTEE ON EDUCATION AND HUMAN RESOURCES

In the case of the Committee on Education and Human Resources (EHR), I was particularly pleased that Admiral James Watkins, Secretary of Energy, agreed to be chairman. He has been ably assisted in that role by the two Vice Chairmen, Ted Sanders of the Department of Education and Luther Williams of the National Science Foundation. Sixteen departments and agencies are members of the FCCSET EHR Committee; they are listed in Appendix B.

I charged the EHR Committee with tasks related explicitly to improving science, mathematics, engineering, and technology education. Among these tasks were the following: To improve interagency planning, coordination, and communication; and to develop and update long-range plans for the overall Federal effort, particularly plans for the Federal role in achieving National Education Goals 3, 4, and 5. (The National Education Goals are listed in Appendix C.)

The Committee's initial challenge was to develop a systematic, comprehensive, and accurate inventory of existing Federal programs and activities related to mathematics, science, and technical education. This task led to the production of the first comprehensive collection of information about the full range of Federal programs for mathematics and science education. In itself, this product is a major accomplishment.

The Committee then established strategic objectives and funding priorities for FY 1992, using the National Education Goals as policy guidance. While the National Education Goals are noble goals, the challenge we face is how to get there. But first, we had to know where we are starting from. As a baseline, the Committee used FY 1990—the year that began immediately after the September 1989 Education Summit—and prepared coordinated budget recommendations for FY 1992.

FINDINGS FROM BASELINE INVENTORY

From the Committee's baseline inventory, we know that:

—There was significant program growth in several Federal agencies, particularly in the precollege area, immediately following the Education Summit (FY 1990) through Secretary- and Administrator-directed intraagency reallocations.

—Many Federal agencies rely on scientists, engineers, mathematicians, and technicians to carry out their basic missions.

—All of these agencies conduct mathematics, science, and technology education activities to some degree and can contribute to achieving the National Education Goals.

—The baseline level of science education effort in these agencies was far greater than had been previously recognized.

—All of these agencies have expert personnel who can be used in an expanded educational capacity.

—There is also considerable work being done on a volunteer basis by scientists and engineers in Federal facilities to help improve mathematics and science education.

—Informational and programmatic linkages within and between agencies could be improved and expanded, resulting in greater dissemination of successful programs.

—The Federal government's unparalleled collection of unique scientific and technical facilities, located in every State, the District of Columbia, Puerto Rico, and the Territories, could be used more fully to serve mathematics and science education, resulting in increased benefit at low or no additional cost.

STRATEGIC FRAMEWORK AND BUDGET PLANNING PRIORITIES

The Committee on Education and Human Resources established four strategic objectives for improving mathematics and science education in the near term, in concert with the National Education Goals. These objectives, in descending order of priority, are: One, improved science and mathematics performance; two, strong precollege teacher workforce; three, adequate pipeline for the science and technology workforce, including increased participation of underrepresented groups; and four, improved public science literacy.

Using these strategic objectives as guides, the Committee established the budget planning priorities reflected in the FY 1992 Budget. Before proceeding to discuss these priorities, I would like to make two points.

First, the FY 1992 Budget request that we are discussing at this hearing includes only those programs for which Congress appropriates funds expressly for science, mathematics, engineering, and technology education and those programs funded under other agency accounts that are expressly managed as science, mathematics, and engineering education activities, such as educational materials developed by specific programs on their specific program topics. These programs are those over which the CEHR member agencies have most immediate and direct control and which will be the focus of this morning's discussion.

It is important to recognize, however, that there are other programs that contribute to mathematics and science education although their primary objective is some other purpose. Programs funded under agency research accounts and managed as research programs may contribute to mathematics and science education, generally at the graduate level, for example through the support of graduate students as research assistants. The estimated number of students receiving such support is substantial. NSF alone estimates that in FY 1992 it will be supporting 21,000 graduate students in this way; the corresponding number for FY 1991 is 19,000 so that our budget request for NSF will allow an 11 percent increase in the support of graduate students.

In addition, there are broad, general education programs that provide a level of support for science, mathematics, engineering, and technology education. An example is the Department of Education's Chapter 1 formula grant program, which provides funds to local school districts that may be used for mathematics education, among other activities. The proportion of the spending devoted to mathematics and science, and how those funds are used is determined by States, local governments, and school districts.

Second, the principal emphasis in my remarks and those of my colleagues today will be on precollege and undergraduate education. I want to emphasize, however, that graduate education remains a top priority for the Federal government. U.S. graduate education is a very real success story, and it should continue to be supported vigorously. The President's Budget does that. Our attention today is on those parts of the U.S. educational system, particularly at the precollege level, that urgently need added attention.

The FY 1992 budget planning priorities for precollege education are as follows: One, teacher enhancement and preparation; two, curriculum; R&D in teaching and learning; materials; evaluation; dissemination; technical assistance; three, comprehensive programs/organization and systemic reform; and four, student incentives and opportunities.

The above priorities indicate those areas for which change should be implemented first to help achieve the National Education Goals by the year 2000. There is special emphasis on increasing the participation of groups currently underrepresented in mathematics, science, and engineering fields. This emphasis cuts across all the priorities and all education levels.

The strategic objectives and the budget planning priorities developed through the FCCSET process align very closely with the National Education Strategy. In mathematics and science education, the Federal programs in the FY 1992 initiative address the four groups of students that President Bush highlighted on April 18: Today's students who will be the first to benefit from teacher enhancement, new curricular materials, and student opportunities; tomorrow's students who will benefit from the full flowering of efforts now being started, particularly comprehensive programs for organization and system reform; all of us who will gain from improved science literacy; and our communities, which will be changed through the design of new schools and programs for the year 2000 and beyond. My colleague Ted Sanders will address this topic is greater depth in his testimony.

The Committee established a similar set of planning priorities for undergraduate education, again with an emphasis on underrepresented groups. My colleague Walter Massey will be discussing this aspect of the Committee's work in greater detail later this morning.

BENEFITS OF A COORDINATED FEDERAL STRATEGY

Our coordinated Federal strategy for improving mathematics and science education will produce many benefits, some of which benefits have already been realized.

Baseline information on Federal activities.—The FCCSET process has produced a government-wide inventory that, for the first time, lists all Federal mathematics, science, and engineering education programs and activities across agencies and categorizes them according to degree of focus on mathematics and science education. The inventory includes previously unavailable information for policymakers about mathematics and science education activities at levels below the traditional agency budget line items, as well as volunteer and outreach activities. The inventory can serve as a valuable guide for teachers, parents, school administrators, and others who would like access to Federal expertise and resources.

An integrated Federal response.—The problems addressed by the National Education Goals and the National Education Strategy cut across the missions of many Federal agencies, and so should the solutions. The programs in the President's FY 1992 Budget will enable member agencies and other policymakers to take a global view of the entire Federal response to mathematics and science achievement and to revise priorities or emphases to form a coordinated Federal strategy for meeting the National Goals.

Reductions in overlap and gaps.—By learning more about missions and programs of different Federal agencies, the President and the Congress can take action to reduce overlaps and fill gaps.

Cost effectiveness.—New knowledge about the range and purposes of Federal programs will result in more effective use of Federal resources. Since many programs in the inventory are cooperative ventures with other levels of government and the

private sector, it will be possible to open new avenues for cost sharing and greater leveraging of public and private funds.

More emphasis on precollege education.—The President has made precollege education the highest priority, focusing resources and attention on the crucial elementary and secondary years. In the America 2000: Excellence in Education Act, which will soon be sent to Congress, the President will propose a number of initiatives to improve and restructure precollege education, including defining new World Class Standards for schools, teachers, and students in five core subjects, including mathematics and science. In his testimony this morning, Ted Sanders will provide a more complete summary of the President's proposals for precollege education.

A stronger teaching force.—Within precollege education, the FY 1992 Budget places first priority on enhancing the skills of teachers. Teachers will gain greater exposure to cutting-edge science, update their knowledge, and become better prepared to educate students.

Better educated students.—The FY 1992 Budget provides for better use of Federal resources to motivate students to stay in the mathematics, science, and engineering pipeline. Student exposure to the latest scientific and technical developments will be increased through hands-on activities that link curricula with the real world of science and through contact with Federal experts and facilities. Targeted Federal programs will help students complete high school with competency in mathematics and science and encourage them to enter college to receive further education in these subjects.

A more scientifically literate public.—The increased coordination achieved through the FCCSET process will better enable Federal agencies to provide science and technology information to the public and increase public understanding.

A more diverse scientific and technical work force.—The multiple programs reaching groups underrepresented in science and engineering, such as women, minorities, and the disabled, will improve career awareness and educational opportunities for these groups, which are integral to the nation's future work force.

More educational facilities.—Federal laboratories and other scientific facilities can become centers for student and teacher learning outside the classroom, offering hands-on opportunities and exposure not available in traditional school settings.

Replication of successful programs.—Greater cooperation among Federal agencies, fostered through the FCCSET, will open new channels for disseminating information about exemplary programs and will expand opportunities for successful programs to be replicated.

Interagency network.—Through the work of the Committee, there now exists a network of mathematics and science education professionals across all Federal agencies who can serve as valuable sources of information and coordination.

Better evaluation.—The inventory of Federal programs developed by the Committee shows how Federal funds are currently being spent. This inventory will allow the Committee to evaluate individual agency programs and will provide a framework within which Federal funds can be refocused as needed to achieve programmatic objectives.

Greater public support.—The coordinated interagency budget and the program inventory are important public information documents about Federal programs, facilities, expertise, and resources for mathematics and science education. Greater public awareness and access to Federal resources can translate into increased public commitment and community action. These elements—increased public commitment and community action—are key elements in the National Education Strategy.

Coordination with the States and public sector.—By coordinating its own efforts in mathematics and science education, the Federal government can provide State and local governments and the private sector with easier and greater access to well-organized and effectively run Federal programs and other resources, such as personnel, educational materials, facilities, and equipment. By working together in this way, national progress toward achieving the National Education Goals by the year 2000 can be made most rapidly.

FY 1992 BUDGET REQUEST

The President's FY 1992 budget request for mathematics and science education programs is $1.94 billion. The requested funding represents a $225 million or 13 percent increase over FY 1991. The following table summarizes the President's request by educational level.

TABLE 1.—FISCAL YEAR 1992 BUDGET REQUEST FOR MATHEMATICS AND SCIENCE EDUCATION

[Dollars in millions]

Level	Fiscal year—		Increase	Percent increase
	1991 enacted	1992 request		
Precollege	$514	$660	$146	28.4
Undergraduate	417	477	60	14.3
Graduate	784	803	19	2.4
Total	1,715	1,940	225	13.1

In conformance with the policy guidance provided by the National Education Goals, the largest single increase in the FY 1992 budget request is in the precollege education area, which received a $146 million or 28 percent increase to $660 million. The next largest increase—$60 million or 14 percent—went to undergraduate education, with graduate education, the single largest component, receiving a 2 percent increase to $803 million.

FY 1990-92 GROWTH

The President's request for FY 1992 marks the second year of significant increases for Federal mathematics and science education programs. The FY 1992 request represents a 13 percent increase over FY 1991 and a 32 percent increase over FY 1990. (See Appendix D for detail.)

The most notable increase has been at the precollege level. The 92 percent growth in precollege funding between FY 1990 and FY 1992 is the direct result of heightened attention to elementary and secondary education brought about by the Education Summit in September 1989.

DEPARTMENTAL AND AGENCY ROLES

Several Federal departments and agencies make substantial investments in mathematics, science, and engineering education, and their roles vary by educational level. Among the departments and agencies over which this Subcommittee has jurisdiction, the following are participating in the President's initiative through the FCCSET process: National Science Foundation (NSF), National Aeronautics and Space Administration (NASA), Environmental Protection Agency (EPA), Department of Housing and Urban Development (HUD), and Department of Veterans Affairs (VA).

At the precollege level, the Department of Education and the National Science Foundation are the principal agencies involved in mathematics and science education. Together, their programs represent 86 percent of the total FY 1992 budget request for precollege programs. The mission agencies—those with primary missions in science and research and development and with traditions of involvement in science and mathematics higher education—also have a modest precollege investment that they are proposing to expand in FY 1992.

At the undergraduate level, the Department of Defense (DOD) provides the highest level of funding for mathematics and science education, followed by the National Science Foundation and the Department of Health and Human Services.

At the graduate level, the Department of Health and Human Services (HHS) provides the greatest amount of support. HHS is followed by DOD and NSF in terms of their budget requests for FY 1992 for graduate science and mathematics education.

DETAILS OF PRESIDENT'S FY 1992 REQUEST

I would now like to call on Ted Sanders, Deputy Secretary of Education, and then on Walter Massey, Director of the National Science Foundation, to provide more specifics of the President's FY 1992 budget request for mathematics and science education. Dr. Sanders will focus on precollege education, and Dr. Massey will cover undergraduate education. They will point out the ways that the recommendations developed through the FCCSET process, particularly as implemented in the programs of their department and agency, dovetail with and support the National Education Strategy.

Again, I want to express my appreciation to Senator Mikulski and her colleagues for holding this hearing.

APPENDIX A

MEMBERSHIP OF FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY (FCCSET)

OFFICE OF SCIENCE AND TECHNOLOGY POLICY, CHAIR

Department of State
Department of Defense
Department of the Interior
Department of Agriculture
Department of Commerce
Department of Health and Human Services
Department of Housing and Urban Development
Department of Transportation
Department of Energy
Department of Education
Department of Veterans Affairs
Office of Management and Budget
National Security Council
National Aeronautics and Space Administration
Environmental Protection Agency
National Science Foundation

FCCSET STANDING COMMITTEES

Committee on Earth and Environmental Sciences
Committee on Education and Human Resources
Committee on Food, Agricultural, and Forestry Research
Committee on Industry and Technology
Committee on International Science, Engineering and Technology
Committee on Life Sciences and Health
Committee on Physical, Mathematical, and Engineering Sciences

APPENDIX B

MEMBERSHIP OF FCCSET COMMITTEE ON EDUCATION AND HUMAN RESOURCES

Department of Energy, Chair
Department of Education, Co-Vice Chair
National Science Foundation, Co-Vice Chair
Department of Defense
Department of Justice
Department of the Interior
Department of Agriculture
Department of Commerce
Department of Labor
Department of Health and Human Services
Department of Housing and Urban Development
Department of Transportation
Department of Veterans Affairs
National Aeronautics and Space Administration
Environmental Protection Agency
Office of Management and Budget
Office of Science and Technology Policy
Office of Policy Development
The Smithsonian Institution

APPENDIX C

NATIONAL EDUCATION GOALS

Goal 1. By the year 2000, all children in America will start school ready to learn.

Goal 2. By the year 2000, the high school graduation rate will increase to at least 90 percent.

Goal 3. By the year 2000, American students will leave grades four, eight and twelve having demonstrated competency in challenging subject matter including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared

for responsible citizenship, further learning, and productive employment in our modern economy.

Goal 4. By the year 2000, U.S. students will be first in the world in science and mathematics achievement.

Goal 5. By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.

Goal 6. By the year 2000, every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning.

ADDITIONAL COMMITTEE QUESTIONS

Senator MIKULSKI. We will submit the balance of the questions for response in the record.

[The following questions were not asked at the hearing, but were submitted to the Department for response subsequent to the hearing:]

QUESTIONS SUBMITTED BY SENATOR MIKULSKI

SCIENCE EDUCATION: PRIORITIES AND COSTS

SENATOR MIKULSKI: If the President's top domestic priority is to make the U.S. "first in the world in science and mathematics achievement" by the year 2000, why is science and mathematics education funding going up by only 13 percent in the 1992 budget, while other science initiatives in supercomputing and climate change research go up 30 percent and 24 percent respectively? In an era of tight budgets, shouldn't the highest priority area, like education, receive a proportionately greater share of funds?

ANSWER: Although a top domestic priority for the Administration is to make the U.S. "first in the world in science and mathematics achievement" by the year 2000, the Federal government is not the major source of funds for education, unlike the case for research in areas such as supercomputing and climate change. For example, in precollege education, Federal dollars represent only approximately 6 percent of total national funding, with most of the balance derived from State and local sources.

While the percentage increases would appear to differ greatly between education and the other science initiatives mentioned above, one must recognize that the bases for comparison are quite different. The proposed 30 percent increase in the FY 1992 budget for research in supercomputing represents an increase of $149 million, while the 24 percent increase designated for climate change research in this year's budget translates to $232 million. By contrast, the 13 percent increase in the 1992 budget for science and mathematics education represents a $225 million increase over FY 1991 and a 32 percent increase over FY 1990. The most notable increase has been at the precollege level. The 92 percent growth in precollege funding between FY 1990 and FY 1992 is the direct result of heightened attention to elementary and secondary education brought about by the Education Summit in 1989.

SENATOR MIKULSKI: If we implemented the Administration plan for 1992 in toto, could you say specifically when we would see tangible or measurable results on each of the four key objectives in the FCCSET Committee on Education and Human Resources plan as described in "By the Year 2000"?

ANSWER: The FCCSET Committee on Education and Human Resources (FCCSET-CEHR) is preparing an implementation plan that will include the measurement of results as part of the FY 1993 plan.

SENATOR MIKULSKI: What will a fully mature program, designed to meet the U.S. goals in science and mathematics, likely cost the federal government annually when implemented?

ANSWER: The President has requested a total of $1.94 billion for FY 1992 for mathematics and science education. This represents a $225 million, or 13.1 percent, increase over the FY 1991 level. The Administration is in the process of preparing the FY 1993 budget, at which time the long-term outlook will become clearer.

SENATOR MIKULSKI: How can the Administration's science and math education plan succeed in an era when state and local governments are making sharp reductions in their education spending? (A recent network news story reported that seven southern states were cutting a combined total of $1 billion from education.)

ANSWER: Adequate funding is important, but it is not the most critical factor. The Administration's education plans do not place heavy reliance on new funds, federal or state. They do place heavy reliance on changes in attitudes, expectations, and organizational behavior. Strong federal leadership can help the states make the most of the aggregate resources provided for education.

FCCSET-CEHR

SENATOR MIKULSKI: Isn't it fair to say that the FCCSET report, "By the Year 2000" is more of an inventory of what the federal government is now doing rather than a strategic plan for science and mathematics education? When will a plan for implementation be completed?

ANSWER: The report By the Year 2000: First in the World is much more than an inventory of federal science and mathematics programs. The report (i) defines the baseline of federal funding and programmatic activity; (ii) outlines strategic objectives and implementation priorities; (iii) presents the first coordinated federal interagency budget for science and mathematics education; (iv) lists criteria for evaluating federal programs; (v) highlights new initiatives and ongoing programs by educational level and agency; and (vi) provides contact information for each agency so that the public can more easily participate in these programs.

SENATOR MIKULSKI: Does the FCCSET Committee on Education and Human Resources have the clout to redirect agencies so that they develop their activities in a way that is consistent with the Administration's plan for science and mathematics education?

ANSWER: Members of the FCCSET-CEHR are representatives of agencies and departments who have policy-making and administrative authority for their programs. Working through the FCCSET process, the agencies and departments are able to coordinate their activities to maximize their effectiveness. Responsibility for implementing these activities remains with the agencies and departments.

SENATOR MIKULSKI: Can you give me three examples of how the FCCSET coordination effort did just that in an agency's original budget request to OMB?

ANSWER: In its first year, the FCCSET-CEHR developed the following materials:

- o The National Education Priority Framework to guide agencies in the design of science, mathematics, engineering and technology education programs.
- o A program inventory to describe the total Federal science and mathematics education effort.
- o Common evaluation criteria for these programs.

As the Committee matures, these tools, together with improved interagency coordination and communication, will strengthen both individual agency programs and the overall Federal effort. The potential of the FCCSET-CEHR to assist agencies and departments to improve their federal science and mathematics education programs is illustrated in the following examples:

- o The FCCSET-CEHR encourages interagency collaboration that leads to effective utilization of resources in meeting common objectives. For example, the Department of Energy (DOE) is seeking to expand use of its national laboratories for improving education and the Department of Interior (DOI) wants to strengthen science and mathematics instruction in its Tribal Schools. In FY 1991, Admiral Watkins and Secretary Lujan signed a Memorandum of Understanding (MOU) which resulted in the pilot DOE Science Advisor's Program. Through this program, 25 scientists from the Sandia National Laboratory will serve as consultants to teachers and mentors to Native American students in New Mexico.
- o Four percent of undergraduate science and mathematics education funding is targeted toward two-year colleges, which are a significant

source of students -- many of whom are women and minorities -- who continue on for baccalaureate and graduate degrees and who gain technical degrees. FCCSET-CEHR agencies singled out two-year colleges as an area of special attention for FY 1993. In response to FCCSET CEHR concerns, the National Aeronautics and Space Administration (NASA) has included a pilot two-year college program in its FY 1992 budget. The agency also allocated part of the additional FY 1991 appropriation it received for education to start the program a year early.

- The FCCSET-CEHR placed a priority on precollege education as a means to achieving national education goals. The Department of Health and Human Services (HHS) has traditionally concentrated its education programs in the graduate arena. In FY 1992, HHS is seeking to establish its second largest precollege program, the Science Education Partnership Awards (SEPA), which will enlist the help of working scientists and educators in enhancing science education and public scientific literacy. The National Science Foundation (NSF) will be collaborating with HHS through all stages of program development.

EDUCATIONAL REFORM

SENATOR MIKULSKI: While the report says that "dramatic changes in educational structures" (p. 35) will be needed to reach our goal of being first in the world in science and mathematics achievement, there are no programs for comprehensive reform in science and mathematics education from the Department of Education. Why not?

ANSWER: Over the past two years the Department of Education has recommended substantial increases in funding for the Eisenhower Mathematics and Science Education Program, which focuses on teacher training. The report of the FCCSET-CEHR sets teacher preparation and enhancement as the number one priority. Clearly, the Department's emphasis on improving teacher training is an extremely important element of a coordinated federal approach to comprehensive reform. Under the Eisenhower national programs, the Department is also supporting, in conjunction with NSF, several national mathematics and science curriculum reform efforts, such as the American Association for the Advancement of Science Project 2061, and the National Science Teachers' Association's Scope, Sequence, and Coordination Program. These are intended to bring about comprehensive reform of math and science curricula.

As for the future, the President just recently announced his AMERICA 2000 education strategy, which sets out a comprehensive and long-range plan for reform and for moving the Nation toward all of the national education goals. Proposed legislation for those aspects of the strategy that require it has been submitted to Congress. The strategy involves defining World Class Standards for performance of American students in all five core subjects, two of which are mathematics and science, standards that represent what young Americans need to know and be able to do if they are to live and work successfully in today's world; developing American Achievement Tests that could be used on a voluntary basis to assess students' achievement against the standards and that are designed to foster good teaching and learning as well as to monitor student progress; Governors' Academies for Teachers in the five core subjects to give teachers the knowledge and skills they need to help students attain the World Class Standards and pass the American Achievement Tests; and support for creating New American Schools, schools that are the best in the world, schools that enable their students to reach the national education goals and achieve a quantum leap in learning.

SENATOR MIKULSKI: If top-to-bottom change in America's 16,000 school districts is a key to reversing our scientific decline, why is less than 3 percent ($58 million) of the total federal science and mathematics education budget in 1992 going for this kind of organizational reform? What are the projected costs for organizational reform if it is to be effective?

ANSWER: By itself, organizational reform is not the entire answer, nor is it necessarily as high a priority as teacher and faculty enhancement or curricular reform. Teachers and administrators who are most directly involved in educating students must gain the knowledge and skills needed to implement "systemic reform" initiatives emanating from the States.

Organizational reform is receiving increasing focus. The National Science Foundation has completed the first round of awards under the Statewide Systemic Initiatives program. The Department of Education's primary role, through the Eisenhower State Grants Program, is to provide States and localities with a flexible resource for teacher enhancement activities. The Department will encourage States to use Eisenhower funds to link up with the NSF systemic reform initiative.

EVALUATION

SENATOR MIKULSKI: Since solid evaluation is the key to spending our money smarter, particularly in these financially tough times, why does evaluation only get $12 million, about 1/2 of 1 percent of the total federal science and mathematics investment in 1992?

ANSWER: The $12 million request reported in the federal science and mathematics education budget represents only those activities expressly funded by agencies for program evaluation and assessment. As such, this level of funding understates federal support for evaluation. It excludes, for example, evaluative components built into large-scale programs. It also ignores the considerable time and expertise afforded by federal staff, peer review panels, and advisory committees in important evaluation-related activities associated with the design, selection process, monitoring, and fine-tuning of program operations. Agencies regularly assess a great deal of information, such as the numbers of teachers and students reached, against which the agencies can calibrate the success of their programs.

Program effectiveness and efficiency is of primary concern to the FCCSET-CEHR member agencies. Over the last year, the FCCSET-CEHR developed common program evaluation criteria against which all agency programs can be assessed and the entire Federal effort itself can be evaluated. These criteria include:

- o Relevance/contribution of programs to meeting national education goals and objectives.
- o Merit/readiness of programs.
- o Expected impact.
- o Alliances forged with members of the educational establishment.
- o The extent of leveraged resources.
- o Adequacy of resources as measured against program objectives and benefits obtained.

FCCSET-CEHR agencies are currently completing an extended process of familiarizing themselves with the full panoply of programs across member agencies to identify opportunities for collaboration, redundancies, and gaps in coverage and to assess effectiveness of various program strategies.

Over the next several years, agencies will undertake formal evaluation of major programs. The National Science Foundation has designed a four-year plan to assess its programs in science and mathematics education. The Foundation has briefed the FCCSET-CEHR on these plans and has agreed to provide the support structure necessary to carry out a Government-wide evaluation process.

SENATOR MIKULSKI: What are the Administration's plans for evaluating the various components of the science and mathematics education initiative (e.g., teacher enhancement, curricula development, etc.)? Which federal agency has the lead for doing an independent evaluation of what works?

ANSWER: Hundreds of science and mathematics education programs are operating in twelve federal departments (ranging from Agriculture to Veterans Affairs) and independent agencies (including the Environmental Protection Agency, the National Science Foundation, the National Aeronautics and Space Administration, and the Smithsonian Institution). The coordination of this vast assemblage of programmatic activities has been assigned to the FCCSET-CEHR.

In January 1991, the agency members of the FCCSET-CEHR Committee began a comprehensive review and evaluation of all math and science education programs. This effort will require intensive and sustained planning and preparation. Each program will be measured against the following criteria to determine its effectiveness: (i) merit/readiness; (ii) impact; (iii) alliances; (iv) costs; and (v) agency approval.

There will be an integrated federal response. Cost effectiveness is being promoted by each agency's assuming basic responsibility for the objective evaluation of the effectiveness of its own programs -- subject to the criteria and standards agreed on at the FCCSET-CEHR level.

The National Science Foundation has agreed to provide the support structure necessary to carry out this government-wide evaluation process. NSF will use the FCCSET-CEHR interagency networks to:

- o Coordinate the various agency evaluation efforts;
- o Regularly aggregate reports and data generated through agency program evaluations;
- o Analyze and interpret the information so developed; and
- o Report periodically to the Congress and to the FCCSET-CEHR member agencies the overall findings of the evaluation effort.

NSF's Directorate for Education and Human Resources (EHR) is now beginning the interagency cooperation and planning necessary to implement these plans.

SENATOR MIKULSKI: Can you give us a specific schedule for the evaluation of each of the components? Estimate what the cost of effective evaluation should be for the mature program.

ANSWER: The National Science Foundation plans to evaluate its education programs on a four-year cycle. FCCSET-CEHR discussions of the education program evaluation planning of other member agencies are still on-going, so it is not possible at this time to indicate their individual or average cycle times. The strategies for carrying out the cross-agency aspects of the evaluation of all federal education activities will be developed cooperatively with the cognizant officials of each agency.

Many authorities on the behavior of governmental and other non-profit organizations suggest that they should devote 2 to 3 percent of their budgets to evaluation and other forms of research on themselves. It is reasonable to assume that such a level of expenditure in the steady state would support an effective program of evaluation.

STANDARDIZATION

SENATOR MIKULSKI: How does the Committee intend to standardize the functions of science and mathematics education in the mission agencies? At what level in the agencies do you see this function being located?

ANSWER: Common to the federal mission agencies are three components:

- o A highly talented work force of practicing scientists, engineers, and technicians;
- o Laboratory and research facilities; and
- o Individual missions that show practical applications of the disciplines of mathematics, science, and technology and their integration.

These features, shared by all mission agencies, provide a common and standardized approach to supporting mathematics, science and technology education at the pre-college, undergraduate, and graduate levels.

The organizational element or function that implements mathematics, science and technology education programs within the mission agencies should have certain characteristics that are common across agencies. These should include, but not be limited to:

- o Ready access to the agency administrator or director and agency senior management;
- o A centralized organizational element for coordinating all agency educational activity (i.e. policy, budgets, data, etc.); and
- o Leadership by a member of senior management.

However, the level at which this function is placed within a mission agency is a decision best made by the mission agency's administrator so as to maximize organizational effectiveness and resource allocations.

SCIENCE EDUCATION AND THE NATIONAL LABORATORIES

SENATOR MIKULSKI: What steps has the FCCSET Committee taken in the last year to coordinate science and mathematics education activities at the nation's federal laboratories? For example, is someone officially in charge of science and mathematics education at each laboratory?

ANSWER: A number of the departments and agencies have research and development activities that are conducted through in-house and/or sponsored Federal laboratories. Many of the laboratories, particularly the larger ones, have established education offices or have designated certain staff to carry out this function. Furthermore, a number of partnerships between the departments and agencies and their laboratories have been established to bring their resources, especially the expertise of their scientists and engineers, to bear on efforts to improve mathematics, science, and engineering education. Funds to initiate or continue partnership activities are included in each department's and agency's FY 1992 budget request under the President's Initiative.

The FCCSET-CEHR report, By the Year 2000: First in the World (enclosed), provides descriptions of a number of these partnerships. Mathematics and science education activities conducted by federal laboratories, including examples of specific partnership agreements for some departments and agencies, are described in the respective chapters for the following departments and agencies:

- o Department of Agriculture (pages 75-79);
- o Department of Commerce/National Institute of Standards and Technology (pages 84-85) and National Oceanic and Atmospheric Administration (pages 88-92);

- o Department of Defense (pages 95-109);
- o Department of Energy (pages 132-146);
- o Department of Health and Human Services (pages 153-161);
- o Department of Housing and Urban Development (pages 161-169);
- o Department of the Interior (pages 175-181);
- o Department of Transportation (222-230);
- o Environmental Protection Agency (pages 255-259);
- o National Aeronautics and Space Administration (pages 266-271); and
- o Smithsonian Institution (pages 292-297).

OSTP has worked with the Department of Education, the National Science Foundation, and the mission departments and agencies to further interagency cooperation with the goal of improving mathematics and science education. These activities are summarized in the chapters on the Department of Education (page 118) and the National Science Foundation (page 280).

SENATOR MIKULSKI: What steps will the Committee take to make sure that successful teacher training programs like the Department of Energy's in Chicago are used as "models" at other agencies and at other federal laboratories?

ANSWER: Prior to replication of specific educational programs, it is necessary to ensure that a thorough evaluation of the program has been performed and that the resulting data validate whether the programmatic objectives have been achieved. The FCCSET-CEHR is currently reviewing all federal education programs to better understand their program effectiveness. As the FCCSET-CEHR process matures, the establishment of new education initiatives and replication of existing programs will be directly tied to evaluation of their effectiveness.

SENATOR MIKULSKI: Are we putting a genuine "science education/technology transfer" process in place in the laboratories? Give some examples.

ANSWER: The federal government laboratories provide an excellent venue to demonstrate the application and integration of mathematics, science, and technology to real world problems and challenges. By opening up our laboratories to pre-college teachers and university faculty, it is possible to enhance the individual knowledge, skills, and abilities of our teachers and faculty. This allows them to transfer their experiences to their students and teach "genuine" science, mathematics and technology and, more importantly, demonstrate the interrelationships among disciplines.

All mission agencies have educational programs to open up laboratories to teachers and faculty. One such example is a NASA program that annually provides training to approximately 200 teachers through its nine field centers. Teachers participate in a variety of hands-on experiences and content lectures that demonstrate real-world applications of science, mathematics, and technology. Central to this experience is "translation time" -- a period when teachers individually assess their experiences and translate them into lesson plans to meet the curriculum standards in their respective school systems.

TEACHER ENHANCEMENT

SENATOR MIKULSKI: Do all the agencies presently support teacher enhancement or training programs? For those that do, please specify (agency by agency):

How much the agencies are spending;

How many of the Nation's science teachers are being reached each year;
What kind of training is provided;
What is the duration of the program; and
How are the programs reviewed to determine if they work well?

ANSWER: Teacher preparation and enhancement programs are supported primarily by three agencies: the Department of Education, the National Science Foundation, and the Department of Energy. The FCCSET-CEHR report, By the Year 2000: First in the World, sets forth on pages 29-31 details regarding the kind of training provided, the numbers of teachers reached each year, and the amount of support provided.

QUESTIONS SUBMITTED BY SENATOR KERREY

SENATOR KERREY: We are now almost 20 months away from the Charlottesville Education Summit. I would like for each of you to tell me what you think the most single important action or effort undertaken by your department or agency during that time has been.

ANSWER: In its first year of activity, the FCCSET Committee on Education and Human Resources (FCCSET-CEHR) established a federal plan for math, science, engineering, and technology education and produced the first comprehensive inventory and budget for existing federal programs against which a comprehensive federal plan and individual agency programs could be evaluated. The federal strategy for improving mathematics, science, and technology education includes both formal and informal education programs and spans all education levels -- precollege to graduate school. Program emphasis in the President's FY 1992 budget is placed at the precollege level in order to facilitate achieving the immediate objective of improving mathematics and science performance by the end of the decade. The intent of the strategy is to catalyze and assist in a general rebuilding of the education system starting at the bottom. A copy of the report, By the Year 2000: First in the World, describing FCCSET-CEHR efforts, is enclosed.

SENATOR KERREY: Next fall, the 1991-92 school year will begin. Those in the fourth grade and above are the ones who will have to bring achievement up to the stated goal, if it is to be done. What do you think the most important program or activity your department or agency will have in place at that time will be?

ANSWER: OSTP respectfully defers to the National Science Foundation and the Department of Education for their responses.

SENATOR KERREY: I want to thank you for the maps in the FCCSET report. Last year I had to do my own. I call attention to them because they illustrate a point that I make over and over: the uneven geographical distribution of federal facilities, federal research funds and even competitive K-12 funds. I would like for each of you to tell me what your department or agency is doing to redress this imbalance.

ANSWER: OSTP respectfully defers to the National Science Foundation and the Department of Education for their responses.

SENATOR KERREY: The FCCSET reports give a number of significant - and unfortunate - figures regarding attraction and retention of teachers. The report also indicates that a major emphasis - if not THE major emphasis - is on teacher preparation and enhancement. Young teachers seem particularly vulnerable to leaving the profession. These are years when their pay is lowest; they may get the least desirable of assignments; they are still in a learning mode, especially with respect to what works and what doesn't work in a classroom; they are often the last to be asked to participate in seminars, symposiums, etc.; they may owe on student loans.

Have you given any consideration to positive incentives to staying in teaching and enhancing skills at this point? Perhaps we should experiment with or try a demonstration program which would reward them for staying in teaching -- give them a stipend for further coursework or research activity related to their subject.

I think many of our incentives tend to be somewhat negative, although I've been a proponent. We'll give you scholarships but you have to teach in certain areas or schools; you have to teach, perhaps teach a specified subject, for so many years. What about coming at the problem from a different angle?

ANSWER: OSTP respectfully defers to the National Science Foundation and the Department of Education for their responses.

QUESTIONS SUBMITTED BY SENATOR HATFIELD

SENATOR HATFIELD: I am interested in the reflections of the National Science Foundation and the Department of Education on the major areas of overlap between them in mathematics and science education and how federal resources can be leveraged to enhance their interagency coordination.

ANSWER: OSTP respectfully defers to the National Science Foundation and the Department of Education for their responses.

SENATOR HATFIELD: Now that the initial FCCSET Report has been issued, what are the future plans and activities of the Federal Coordinating Council for Science, Engineering and Technology, Committee on Education and Human Resources? Will the Committee remain in existence and move to the next step of recommending action to both the Congress and the Administration to enhance the expenditure of federal funds in these areas? How will this report be used by the President in the federal budget process?

ANSWER: The FCCSET Committee on Education and Human Resources is currently working on a review of existing federal programs for mathematics, science, engineering, and technology education. The Committee is also reexamining the goals and priorities it developed last year to take into account the new National Education Strategy (AMERICA 2000) and the continuing work on the National Education Goals. The Committee expects to make recommendations that will assist in formulating the President's FY 1993 budget.

SENATOR HATFIELD: Public Law 101-159 included authorization for a National Clearinghouse on Science, Mathematics, and Technology Materials. Congress provided $500,000 in FY91 to begin design and implementation of this project. It is my understanding that the National Science Foundation has been consulting with the Department of Education on the design for the clearinghouse. Please provide me with an update on this project and the role of the National Science Foundation in assisting with its development.

ANSWER: OSTP respectfully defers to the National Science Foundation and the Department of Education for their responses.

NATIONAL SCIENCE FOUNDATION

STATEMENT OF DR. WALTER E. MASSEY, DIRECTOR

Senator MIKULSKI. Why not turn now to Dr. Massey in his first appearance before this subcommittee, the new Director of the National Science Foundation.

Doctor, we have had a chance to meet on a field trip, but the committee would like to give you a really cordial welcome. We really look forward to working with you on this year's budget request and all the other matters that will come over the next several years.

Dr. MASSEY. Thank you very much, Madam Chair.

It is a pleasure to appear before this subcommittee for the first time as Director of the National Science Foundation and to be here with my colleagues, Allan Bromley and Ted Sanders.

As we all know, this week is National Science and Technology Week. And yesterday to commemorate this event, as the chair of the committee has said, the two of us spent what I thought was a very memorable day, first at the Maryland Science Center in Baltimore and later at the Owens Science Center in Prince Georges County. At both places we were surrounded by eager, excited young people who were very much involved in math and science projects, hands-on projects.

I believe we have a special responsibility to these young people and to young people everywhere to provide them with opportunity and encouragement so that their natural curiosity and interest in science or math or engineering is allowed to flourish and grow.

NSF'S ROLE IN EDUCATION AND HUMAN RESOURCES

I believe we all share a deep and personal commitment to the improvement of our educational process and the development of all of our country's resources. I welcome this opportunity to discuss with you, Madam Chair and the committee, both the Foundation's own programs and the role of the Foundation in the FCCSET process of the Committee on Education and Human Resources.

The education and development of our human resources has long been recognized as essential to ensuring the vitality of our research enterprise and securing U.S. leadership in the world economy. Yet somehow over the past several decades, we as a nation have allowed science and mathematics education to erode to the point where we are jeopardizing our ability to produce skilled scientists and engineers, technical workers, and a scientifically literate public.

The problem we face is large and very complex. But I believe we as a nation are equal to the challenge. The Foundation has a special role in this area. Our mandate is to support math and science education programs covering the full spectrum of the pipeline,

precollege through graduate education. And the Foundation's portfolio of programs is varied, comprehensive, and increasingly strategic.

NSF'S STRATEGY IN EDUCATION AND HUMAN RESOURCES

Last year NSF began to redirect its programs in response to the challenges set forth in the national education goals. This new direction places us in partnership with all segments of the research and education community and challenges that community to join with us in a concerted effort to improve the quality of the math and science education we are providing for our young people.

Our approach calls for some changes in emphasis. First, the increased dissemination about and replication of successful model programs, providing national leadership to stimulate wholesale reforms in math and science education at the State and local level, collaborating with external communities to capitalize on their strengths and elicit assistance in achieving common goals. Finally, and perhaps most important, evaluation, the evaluation of the programs to ensure that they are effective and that they meet their objectives. This approach is consistent with that proposed by the FCCSET Committee on Education and Human Resources.

The NSF programs also focus at critical points along the education pipeline and attest to the belief that the education system needs to be structured from the bottom up. But it also recognizes that all is not doom and gloom, that there are some success stories in the country. We saw two of those yesterday, at least on their way to becoming successful. And we need to learn more about these.

If I might, Madam Chair, I would like to just read a couple of paragraphs that I happened to find in the Chicago Tribune this morning when I left on the plane.

It says, quote:

> The game had come down to the wire and a nervous hush fell on the packed gymnasium. It was Illinois' last chance to tie California's powerhouse team. And their star student was on the line. On the sidelines, coach Larry Minkoff, removed his glasses, wiped his brow, put his glasses back on and stared at the slim student near the foul line.
>
> The student concentrated, put pencil to paper and marked "C: hundreds of individual ringlets of water, ice, debris." The Illinois cheering section erupted. This answer to the question, what are Saturn's rings made of, placed Illinois second in the Super Quiz, perhaps the noisiest, most gut-wrenching competition played inside a gym without a ball.
>
> It gave Chicago's young magnet high school, the Whitney Young Magnet High School, a fighting chance to become the first team outside California and Texas to bring home the U.S. academic decathlon championship.

I read that because I think it exemplifies what we too often overlook, that there are successes, and successes can be achieved in the most difficult circumstances. This is from an inner-city school that a previous Secretary of Education called the worst in the Nation.

ABILITY TO LINK RESEARCH AND EDUCATION ACTIVITIES

One of the hallmarks of the Foundation's programs is its ability to link research and education activities. In this regard all NSF directorates share in the responsibility for the health of their dis-

cipline and have developed education programs suited to their own particular needs.

I believe it will become increasingly important for the research community itself to acknowledge that it has a responsibility to contribute to the improvement of math and science and engineering education at all levels.

And I am very pleased to have learned that practically all of the NSF centers, including the engineering research centers, the science and technology centers, have outreach efforts designed to reach out to the community and connect with precollege institutions in science and math education.

FCCSET COMMITTEE ON EDUCATION AND HUMAN RESOURCES

Just a couple of words on the FCCSET process. The FCCSET Committee on Education and Human Resources has put in place a strong set of interagency partnerships. Although I did not participate in this process, I can see from its results that it has demonstrated the value of the process. Its national education priority framework, the budget planning priorities, and program evaluation criteria are being incorporated into the education agenda of every member agency.

Above all, coordination and communication among the various agencies has improved cooperation between agency math, science, and education programs. And the participating agencies are now looking for additional opportunities to pool resources for projects that promise to achieve common objectives, but are beyond the capabilities of any single agency.

We are also collaborating on the development of each other's programs. For example, NSF is working with the Department of Health and Human Services on all phases of its new Science Education Partnership Act. The Foundation and the Department of Energy will be combining resources to train nearly 1,000 science and math teachers at five DOE national laboratories over the next year. Under this arrangement, the NSF will provide support and instructional material while the Department of Energy provides in-kind services to access to its laboratories and personnel.

Also, regular dialog continues between NSF and the Department of Education to share expertise as well as collaborate on projects of mutual interest. One exciting example is the collaboration of the National Science Teachers Association's curriculum development project entitled, "Scope, Sequence and Coordination." The NSF provided the initial seed money to develop the concept and the Department of Education provided substantial resources to fund the planning and application of the concept. And the NSF is following-on with the funds necessary to place the project in the field.

In conclusion, Madam Chair, I would like to thank the subcommittee and you personally for your continued interest and sustained support for science and mathematics education. Both your support and that of the committee as a whole, the subcommittee as a whole, is essential to achieving our goals.

In my new role I look forward to working with this subcommittee to achieve the National education goals and in so doing provide a better educated, trained, and scientifically literate population.

Thank you.

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PREPARED STATEMENT

Senator MIKULSKI. Thank you, Dr. Massey. We have your complete statement and it will be inserted in the record.

[The statement follows:]

STATEMENT OF DR. WALTER E. MASSEY

Madam Chairman and members of the subcommittee, it is a pleasure to appear before you for the first time as Director of the National Science Foundation. The topic of today's hearing, education and human resources development, is one in which we both share deep and longstanding personal commitments. I welcome the opportunity to discuss with you both NSF's role in the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) program plan and the Federal undergraduate education strategy.

Human resources have long been recognized as essential to ensuring the vitality of our research enterprise and securing U.S. leadership in the world economy. Yet, somehow, over the past several decades, we have allowed science and mathematics education to erode to the extent that we are jeopardizing our ability to produce skilled scientists and engineers, technical workers, and a scientifically literate public. The problem we face is large and complex, especially considering fiscal and time constraints. But I believe that we are equal to the challenge.

As a nation, we have done an excellent job thus far of laying the foundation for an effective solution. We have taken the first critical step of identifying and defining the problem. We enlisted public support for broad-based commitment for action. The President and Governors articulated the National Education Goals and energized the entire process by setting a deadline for their achievement. Office of Science and Technology Policy (OSTP) established the FCCSET Committee on Education and Human Resources (CEHR) demonstrating the willingness of the Federal government to be creative in developing expertise and maximizing the effective utilization of its resources for improving education.

NATIONAL SCIENCE FOUNDATION'S EDUCATION AND HUMAN RESOURCES STRATEGY

Since its establishmen[illegible] 1950, NSF has been charged with the dual mission of strengthening and monit[illegible]ing the health and quality of this nation's performance in science and engineering re[illegible]search and education. The [illegible]ong ties developed with both the education and broad scientific communities provide the agency with a unique and strategic role in science, mathematics, and engineering education.

NSF has a broad mandate to conduct education programs covering the full spectrum of the pipeline in science and engineering fields—precollege through graduate education. Our portfolio of programs are varied and comprehensive. Over the years, literally hundreds of NSF-supported projects have contributed to an impressive knowledge-base on the processes of teaching and learning; improving the disciplinary background of teachers; developing instructional materials, courses, and curricula; eliciting the curiosity and enthusiasm of students; and using media and non-school organizations to reach learners of all ages.

Over a year ago, the Foundation began redirecting its programs in response to the challenge set forth in the National Education Goals. This new direction places us in partnership with all segments of the education community and ch[illegible]llenges that community to join with us in identifying obstacles and devising inn[illegible] proaches for surmounting them.

Our approach calls for: Increasing our knowledge-base, as well as its application through greater dissemination and replication of successful, model programs; catalyzing systemic, permanent reform by fostering comprehensive programmatic approaches to complex educational problems; collaborating with science and engineering research and education communities outside the Federal government to capitalize on their strengths and elicit assistance in achieving common goals; continuing evaluation and monitoring of programs to guide project development; ensure that programs meet objectives; and determine the overall effectiveness of education activities; and leveraging of Federal resources.

Our approach is consistent with that proposed by FCCSET CEHR and the newly released America 2000 Initiative. It has generated excitement within the science and engineering research and education communities. And, we believe, it is one that shows great potential for success.

Foundation programs focus on critical points along the education pipeline. Our broad-based precollege program attests to our belief that the education system needs to be restructured from the bottom up. At the precollege level, NSF is: Developing

comprehensive and coherent curricula that integrate science and mathematics training throughout elementary, middle, and high schools, including large-scale national curricula projects;[1] supporting major, comprehensive reform of State education systems through the Statewide Systemic Initiative (SSI) Program which requires collaboration of State executive, legislative, education, business, and public leadership; undertaking a multi-year expansion of teacher enhancement activities to increase both direct and indirect outreach of inservice teacher training; developing Teacher Education Centers that will engage both schools of education and disciplinary departments at higher education institutions to enhance the quality of preservice teacher training; and linking informal and formal education activities to improve the science and mathematics programs offered our youth.

NSF higher education programs will: Build regional coalitions under the Alliances for Minority Participation (AMP) Program (supplementing the precollege Career Access Centers) to produce a several-fold increase in the degree production of underrepresented groups; integrate faculty, course and curriculum, laboratory, and instrumentation programs to ensure high-quality education to technical majors, future precollege teachers, and nontechnical majors; and provide financial support and research experience to thousands of the nation's best science and engineering graduate students.

As I mentioned earlier, one of the unique qualifications of the Foundation is its ability to meld education with disciplinary expertise. Each NSF Directorate shares in the responsibility for the health of its discipline and develops education programs suited to its particular needs. In addition, virtually all NSF-run Federal laboratories, Engineering Research Centers (ERCs), Science and Technology Centers (STCs), and Advanced Scientific Computing Centers (ASCs) are developing educational components that provide access of teachers, faculty, and students to state-of-the-art research projects and facilities sponsored at these locations.

NSF'S ROLE IN THE FCCSET PROCESS

The FY 1992 NSF budget request for education and human resource activities as defined by FCCSET CEHR totals nearly $456 million (Table 1). Precollege programs comprise 55 percent of the agency request; undergraduate programs, 29 percent; and graduate programs, 16 percent.

Within the 11-agency FCCSET education program plan, NSF represents nearly one-quarter of the total Federal effort, ranking second only the Department of Health and Human Services (DHHS) (Figure 1). The Foundation is a major Federal player at each education level and plays a key role in a number of critical program areas.

The NSF precollege request totals $253 million, or 38 percent of the total Federal request at this education level. NSF support of curriculum development and organization reform activities exceeds that of other agencies. The level of funding for teacher preparation and enhancement programs is second only to Department of Education activities administered under the Eisenhower Program.

The undergraduate request totals $132 million, or 28 percent of the Federal total. At this level, NSF provides most of the support for formal faculty enhancement and preparation, curriculum development, and organizational reform programs. The $71 million request at the graduate level represents 9 percent of the total, placing the agency third behind DHHS and the Department of Defense.

By broad education level, growth in the Foundation's budget request for education and human resources closely tracks the priorities set by FCCSET CEHR. Between FY 1991–92, an $84.4 million or 22.7 percent increase is requested (Table 1). Precollege programs make up over one-half the increase; undergraduate programs over one-third.

THE INTERAGENCY PROCESS: BENEFITS OF COOPERATION

The FCCSET Committee on Education and Human Resources puts in place a strong Federal infrastructure forged on interagency partnerships. Its first year has demonstrated the value of the process. Its national education priority framework, budget planning priorities, and program evaluation criteria are being incorporated into the education agenda of every member agency.

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[1]These include the American Association for the Advancement of Science (AAAS) Project 2061; the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for School Mathematics; the National Science Teachers Association (NSTA) Scope, Sequence, and Coordination of Secondary School Science; and the National Academy of Sciences (NAS) Mathematics and Science Education Board.

Regular communication across agencies is strengthening Federal programs. Member agencies are actively exploring pooling their resources for projects that promise to achieve common objectives but are beyond the resource capabilities of one agency. Agencies are also beginning to collaborate in development of each other's programs. For example, member agencies will soon participate in an upcoming Public Health Service Workshop which will set a plan for the life sciences and education communities. Most FCCSET CEHR agencies will be participating in a task force to advise the new EPA Office of Education in development of its program and coordinate its activities with those of other agencies.

Taking the Foundation as an example, NSF's interactions with other agencies are increasing. For example, NSF is working with DHHS on all phases of its new Science Education Partnership Act (SEPA), from initial stages through possible linkage with NSF programs. NSF and the Department of Energy are combining resources to train nearly 1000 science and mathematics teachers at five DOE laboratories over the next year. Under this arrangement the Foundation provides participant support and instructional materials, while the DOE provides in-kind services through access to its laboratories and personnel.

Both NSF and the Department of Education have large, legislatively mandated education programs. Their collaboration is therefore of particular interest to Congress, OMB, and OSTP. Regular dialogue continues between these agencies to facilitate the sharing of expertise, as well as coordination and collaboration on projects of mutual interest. Examples of interagency NSF/ED cooperation include: The Department's encouragement of State Eisenhower Act coordinators to collaborate with State leaders in the NSF Statewide Systemic Initiative (SSI) Program; Eisenhower funds are being leveraged under the SSI Program to promote systemic reform in science and mathematics education; joint support of studies on student assessment and international achievement comparisons. NSF Provides both financial resources and substantive input to ensure that issues in science and mathematics education are adequately addressed; and dissemination of successful curricula and informal science media projects.

One particularly fruitful area indicative of the benefits of collaboration between our agencies is that for the NSTA curriculum project on Scope, Sequence, and Coordination. NSF provided the initial seed money to develop the concept; the Department provided substantial resources to fund planning and application in test sites; and NSF followed with funds necessary to place the project in the field.

THE FCCSET CEHR UNDERGRADUATE EDUCATION STRATEGY

In addition to presenting NSF programs, Dr. Bromley requested that I describe the undergraduate education strategy developed under the FCCSET process. This assignment is appropriate to the Foundation which, since 1986, has been following a well-defined plan developed by the National Science Board to catalyze efforts to improve science and mathematics training at the nearly 3,300 institutions of higher learning in the United States.

The concern in undergraduate education is two-fold: First, can we produce adequate numbers of degree recipients in science, mathematics, engineering, and technology? And, second, are undergraduate students—majors and non-majors alike—receiving the high-quality education necessary to meet requirements of the workplace and society?

Demographic trends underlie the issue of quantity. Since 1986, the decline in the college age population has resulted in a drop in bachelor-degree production. Within the next few years, graduate degrees are expected to follow suit. To reverse the trend, we will need to attract more students to these disciplines, reduce attrition, and increase participation of underrepresented groups.

The quality issue in part derives from the fact that, in a number of critical fields, undergraduate courses are virtually the same today as they were 20 years ago. The curricula have not kept pace with advances in scientific research nor with new teaching concepts that encourage student participation in hands-on research and laboratory investigation. Undergraduate faculty also require opportunities and incentives to upgrade their teaching and disciplinary skills

THE FEDERAL FY 1992 UNDERGRADUATE REQUEST

Twenty-four (24) percent of the fiscal year 1992 Federal budget request for science, mathematics, engineering, and technology education is allocated to programs at the undergraduate level. The total request at this education level is $477 million, which represents an increase of $60 million or 14 percent over the FY 1991 request.

The issue of underrepresentation is central to the undergraduate strategy. Nearly $152 million, more than 57 percent of all funds targeted on minorities, women, and the economically disadvantaged is expended at this level. These funds represent one-third of the total undergraduate effort with most either providing financial assistance or supporting comprehensive programs designed to attract and retain these students in the sciences and engineering thereby elevating degree production.

Nearly all undergraduate programs target four-year colleges and universities—nearly 70 percent for formal and 26 percent for informal experiences, such as research opportunities at Federal laboratories. Despite the fact that two-year community and junior colleges are a major source of supply both for skilled technicians and students (underrepresented and majority) who go on to study at four-year schools, only four percent of Federal undergraduate education funding is targeted on these institutions; more effort needs to be addressed by the Federal sector on these institutions.

PROGRAM CHARACTERISTICS

Four types of programs characterize Federal activities at the undergraduate level (Figure 2).

Student support and opportunities programs total $230 million or 48 percent of undergraduate support. These programs are designed to attract and retain students in science and technical fields either through provision of financial support or research opportunities.

Curriculum-related programs represent $124 million or 26 percent of the undergraduate request. These activities assist in development and dissemination of course materials representing the most current advances in science; provide strong linkages between classroom and laboratory experiences; encourage applications of advanced educational technologies; and support research in teaching and learning.

Major emphasis will be placed on the introductory sequence which provides core skills to technical majors; disciplinary focus for future generations of precollege science and mathematics teachers; and scientific literacy for nonmajors. Entry college programs also need to be articulated with precollege curriculum reform activities.

Faculty preparation and enhancement programs make up $42 million or 9 percent of the undergraduate request. These programs provide faculty with opportunities to enhance teaching skills, as well as learn new research and teaching technologies, information delivery and student interaction.

Systemic reform programs account for $49 million or 10 percent of the undergraduate request. These programs are either "comprehensive," striving to accomplish multiple programmatic goals in a single institution, or "systemic," attempting to achieve one or two fundamental objectives sometimes crossing institutional or educational boundaries.

AGENCY ROLES

Nearly two-thirds of undergraduate education support comes out of the Department of Defense (DOD) and the National Science Foundation (Figure 3). The majority of DOD funding supports ROTC scholarships and informal education technology programs; NSF focuses on formal curricula, laboratory development, faculty enhancement and systemic reform.

Other agencies make substantial investments across a variety of program categories. DHHS, for example, has significant funding in direct student support for underrepresented groups. DOE and NASA together account for more than one-third the support for informal programs. USDA, the Departments of Interior and Commerce, and EPA fill important programmatic niches that reflect their respective disciplinary missions.

BUDGET PLANNING PRIORITIES

The Federal program plan sets out to rebuild the education system from the ground up. Undergraduate education programs, therefore, follow precollege priorities in importance. The highest priority at this level is curriculum development, followed by faculty preparation and enhancement, then student incentives. The FY 1991–92 growth in these program areas is 22.9 percent, 13.9 percent, and 13.1 percent respectively (Figure 4). During development of the FY 1993 program, we will carefully evaluate the level and growth of undergraduate program activity in the context of our priority framework.

CONCLUSION

I would like to thank the subcommittee for their continued interest and sustained support for science and mathematics education; such support is essential to achieving our goals. I look forward to working with you not only in developing the Foundation's programs in this area, but also in ensuring the effectiveness of the FCCSET process.

Thank you, Madam Chairman. Now, I will answer any questions you may have.

TABLE 1.—NSF FCCSET CEHR BUDGET REQUEST: FISCAL YEAR 1992

[Dollars in millions]

Education level	Fiscal year 1992		Fiscal year 1991–92 change (percent)
	Absolute	Share (percent)	
Total	$456.1		22.7
Precollege [1]	253.1	100.0	19.0
Teacher enhancement/preparation	97.3	38.4	3.8
Curriculum development	73.8	29.2	21.0
Organizational reform	47.6	18.8	48.5
Student incentives	11.0	4.3	22.2
Evaluation/assessment	11	4.3	22.2
Undergraduate [1]	132.3	100.0	31.1
Faculty enhancement/preparation	27.6	20.9	29.3
Curriculum development	63.7	48.1	19.2
Organizational reform	15.0	11.3	230.0
Student incentives	24.8	18.7	24.8
Graduate [1]	70.7	100.0	21.8
Fellowships	61.4	86.8	26.7
Traineeships	8.4	11.9	25.3

[1] Includes "other" programs.

ADDITIONAL COMMITTEE QUESTIONS

Senator MIKULSKI. We will submit the balance of the questions for response in the record.

[The following questions were not asked at the hearing, but were submitted to the Department for response subsequent to the hearing:]

QUESTIONS SUBMITTED BY SENATOR MIKULSKI

SCIENCE AND MATHEMATICS EDUCATION

SENATOR MIKULSKI: What are you doing, both within the NSF and in cooperation with other federal agencies, to reach 20% of all science teachers each year? Will we reach that goal by 1993, as was directed in last year's Subcommittee report (p. 159)?

ANSWER: In 1990, 12,000 teachers were reached through NSF Teacher Enhancement projects, with a budget of $53.6 million; the $80.0 million available in FY 1991 was expected to support projects that would reach nearly 20,000 teachers. NSF's Budget Request for FY 1992 included $83.3 million for Teacher Enhancement, enough to reach approximately 21,500 teachers.

To obtain the 20% goal requires reaching about 60,000 teachers. However, it is difficult to assess the total reached because the educational programs of different federal agencies reach different populations of teachers and in different ways. Most of NSF's Teacher Enhancement projects engage participants directly in intensive work for 4-6 weeks during the summer. In contrast, the teacher-oriented activities supported by the funds made available to the states through the Department of Education are much less intensive than those of the NSF, but they reach virtually every one of the 2.1-million teachers in the United States who has responsibility to teach mathematics and/or science.

In order to leverage the funds appropriated to it, and to extend its reach, NSF will emphasize support of teacher enhancement projects that have a significant leadership dimension -- that represent a "teachers teaching teachers" model -- and that have a strong second level component for inservice activities in the local schools. It is expected that much of the local inservice will be supported by other fiscal sources, such as Eisenhower funds, state and local funds for education, and private sector funding. This program design makes it possible to reach a larger number of teachers with quality inservice education than can be accommodated directly in NSF-supported projects.

In addition, the NSF is an active member of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) and has provided funding for a number of leadership-type projects by other member agencies -- especially at the National Laboratories (DOE) and the Jet Propulsion Laboratory (NASA). As more federal agencies follow the lead of NSF, larger numbers of teachers will be involved in substantial inservice activities.

SENATOR MIKULSKI: Increased funds for NSF's State Systemic Reform initiative makes up over 85% of the increase in the reform area, yet at best, it will reach only 15 - 20 states. Shouldn't this "reform" program be

active in all 50 states? What can we do to strengthen it as a means to reform?

ANSWER: It is our intention that SSI be a highly competitive program in order to assure the highest quality models for change, the broadest involvement of key players, and the maximum use of state and local resources. We expect the results to be a variety (up to 30) of carefully developed projects distributed throughout the nation and available as models for their ongoing efforts to the states which did not receive SSI awards. It has been shown that states do look to each other for advice and assistance on common concerns such as those which this program addresses.

NSF is offering technical assistance to all states in the general area of reform of science and education, so even those which do not receive SSI awards will have the basis to develop their own reform efforts. Because the first states to be funded will be starting their efforts in the 1991-92 academic year, it may be well into FY1993 before it is possible to identify other steps that might be needed to strengthen the SSI program as a means to reform.

SENATOR MIKULSKI: What have we learned about "reforming" the system since the first awards were made in this program last year?

ANSWER: The first operational awards will be made this summer; however, the Foundation has learned a number of very important facts about the implementation of statewide systemic change. For example:

- Many of the states need to develop better ways to plan and implement a systemic change in the educational system.
- Too often the planning activities have not been delegated to the most appropriate agency or institution.
- Technical assistance must be made available to many of the states.
- The Foundation must be more explicit about the meaning of the word "systemic" in the context of the program.
- The states are showing a rich diversity of approaches to systemic reform; their proposals reflect the differences among them in needs, resources, population, geography, and cultural and political traditions.
- While some states have started with a slate of new systemic strategies within which they then incorporate the best of current activities, and other states have begun by bringing together existing efforts into a new structure with its own resulting systemic elements -- *both* approaches have resulted in some projects that are promising.

- Most states recognize that systemic reform must involve persons and organizations at the both the state and local levels. For example, many proposals include plans for regional alliances, or centers, or consortia throughout the state.

- The Foundation's establishment of the SSI Program has revealed widespread determination at all levels to attack the pressing needs of science and mathematics education through coordinated efforts among partnerships of people and institutions rather than with many uncoordinated projects.

SENATOR MIKULSKI: Has NSF contacted all 50 governors about the initiative? If not, why not? What has been their response?

ANSWER: NSF sent to the governor of each state, and to corresponding officials in the District of Columbia and Commonwealth of Puerto Rico, 20 copies of the initial solicitation with a cover letter from the Assistant Director of the Education and Human Resources Directorate. The program requires that the proposals must be submitted by the Governor's office or an agency designated by the Governor. Governors have shown a great interest in the program. Some Governors met in person with the site visit team in those states which were visited.

The Governors of the states which do not receive SSI awards in the first competition are being invited to send a team to a technical assistance conference to be held in Washington on June 22, 23, 24, 1991.

SENATOR MIKULSKI: How do the Department of Education's Eisenhower training programs for teachers differ from the NSF teacher enhancement training programs?

ANSWER: The NSF and Department of Education programs have similar objectives, but employ different emphases and obtain different results.

The Department of Education has three different training activities included under the rubrics of the Eisenhower program. One set of activities is conducted under grants to individual schools for science and mathematics staff development. The local activities supported by such funding tend to be of limited scope and duration; one would not expect them to have a lasting impact on the teachers. However, some of this type of funding has been used as additional local support for NSF teacher enhancement activities; such coordinated funding supports activities that appear to have beneficial and lasting effects for teachers (and is the reason such coordination is a project requirement in the Statewide Systemic Initiatives Program).

A second kind of use for Eisenhower funds awarded competitively at the state level is to support programs that are local, scaled-down versions of NSF Teacher Enhancement projects.

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A third activity, the nationally competitive Eisenhower program, has been funding projects which greatly resemble those funded by the Foundation.

We believe that the Foundation's proposal review process results in projects that have a very strong base in mathematics and science; further, the local project staff are drawn primarily from mathematics and science faculty members. Recently, the Department's review process has begun to resemble that of the Foundation.

SENATOR MIKULSKI: The Eisenhower program has been in operation for some years. How has it been evaluated? What is the result of that evaluation?

ANSWER: NSF understands that the Department of Education has had the Eisenhower program evaluated by SRI Inc., and that the results have been published recently.

SENATOR MIKULSKI: NSF and the Department of Education both have teacher enhancement efforts. Which of the two is more effective in reaching teachers? Why?

ANSWER: It is certain that each of the agencies regards its own programs as the "more effective." However, effectiveness in "reaching teachers" has both qualitative and quantitative dimensions. Many teachers receive some benefit each year from the funds made available by the Department for the improvement of science and mathematics education. But, NSF feels that its direct Teacher Enhancement activities are the more effective qualitatively -- especially when viewed from the perspective of the individual participating teacher.

The high effectiveness of the Foundation's projects in enhancing the capabilities of teachers is due to their intensity, rigor, and thoroughness; to the care with which they are planned; to the involvement of teachers in their planning and execution; and to the expertise brought to their conduct. It also derives from the fact that they are selected by competition, from NSF's use of the merit review process to determine which projects will be funded, and from the closeness of the relationship of NSF to the mathematics and science education and research communities. Those communities trust the Foundation's ability to lead their involvement in the improvement of education; through the Foundation's efforts, they are being brought more closely together in common commitment to the improvement of science and mathematics education at all levels, but especially in the schools. The Foundation's project selection and program advisory, review, and evaluation processes all rely heavily on the direct involvement of persons drawn from those communities, and both the rotating and permanent program staff of the Foundation are drawn from them.

SENATOR MIKULSKI: What is the feedback from teachers who finish these programs and courses? How is it used to improve the program?

ANSWER: One part of the evaluation of every NSF Teacher Enhancement project involves the use of a questionnaire or other mechanism to secure opinion and comment from the participating teachers. Further, NSF program staff contact teachers during site visits and at professional education meetings to solicit their opinions. This project level in-gathering of information is supplemented during the Foundation's evaluations of the over-lying programs. The regular evaluation of the Teacher Enhancement Program was begun recently; its design provides for sending a special questionnaire to a large sample of participating teachers and for a telephone interview survey of project directors.

Evaluative information is made available to all persons with management responsibility and is used formatively to refine all aspects of program design and conduct and summatively to determine whether or not a program should be continued.

QUESTIONS SUBMITTED BY SENATOR KERREY

SCIENCE AND MATHEMATICS EDUCATION

SENATOR KERREY: We are now almost 20 months away from the Charlottesville Education Summit. I would like for each of you to tell me what you think the most single important action or effort undertaken by your department or agency during that time has been.

ANSWER: In the context of the Summit-derived national education goals, NSF's most important action in the last 20 months is the establishment of a strong implementation orientation in the EHR Directorate. Two specific programmatic thrusts exemplify this orientation: the establishment of the Statewide Systemic Initiatives Program, and the development now underway of a comprehensive Dissemination Plan. The first is designed to accelerate implementation of mathematics and science education reform and strengthening by helping the states reduce barriers to desirable systemic change; the second is being designed to bring more rapidly and effectively to the attention of those responsible for educational change the most significant results and best products generated by NSF-supported projects.

SENATOR KERREY: Next fall, the 1991-92 school year will begin. Those in the fourth grade and above are the ones who will have to bring achievement up to the stated goal, if it is to be done. What do you think the most important program or activity your department or agency will have in place at that time will be?

ANSWER: On September 1, 1991, NSF's most important educational activity to serve the interests of students past the third grade will be the cluster of related

programs designed to improve school science and mathematics instruction. The cluster includes increasingly coordinated teacher enhancement and curriculum and materials development programs.

SENATOR KERREY: I want to thank you for the maps in the FCCSET report. Last year I had to do my own. I call attention to them because they illustrate a point that I make over and over: the uneven geographical distribution of federal facilities, federal research funds and even competitive K-12 funds. I would like for each of you to tell me what your department or agency is doing to redress this imbalance.

ANSWER: There is not a serious geographical imbalance in the awards of NSF "competitive K-12 funds." The vast majority of proposals submitted in this area are unsolicited and represent provider responses to continuing program announcements. The pattern of awards is a general reflection of the pattern of proposal submissions and correlates remarkably well with the distributions of population and of institutions of higher education, which are our principal providers.

SENATOR KERREY: The FCCSET reports gives a number of significant - and unfortunate - figures regarding attraction and retention of teachers. The report also indicates that a major emphasis - if not THE major emphasis - is on teacher preparation and enhancement. Young teachers seem particularly vulnerable to leaving the profession. These are years when their pay is lowest; they may get the least desirable of assignments; they are still in a learning mode, especially with respect to what works and what doesn't work in a classroom; they are often the last to be asked to participate in seminars, symposiums, etc.; they may owe on student loans.

Have you given any consideration to positive incentives to staying in teaching and enhancing skills at this point? Perhaps we should experiment with or try a demonstration program which would reward them for staying in teaching -- give them a stipend for further coursework or research activity related to their subject.

I think many of our incentives tend to be somewhat negative although I've been a proponent. We'll give you scholarships but you have to teach in certain areas or schools; you have to teach, perhaps teach a specified subject, for so many years. What about coming at the problem from a different angle?

ANSWER: Barbara H. Nelson, Iris R. Weiss, and Joanne Capper, in the "Science and Mathematics Education Briefing Book (1990)," provide the following significant facts about the retention of teachers:

- Teachers are more likely to leave during the first five years of teaching and after 21 years in the profession;

- Teachers certified to teach in their area of specialization are more likely to remain in teaching;
- Teachers involved in inservice education appear more likely to remain in teaching; and
- Teachers who enjoy teaching stay in teaching.

The Foundation's Teacher Enhancement Program provides at least three different kinds of incentives to participating teachers, all based on respect . . . respect for personal needs, respect for intellect, and respect for leadership:

Stipends (respect for personal needs) are an ongoing and recommended incentive in all our teacher enhancement projects. The maximum stipend that NSF will support is $60/day ($300/week); however, we encourage the use of supplementary local funding to yield more realistic stipends -- particularly in urban areas where the cost of living tends to be higher. In addition to increasing the actual money incentive, the commitment of additional funding from local sources indicates the esteem in which teachers are held, the realization of the teachers' importance to the improvement of education, the local school's "ownership" of the project and the real possibility that the teacher enhancement activities will continue after the period of NSF funding has ended.

A number of grants support interesting research opportunities for teachers (respect for intellect) and thus greatly enhance their professionalism in science, mathematics and education. In these projects, teachers work directly with researchers -- developing their own knowledge base, applying their classroom experiences, transporting the research mode to their teaching, and, incidentally, to raising the awareness of the scientific community to their responsibility for helping to improve precollege education. This type of project provides a real incentive to teachers who need the stimulation of further study in discipline areas.

Perhaps the most significant incentive (respect for leadership) lies within the design of Teacher Enhancement "leadership projects;" these give well-qualified and highly capable teachers the opportunity to affect substantively and substantially the educational environment in their schools. The educational experiences, support, and resources which are built into these projects empower teachers to lead and can change the directions in which their schools are going.

A new emphasis in the Teacher Preparation Program specifically addresses the need to continue professional support by working with new teachers during their first five years on the job -- a difficult period during which many young teachers leave the field. In addition, the new directions involve successful teachers much more closely with the preparation of new teachers than do most current teacher training curricula.

QUESTIONS SUBMITTED BY SENATOR HATFIELD

SENATOR HATFIELD: I am interested in the reflections of the National Science Foundation and the Department of Education on the major areas of overlap between them in mathematics and science education and how federal resources can be leveraged to enhance their interagency coordination.

ANSWER: The U. S. Department of Education and the National Science Foundation have many common interests in science, engineering and mathematics education. Collaboration with the Department is facilitated by periodic meetings (approximately bi-monthly) to address these interests and concerns. The contact person for this collaboration at NSF is Kenneth Travers, Head of the Office of Studies, Evaluation, and Dissemination in the Foundation's Directorate for Education and Human Resources. He is in regular (typically, weekly) communication with his counterparts at the Department of Education: Milton Goldberg, Director of the Office of Research; and Emerson Elliot, Acting Commissioner, National Center for Education Statistics.

Major areas of mutual concern and collaboration include:

Indicators of the condition of science and mathematics education

Large scale surveys, such as National Assessment of Educational Progress, International Assessment of Educational Progress, National Educational Longitudinal Survey (e.g. NELS88), while typically the major responsibility of the Department, are designed and implemented with input from NSF staff themselves or from outside experts recommended by NSF staff. NSF also shares in the funding of many of these surveys. Supplementary funding is targeted to ensure that issues in science and mathematics education are adequately addressed.

Systemic reform in education

In the recently implemented NSF Statewide Systemic Initiatives program (SSI), linkage with the Department of Education will be utilized to take advantage of its reform initiatives. For example, as the cooperative agreements with the SSI Principal Investigators are put into place, emphasis will be placed on leveraging Eisenhower Program funds in those states. Furthermore, proposers for the next rounds of SSI will be apprised of the need to demonstrate how they plan to link their work with existing programs in their states, and specifically with those funded by the Department of Education.

National standards and national tests

As the issue of national standards and tests comes to the fore, NSF will work with the Department to help

ensure that science and mathematics education receives full attention. The implications of this issue for teacher preparation, curriculum development and assessment are profound and pervasive. The two agencies will continue to share expertise and resources to help ensure that the requisite infrastructure is provided to enhance the quality of science and mathematics education across the nation.

SENATOR HATFIELD: Now that the initial FCCSET Report has been issued, what are the future plans and activities of the Federal Coordinating Council for Science, Engineering and Technology, Committee on Education and Human Resources? Will the Committee remain in existence and move to the next step of recommending action to both the Congress and the Administration to enhance the expenditure of federal funds in these areas? How will this report be used by the President in the federal budget process?

ANSWER: NSF respectfully defers to the Office of Science and Technology Policy for its response.

SENATOR HATFIELD: Public Law 101-589 included authorization for a National Clearinghouse on Science, Mathematics and Technology Materials. Congress provided $500,000 in FY91 to begin design and implementation of this project. It is my understanding that the National Science Foundation has been consulting with the Department of Education on the design for the clearinghouse. Please provide me with an update on this project and the role of the National Science Foundation in assisting with its development.

ANSWER: In January and February of this year, the Department of Education scheduled a series of meetings with NSF and other Federal agency personnel (representing the membership of the Committee on Education and Human Resources of the Federal Coordinating Council for Science, Engineering, and Technology, FCCSET-CEHR) to undertake a nation-wide dissemination strategy for science and mathematics education materials. The goal was to provide wide access and implementation for the many instructional products of Federal programs.

The meetings were very helpful to NSF since they provided a means for coordinating our efforts in dissemination and in establishing linkages with key materials dissemination centers around the United States. NSF has made development suggestions to the Department that would target national needs in science, engineering, and mathematics education.

Within the next few months, NSF will submit to the Committee its materials dissemination plan. This plan calls for continued close cooperation with the Department of Education and the other Federal agencies that develop science, mathematics, and engineering education materials.

DEPARTMENT OF EDUCATION

OFFICE OF THE DEPUTY SECRETARY OF EDUCATION

STATEMENT OF DR. TED SANDERS, DEPUTY SECRETARY OF EDUCATION

INTRODUCTION OF WITNESS

Senator MIKULSKI. We will now hear from Dr. Ted Sanders, the Deputy Secretary of Education. And Dr. Sanders, we welcome you in a cordial way.

We are disappointed that Secretary Alexander did not join us. Please do not misunderstand, it is not directed at you.

This particular chairperson really advocated the appointment of Secretary Alexander within the Kennedy-Hatch subcommittee. Last year when we held this hearing we had a Secretary of Education who did not think it was important to come. This is the second year in a row. Like the Orioles, you get three strikes and you are out.

The mission agencies, Department of Education and National Science Foundation, will be absolutely key to the implementing of this policy. This is not meant to be tart or prickly, but I must say I am extremely disappointed. It is the pattern of the Department of Education. We hoped that with Secretary Alexander the patterns and practices of the past 2 years in which the Department of Education has been gripped with the Sargasso Sea reputation would be reversed. We had hoped that this would be a new kickoff.

I would hope that you would convey this to the Secretary. We look forward to working with him in authorization, and although we do not handle direct appropriation, there is a linkage. The National Science Foundation is the incubator, it is not the implementor.

And, quite frankly, when it comes to the implementation, we have been very disappointed. On most days the Department rates a C-minus.

So we look forward to your testimony, but most of all we look forward to a far greater cooperation with the Department of Education and the kind of quick step that we know former Governors and current Governors are used to exercising, no doubt why the President picked this particular Secretary.

Dr. SANDERS. Thank you very much, Madam Chair.

Secretary Alexander does regret that he is not able to be with you this morning. There have been considerable demands on his time, as you might well imagine. He is a very energized Secretary and is literally working every waking moment of the day. I know that he looks forward to working with you. Mathematics and science education is a very, very important part of the agenda to him.

Today is the beginning of the National Summit on Mathematics Education, which is being chaired by the Secretary. I think you will find him vitally interested in the agenda of this committee and committed to working with you as well as with the other agencies in the Federal Government.

I, too, Madam Chair——

Senator MIKULSKI. Doctor, would you pull the microphone closer to you? It is a little hard for everyone to hear you.

Dr. SANDERS. Is that better?

I, too, would like to submit my formal testimony to you for the record and just highlight that testimony for you today, if that is satisfactory.

Senator MIKULSKI. Please do.

Dr. SANDERS. I would like to divide my remarks into three areas. I would like, as Dr. Bromley indicated, to share with you just a bit of information about the President's education strategy that was announced just last week, "America 2000." You have a full copy of the monograph that was distributed last week. And you will be seeing specific legislation coming forward to the Congress in the next 2 to 3 weeks as a part of the implementation of the "America 2000" strategy.

I would like also to highlight some of the activities of the Department as we have engaged in efforts to improve mathematics and science education and then reflect a bit on our collaboration with other agencies to achieve a common end, the accomplishment of the national goals, particularly that one that would make us first in mathematics and science education in the world.

PRESIDENT'S EDUCATION STRATEGY

First, Madam Chair and members of the committee, "America 2000," the President's strategy on education, focuses on four related themes. The first of those, as has been mentioned in earlier statements, is better and more accountable schools for today's students. In this country, we have over 110,000 public and private elementary and secondary schools. This part of the President's strategy recognizes that not a single one of those schools is performing at the level that we will require as a society in the next century and that we must be about the task of improving each and every one of them.

The second theme in the President's strategy recognizes that if we improve all of the schools in the country, they still will not be adequate to prepare the generations of students who will live and work in our society in the next century. And therefore, we ought to be about unleashing the creative genius of America in creating a new generation of American schools.

The third theme, Madam Chair, recognizes that if we are going to deal with the productivity issues of the year 2000 as we enter this next century, we must recognize that it cannot be done simply by improving the performance of those coming out of our elementary and secondary schools because 85 percent of the work force for the year 2000 is already in place today. They too are going to need to be able to meet these new world-class standards and therefore, each and every adult American must be concerned about improving his or her knowledge and skills to function in the next century.

The fourth recognizes, as Senator Kerrey has pointed out, that if you look at the typical 18-year-old and the time spent in school in his or her lifetime, only 9 percent of his or her life has been spent between birth and age 18 in a school, in a classroom; 91 percent was spent outside of school. The challenge before us involves more than just fixing America's schools. We must be concerned with life outside of school and particularly with communities and institutions in communities.

EDUCATION STANDARDS

Some details for you just quickly. To create better and more accountable schools, as Dr. Bromley has stated, the strategy calls for the setting of world-class standards in each of those five core learning areas; then we set into place the mechanisms necessary to measure and report our Nation's progress against those world-class standards, an American achievement test if you please, not necessarily a single test, but a system of testing so that we, as a nation, know how well we are improving and performing against those expectations. And more importantly, so that parents know how their children are performing as well as how the schools their children attend are performing.

The strategy calls for incentives for improvement. It would provide incentives to schools that make great improvement in achievement. It would recognize students who achieve by issuing Presidential citations to be affixed to high schoolers' diplomas when they graduate if they have met those world-class standards. It recognizes, as this committee has recognized, that if we are going to improve the quality of our schools, we must devote attention to the people who make them work, that is teachers and school leaders, and calls for academies, summer institutes, for teachers as well as school leaders in each of the five core learning areas.

In order to create a new generation of American schools, two very, very exciting things are to happen. First of all, a major new research and development effort will be jump-started by the private sector in America with the establishment of a nonprofit corporation to fund somewhere between three and seven R&D teams in the country to work on the ideas required to drive this new generation of schools. That R&D effort would be funded by over $150 million to be raised privately.

At the same time the strategy envisions the creation of 535 of these new American schools to be in place by 1996 and literally thousands of them in the country by the turn of the century. Those are to be funded through a proposal that we will bring to Congress, to invest $1 million in each of those schools for the purpose of providing support in their creation, from linking up to the R&D teams to bringing new materials and improving the training of staff.

This strategy also envisions creating a technological linkage between these schools that are being created, an America On-Line Program, that would bring to the fingertips of practioners in those schools the latest information that they might use as they are going through that process of creating new schools.

In terms of dealing with adult America, as well as with the conditions in which schooling occurs and children live, the "America 2000" strategy relies heavily on collaboration with other Federal

agencies, much as the strategy relies on collaboration with States and local communities in meeting these challenges.

EISENHOWER MATHEMATICS AND SCIENCE PROGRAM

Now let me highlight for you something of what you have already heard in general terms in Dr. Bromley's testimony. You already know that the centerpiece of mathematics and science education improvement in the Department of Education resides in the Eisenhower Mathematics and Science Program. We are requesting a $40 million increase to bring State grants up to $239 million in fiscal year 1992 and national programs funding up to $14.7 million.

This particular program provides States and local communities with considerable flexibility as they design their own professional development programs for teachers in order to improve mathematics and science instruction. It amounts to roughly one-half of the investments that are made in mathematics and science education improvement in the country and reaches roughly one-half of the Nation's mathematics and science teachers.

We have recently completed, Madam Chair, an evaluation of this program. It was done by a private contractor, SRI, and the results are very favorable.

We will be announcing very shortly the first winners in the new National Science Scholars Program. This is a $5,000 scholarship, as you know, for two students from each congressional district. And we are asking for considerable expansion in 1992, a little over 10 times growth in the base for this particular program.

Finally, Madam Chair, I think one of the most exciting things that has happened in the last 2 years is the increased collaboration between and among Federal agencies in the improvement of mathematics and science education. The Department of Education and its staff have taken very seriously the need to improve our coordination, cooperation, and collaboration with other agencies, and in particular with the National Science Foundation.

Under Dr. Bromley's leadership, FCCSET has brought education to the table, cajoling, leading, to make possible the kind of collaboration that is required. Mr. Watkin's leadership in Energy and as chair of the Committee on Education and Human Resources, which produced the inventory that you have already commented about today, is also noteworthy from our point of view.

Beyond that, there is a new spirit of cooperation, particularly with the National Science Foundation. You can see it. You have heard Dr. Massey highlighting it in the project with the National Science Teachers Association. You can see it in other places. We have worked directly with NSF in continuing and building upon the work of Project 2061, Science for all Americans, as well as in the efforts of the Mathematical Sciences Education Board to coordinate and to lead reformation in mathematics education.

You see this constant working together at the staff levels as well as at the leadership levels. It is very encouraging and, I think, very noteworthy.

I would stop there, Madam Chair, so that we could move on to the questioning.

PREPARED STATEMENT

Senator MIKULSKI. Thank you very much, Dr. Sanders. Your complete statement will be inserted in the record.

[The statement follows:]

STATEMENT OF TED SANDERS

Madam Chair, I want to thank this Subcommittee for the opportunity to describe the role of the Department of Education in the drive to achieve the six national education goals, particularly the goal to make U.S. students first in the world in science and mathematics. To do so I want to emphasize three points. First, the Department, by its very nature, is engaged in a number of initiatives that promote better education in general, and better math and science education in particular. Second, the Department continues to collaborate with a number of Federal agencies to achieve these same ends—in particular the National Science Foundation (NSF), the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), the Department of Health and Human Services (HHS), and the other agencies that make up the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) Committee on Education and Human Resources (CEHR). And third, we need to do more—much more—in order to achieve the ambitious goals we have set for ourselves.

ACHIEVING THE NATIONAL GOALS

Last week the President announced his AMERICA 2000 strategy for moving America toward achieving our National Goals. The plan of action builds on four related themes:

First, For Today's Students, Better and More Accountable Schools. AMERICA 2000 will spur development of World Class Standards and American Achievement Tests to measure progress toward those standards. School, district, State, and national results will be made available through regular Report Cards. Colleges and businesses will be encouraged to consider the test results when making admissions and hiring decisions.

AMERICA 2000 will provide incentives for students, teachers, and school leaders to reach World Class Standards. The Merit Schools program will provide financial rewards for schools that have achieved demonstrated progress toward the national goals. Presidential Citations will reward high school seniors who excel academically. Incentive grants will be awarded to States and localities for comprehensive choice policies, and Chapter 1 of the Elementary and Secondary Education Act will be revised to remove impediments to participation of disadvantaged children in local choice programs.

AMERICA 2000 will help strengthen teaching and school leadership. Federal seed money will help States establish Governors' Academies for School Leaders and Governors' Academies for Teachers in Core Subject Areas.

AMERICA 2000 will make grants available to States and districts to develop alternative certification systems for teachers. Such programs are our best hope for bringing highly qualified individuals who have not completed traditional teacher education programs into our mathematics and science classrooms.

Second, For Tomorrow's Students: A New Generation of American Schools. AMERICA 2000 will establish Research and Development Teams, through a new, non-profit corporation supported by private sector funding, to help communities across the country create New American Schools.

AMERICA 2000 Communities, designated by Governors, will design schools that will break the mold and help all students meet World Class Standards. These communities will be eligible to receive grants to help cover start-up costs for the first New American Schools, with at least one in every congressional district. At least 535 New American Schools will open by 1996.

AMERICA 2000 will support planning for America On-Line—one or more electronic networks designed to provide New American Schools with immediate access to the best information, research, instructional materials, and educational expertise.

Third, A Nation of Students. Improving today's schools and inventing tomorrow's schools is not enough. America's adults must demonstrate that learning is lifelong.

AMERICA 2000 will spark a private-sector effort to create job-related skill standards and skill certificates, and will encourage communities and companies to create Skill Clinics where adults can learn what skills they need for the jobs they want and where to acquire those skills. The Federal Government will lead the way with its own Government-wide program of skill-upgrading.

AMERICA 2000 will stimulate stronger literacy efforts through community-based programs, assessment of national literacy levels, and other Federal efforts, including a National Conference on Education for Adult Americans.

Fourth, Communities Where Learning Can Happen. AMERICA 2000 recognizes that 91 percent of a child's life is spent outside school, so parents, families, neighbors, and other adults must build relationships that nurture children. The President is challenging every city, town, or neighborhood in the Nation to become an AMERICA 2000 Community. To accept goals, devise a plan for reaching them, create a report card for monitoring their progress, and demonstrate a commitment to create and support a New American School. Governors will designate AMERICA 2000 Communities.

AMERICA 2000 also recognizes that the Federal Government must adopt its own sense of community. In support of comprehensive local community efforts, and working through its Economic Empowerment Task Force and with the Governors, the Administration will undertake better coordination of existing Federal programs with corresponding State and local activities.

Those portions of the AMERICA 2000 strategy which require Congressional action will be included in the forthcoming America 2000: Excellence in Education Act.

ONGOING DEPARTMENTAL EFFORTS

The Eisenhower Act is the centerpiece of the Department's current programmatic effort to improve science and mathematics education. The recently released national evaluation of the Eisenhower State program calls the three-part (local formula grants, State higher education grants, and State demonstration grants) program an experiment that is "largely successful." The State program annually provides professional development experiences for more than one-third of the Nation's science and mathematics teachers, including those teaching a broader curriculum at the elementary level. The flexibility provided to the States and localities has led to innovative uses of the funds provided, including efforts to collaborate with NSF-funded teacher enhancement projects. The evaluation conducted by SRI International calls the Eisenhower Act an "enabling resource."

According to the evaluation, the success of the program is due largely to its design. It provides annual funding to all States and almost all school districts. This funding is flexible and easy to obtain. The program reaches three important institutions within each State—local education agencies, State agencies, and institutions of higher education—and encourages them to collaborate.

Although the program provides many teachers with only short-term professional development experiences (an average of six hours in the LEA program), it has provided them with an awareness of many of the national reform efforts and important problems in science and mathematics education. In many school districts, the Eisenhower program is the only staff development program dealing with substantive issues in science and mathematics education.

The Department also supports programs to provide learning opportunity through direct assistance to students. This year we will launch the National Science Scholars Program and will seek to expand greatly the program in fiscal year 1992. This scholarship provides scholarships of up to $5,000 for two students from each congressional district.

COLLABORATION WITH OTHER AGENCIES: FCCSET-CEHR

The Department continues to expand its efforts to cooperate with the National Science Foundation (NSF) and with science and engineering mission agencies in the areas of science and mathematics education. The Department is actively engaged in specific cooperative efforts with the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), the Department of Health and Human Services (HHS), and the Environmental Protection Agency (EPA).

I am submitting for the record a recent report that we submitted to the Appropriations Subcommittee on Labor, HHS, and Education, which describes our collaborative activities.

I would like to highlight several of the activities from that report. As you will see, the CEHR has promoted broad collaboration and provided much greater insight into the programs of each agency. We are just finishing an agency-by-agency review of programs that will enable us to operate with greater coherence in the years ahead.

Joint funding of national reform projects.—ED and NSF have been cooperatively funding the following national mathematics and science education reform initiatives:

—The American Association for the Advancement of Science—AAAS—Project 2061 curriculum reform program. NSF is supporting the development of curriculum frameworks—descriptions of what students should know and be able to do

at various levels of schooling. This activity is taking place in 6 different local sites (school systems or consortia of systems) and is based on the Project 2061 Report, "Science for All Americans," a description of what should be learned as a result of K–12 science and mathematics education. ED is supporting efforts to establish a network of other sites interested in using the 2061 approach to science and mathematics education reform

—The National Science Teachers Association—NSTA—Scope, Sequence and Coordination program. The NSTA/SSC initiative is a major effort to reform the way secondary (middle school through high school) science is taught in the United States. NSF funded the initial development and planning of the project and is funding the second round of experimental projects. ED funded the first two pilot sites and the NSTA coordination, technical assistance, and documentation project. ED is also supporting an effort to use interactive technology to assess student learning.

—The National Academy of Sciences' Mathematical Sciences Education Board—MSEB—efforts to coordinate reforms in mathematics education and the National Council of Teachers of Mathematics—NCTM—education, evaluation, and teaching standards. MSEB/NCTM initiatives are well-coordinated reform strategies instituted by the mathematics community. NSF has supported the core operations of the Board. The Department is funding the national assessment summit and dissemination activities of the Board. The research staff and Director of the Department's National Center for Mathematics Teaching and Learning have been instrumental in the preparation of those standards.

National Center for Education Statistics (NCES)/National Science Foundation Directorate for education and human resources (NSF–EHR) Cooperative Studies and Indicator Projects.—Over the past five years, NCES and NSF's studies program have collaborated to enhance data collection, analysis, and reporting on the condition of mathematics and science education in the United States. NSF often supplements NCES data collection activities in order to increase the available information on mathematics and science education. NCES also joins NSF in collaborations on international assessments of student learning and in the analysis of science and mathematics education data bases on students, teachers, and attitudes. The following are specific examples:

—NCES co-funded with the NSF studies program the following studies: 1) a systemic analysis of school and community; 2) student engagement in learning; 3) differences in student subcultures; 4) outcomes for low-performing students; 5) the National Education Longitudinal Study (NELS:88) research information management system.

—NCES and NSF are jointly funding the Education Testing Service (ETS) to conduct an international assessment of the mathematics and science achievement of 13-year-olds in 20 countries. Most of the countries will also participate in an optional geography probe. About two-thirds will participate in an experimental performance assessment of 13-year-olds. Additionally, an assessment of 9-year-olds in mathematics and science will be implemented by about two-thirds of the participating countries.

—NCES and NSF jointly fund the National Academy of Sciences to administer a board of researchers and administrators who examine U.S. participation in international education studies.

—NCES is one of the several Federal agencies that support the core activities of the Committee on National Statistics of the National Academy of Sciences. The National Science Foundation coordinates the activities of the Committee.

—NSF augments NCES' Teacher Supplement to the National Education Longitudinal Study (NELS:88) to collect information on math and science teachers.

OECD case studies.—ED and NSF are working together on the development of an international framework for studying the reform of mathematics and science education in the Organization for Economic Cooperation and Development (OECD) countries. ED and NSF have jointly reviewed a number of potential case studies on U.S. reforms. These case studies will serve as the U.S. contribution of an OECD curriculum study program. When the program is complete, each OECD country will have conducted case studies of its most prominent reform efforts.

National Science Scholars.—ED and NSF are cooperating in the implementation of ED's National Science Scholars program. NSF establishes award criteria. ED administers the program.

NCES/NSF international achievement comparisons.—NCES and NSF are jointly providing funds for the international component of the Third International Mathematics and Science Study (TIMSS). NCES and NSF will also jointly support the collection of the U.S. data for the TIMSS.

ED–DOE.—ED and DOE have signed a memorandum of understanding promoting cooperation between the Department's various science and mathematics education, research, and improvement programs and the DOE National Laboratories. Eisenhower funds may be used to encourage teacher participation in research at the National Laboratories.

A national clearinghouse for mathematics and science education.—ED and NSF, with the cooperation of NASA and DOE and other FCCSET–CEHR gencies, are exploring the feasibility of a national clearinghouse of mathematics and science education materials, research and program information, and assessment strategies. This clearinghouse would be an integral part of a broader dissemination and technical assistance strategy to bring high quality materials, ideas, and reform strategies to teachers and administrators at the school level, to local and state policymakers, and to those providing reform assistance at all levels of education.

We have made significant progress since we reported to you last June; however, our work is far from over. We believe that AMERICA 2000 provides us with the strategy for achieving excellence in our educational system and that by working with other federal agencies and Congress we will be able to reach our goals.

TEACHER PREPAREDNESS

Senator MIKULSKI. We also had invited Dr. Watkins to testify. We know he has been your chairman, Dr. Bromley, over at the FCCSET committee and has taken some really bold steps with the so-called mission agencies in playing a larger role in education.

But, Admiral Watkins is out of the country on an assignment. We look forward to other conversations with him.

Let us move on to the issues before us. I think we all support the Presidential and national goal in terms of our readiness in math and science for the 21st century. It is not the purpose of this subcommittee's hearing to review the President's new initiative and education strategy. That will occur in the authorizing committees. We are really looking at where we are now and what we could be doing while we are waiting to authorize new programs. So we are not here as a backdoor authorizing hearing. We welcome these ideas and initiatives.

I think the Congress feels we should take the best of the Bush administration proposals, the best of what we have been thinking about for a number of years and just get on with it, which is why there is a sense of urgency now, particularly in the fiscal year 1992 budget.

So let us focus on a couple of specifics. When I travel around my own State and around the country, one of the most important criterion that they talk about in math and science education is the need to retool teachers. First of all, to make sure that teachers are ready when they come into the classroom to teach, and among those who have been willing to teach for a number of years, many need to be retooled. Science and math are changing, techniques in teaching, which we already know, are changing. Also, there are so many demands now on being a teacher that the teachers need to be refreshed and reenergized themselves.

Therefore, I am going to focus my attention on teacher preparedness: the recruitment, the retention, and the retooling.

Now to move to the retooling, I would like to start with Dr. Massey. What is going on within the National Science Foundation and other Federal agencies that you are stimulating to focus on the retooling of teachers and teacher preparedness?

Dr. MASSEY. Madam Chair, I agree with you that that is the place we can make the most immediate difference by trying to im-

prove the quality of the present-day teaching work force and to assist those teachers who are already in the field trying to do a very good job under sometimes very difficult circumstances.

Teacher enhancement is the highest priority in the precollege education activities at NSF, and it occurs in a number of activities. In the statewide systemic program there are efforts to bring together universities, other institutions, public and private, on a broad strategic basis to involve teachers in processes working with other agencies to improve the quality of their teaching and to help them have access to new equipment, new materials, and help them to design new curricula programs for the schools.

More specifically, there is a proposal to establish teachers' centers connected with universities that will bring together those researchers and scientists and engineers who are themselves at the forefront of their fields to work with teachers to provide them with the kind of upgrading in their knowledge of their disciplines in their fields in which they will have to teach.

In all of the activities what the Foundation is attempting to do now is to bring together a number of the parties who are interested in the problem to work across a broad spectrum of activities and to have goals that can be measured and evaluated so that the programs can be improved.

But if it is appropriate, I would like to ask Dr. Williams to join us at the table because he was chairman of the committee, and actually he is the leader in this area and can answer these questions, this one, with some more specificity, if that is OK, Madam Chair.

Senator MIKULSKI. Yes; Dr. Luther Williams, who has the responsibility in this area.

How about using the microphone, Doctor?

Dr. WILLIAMS. Well, I agree with the points already made by Dr. Massey. I would not repeat the effort under the statewide systemic initiative. But broadly, consistent with teacher enhancement and preparation being the first priority under the FCCSET and consistent even with the President's proposal of what is called the first effort with the students, clearly, if one wants to make the most substantial and immediate effect on the quality and character of precollege math and science education, long before one can reform the schools one impacts directly the quality of those individuals who have responsibility for the instructional program.

So the Foundation has developed in broad terms in response to the Congress a 3-year plan by which principally through summer institutes, very intensive workshops for teachers taking advantage of an array of resources like the Science Center we saw yesterday, the Department of Energy Laboratories, a multifaceted agenda to substantially increase the preparation of our math and science teachers.

In agreement with Dr. Massey, however, ultimately, in the long term, what the Foundation desires to do is to decrease the amount of expenditure that is devoted to teacher enhancement. And in order to accomplish that, one should place primacy on ensuring that the teachers were appropriately trained in the first instance. So we are creating these math and science teachers' centers in which, as he indicated, the broad scientific community is going to be a major part of that training to ensure that they are appro-

priately and substantially trained in math and science in the first instance.

Senator MIKULSKI. Well, Dr. Williams, I am going to ask you a question, and perhaps other panelists want to concur. First of all, teacher training starts at the undergraduate level as teachers get their training.

Mr. WILLIAMS. Right.

Senator MIKULSKI. There has been in many communities an expression of concern about whether the so-called teachers' colleges fill the need for teachers to become more contemporary and more assertive in this area. And if the academies seem to be almost remedial. I would wonder if we want from teachers kind of what young interns and residents do to doctors.

For example, if we were in the operating room with shock trauma in Baltimore, you have got that resident that is so hot to trot with all his new education and new ideas, and he energizes the senior doctor doing the surgery. And that older doctor feels that edge and is listening to that. But he provides wisdom, maturity, experience, steady hand. What I am looking for is the younger teachers coming out with the new ideas and the older teachers who have a lot of street smarts and a lot of savvy and a lot of that wisdom. With a 20-percent teacher enhancement goal, we could have the benefit of maturity and the benefit of those new ideas, each one energizing the other and learning from each other.

What about that? Do you see that as the National Science Foundation role? Is that the Department of Education role?

Mr. WILLIAMS. I see it as perhaps the role of both agencies. But what we are doing in the Foundation is exactly consistent with your description. Let me briefly describe it to you. I fully agree with you. The problem with producing math and science teachers lies in part with the historic role of schools and departments of education not making the adjustment, but also in the fact that what one really is trying to produce is what I call a composite outcome.

To produce an excellent middle school math or science teacher one needs substantive input and expertise from the education faculty, to be sure. But you clearly need the science and math faculty to participate. The third component is that the person integral to that training really needs to learn the profession. So there has to be a linkage with the school system on a continuing basis, not practice teaching at the end of the process, but integral to that training so that a teacher in training is interacting with the profession.

These centers are designed deliberately by the Foundation to force a linkage between those three partners that otherwise do not participate in a cooperative fashion. So we are trying to, in effect, ensure that that fundamental process takes place properly.

On the second point, the point of what happens to these newly minted, well trained young teachers who enter the work force and join older individuals? One of the goals under the statewide systemic initiative is that working in schools in the State in math and science is to create exactly that kind of partnership.

Senator MIKULSKI. That is the National Science Foundation's statewide initiative.

Mr. WILLIAMS. That is right.

Senator MIKULSKI. I want to come back to that. That is terrific.

Senator MIKULSKI. Is it Doctor or Mister Sanders?

Dr. SANDERS. It is Doctor.

Madam Chair, the Department has several proposals, too, that tie in directly with what you are advocating. And let me just mention that we are proposing a program to support what are called in the practice professional development schools, changing the nature of teacher training so that it is taking place in real schools where the very best of practice is occurring, much like the clinical training of doctors in a teaching hospital.

We also are proposing another initiative calling for alternative routes to certification. Far too many of the people who are working in our mathematics and science classrooms are inadequately trained in the discipline itself and, from what we know in States that have experimented with alternative routes, we can see considerable improvement by bringing in midcareer individuals who have trained in mathematics or science, who want to see some kind of a change in their career path and are willing to come back into schools but who are currently barred from doing so because they have not met the traditional teacher training requirements. We are advocating an initiative that would bring States to look carefully at those kinds of policies.

Senator MIKULSKI. What I am saying is, Are you having meetings? Are you bringing in the teachers colleges? Are you saying, we have got a whole new world order here? Are we being bold?

For example, I had the opportunity to be at the University of Arizona where they do first-class work in astronomy, much of which is funded by the NSF, Doctor.

Dr. Richard Greenberg, a really exceptional and extraordinary scientist in the Department of Planetary Astronomy, has a dual appointment in their Department of Teaching and Teacher Education, and he really is bringing science to teacher education. I had a chance to meet with him, watch the training and see the interaction with children. And I will tell you, it was really a—well, you know how kids are. It was joyful noise that we heard there. That is the kind of thing I am talking about, really. We love these new initiatives, but it is in the implementation that we see results.

Dr. Williams, you are shaking your head.

Dr. WILLIAMS. I agree with you. That is exactly what we believe.

GOALS FOR TEACHER EXPERIENCES

Senator MIKULSKI. The question is this: The subcommittee established a goal last year asking that 20 percent of the science teachers be retooled through some type of Government-sponsored program every year. We had hoped that through a 5-year process everyone would have been through a modernization program. Toward that 20 percent, we would count the new graduates. Is that a reasonable goal?

Dr. Bromley.

Dr. BROMLEY. Madam Chair, may I add to what my colleagues have just said? I think that there is another dimension that Admiral Watkins would have wished to emphasize had he been able to join us this morning. And that is the role that the 726 national lab-

oratories we have and that the industrial activities across our Nation can play complementing what you have just heard about.

We tend, I think too often, to focus on the fact that our teachers are ill prepared and ill trained. And indeed, a great many of them are. But as you yourself said, Madam Chair, a great many of them have put up a valiant battle under dreadful conditions, and they are getting tired and they are getting discouraged. And so it seems to me that one of the most important things we can do for today's teachers—and those are the people who are going to make the difference between now and the year 2000.

The best thing we can do for them is to bring them into contact with people in their professions, in the national labs, in industrial laboratories. Let them feel that they are really part of a profession, that they can get their prestige reinflated, that they really have contact with the frontiers of their field, and that their motivation is brought back to the level that most of them had when they got into the field and that has been beaten down over the years.

So I feel that one of the most important things we can do—and we are doing it. And I think that we can honestly say that some 20 percent of our teachers will have had some kind of exposure of this sort within this next year to 18 months in the kind of environment that I have just discussed. There is a very active program within the Department of Energy, within the Department of Defense, within NASA, and within Health and Human Services to use the Federal facilities we now have for this educational purpose. I think it is very important.

FEDERAL LABORATORIES

Senator MIKULSKI. Well, Dr. Bromley, that takes me to my next question. I am going to ask one more and then turn it over to Senator Kerrey, who has been waiting patiently. And then we will come back for another round.

There are over 700 Federal labs.

Dr. BROMLEY. 726.

Senator MIKULSKI. 726 Federal labs. And we also know they have done pioneering work. Dr. Massey, at FermiLab, was one of the leaders in getting the laboratory involved with the Chicago school system. And now that cooperation that you began, Dr. Massey, is one of the prime models for the so-called Watkins approach.

My question, though, is: How can we do this in an organized way? First of all, I think it is desirable, since all parties gain. The labs gain, and teachers I know who have been engaged in it really do feel refreshed interacting with these colleagues.

But there seems to be a disparity in how the mission agencies organize their work. Energy runs its programs out of the Office of the Secretary, and the Admiral is very much the captain of the ship. At NASA, it is below the Assistant Secretary. At EPA, with laboratories even in small rural areas, it is run out of Public Affairs. And there seems to be different priorities, different focus, different commitment, and so on. I wonder if we should be designating a common structure, not to create more bureaucracy, but more linkage. By having some kind of a systematic designation, we would really get those laboratories involved in an organized way.

Dr. BROMLEY. I agree with you entirely, Madam Chair, and we have made a start. And if you will look at page 142 of the large volume of "By the Year 2000," you will find the names, addresses, telephone numbers, fax numbers of everybody involved in the Department of Energy laboratories. It is the goal of the Education and Human Resource Committee to have a complete directory of this kind covering all of the 16 agencies available for public distribution in the very near future. This is one of the early goals in this year's activity of that committee just for the reason you indicate so that teachers anywhere in the Nation can immediately identify where their nearest Federal facility is and how to get in touch with the people that can make them part of it.

Senator MIKULSKI. Well, I am going to ask a bold question here, or a somewhat bold question. Do you think, first of all, we should establish point persons for education in the major mission agencies to be sure that the President's objectives are met? There needs to be workshops and training to incorporate the models developed by the Department of Energy. We need focus at the laboratories rather than somebody handing people a memo and saying, see what you can do about it; headquarters wants us to do it.

Dr. BROMLEY. Again, you are absolutely right, Madam Chair. Working its way through the system at the moment, that will add, when the President signs it, to the mission statement of all the mission agencies, a specific paragraph that addresses their responsibility toward education. And that, in itself, opens and removes a lot of difficulties that we have had in the past. And so that is the first part of my answer.

The second part of the answer is that we are very much in agreement with you that it is going to be important to use the successful programs—and you have mentioned one of them, the Chicago one—there are a number of others—to use those as models. And we want to bring people from the other laboratories to spend time with these successful programs so they can take them home again. I happen to believe that nothing really transfers—technology, science, nothing transfers except in the heads of individuals.

And so by bringing them in then sending them home to take the program with them, I think we can begin to disburse the better programs much more widely in this large group of facilities.

NATIONAL LABS PARTICIPATION IN EDUCATION

Senator MIKULSKI. Dr. Massey and then Senator Kerrey.

Dr. MASSEY. I think the idea of making it legitimate for scientists and engineers to participate in precollege education, those in the national labs, is very important. As a former director of a laboratory I can testify that you will respond to what you think your mission is and what the Nation believes is important. Quite often, the legitimacy of scientists taking time and finding it important to participate in these activities perhaps is not emphasized enough.

And you are right; Admiral Watkins made a great deal of difference to us in the Department of Energy labs when he made it clear that that was a primary and important mission. So I would just agree with your thrust that making it seem nationally important would give encouragement to those who want to participate

but who now are unsure whether that really is appreciated or legitimate.

Senator MIKULSKI. Thank you, Dr. Massey.

Senator Kerrey, you have been waiting very patiently.

Senator KERREY. I just appear patient. [Laughter.]

Senator MIKULSKI. And appearances are what they are.

Senator KERREY. Dr. Bromley, I would like to follow on this. There are 700 and how many?

Dr. BROMLEY. 726.

Senator KERREY. It seems to me fair to observe that there is a substantial difference between the impact of some of those facilities on the community and others. For example, one of them is a museum called Agate Fossil Beds in Nebraska. And one reason it is on the list is because I insisted that there be some sort of educational function attached to it. But, it is very different from an Oak Ridge or an Argonne.

By the way, I think NSF in particular should consider, as you work with institutions of higher education across the country encouraging them to think as affirmatively about creating prominent space inside of their facilities where primary and secondary education and community education can be done, apropos again, of the President's attempt to try to make us a community of learners.

IMPACT OF NATIONAL LABS ON COMMUNITY

So I would say that there is something going on in those Department of Energy labs that make them unique in their ability to impact the community.

Those DOE labs self-generate an awful lot of activity. I know that FERME generated the Illinois Math and Science School, or at least the leadership there did. I know that every time I talk to other politicians who have the benefit of the DOE lab they talk about the things that those labs are doing at the community level. I am not suggesting building 50 of them. But there is something there. And I do not know if in that model we could discover some way of energizing other communities.

It is not enough just to have our teachers go to these institutions. What happens is that the labs permanently impact community leaders. And the people in the research institutions themselves become the agent of change. They get involved in the community and their desire to create a math and science school independent of that lab becomes the reason that school ends up being created.

So I would hope that the administration in the FCCSET process can come to us and say we have got something that works, and there are ways to bring its benefits to additional communities.

NEBRASKA SCHOOLS

Dr. Massey, you have talked about a couple of schools you visited in Maryland yesterday. I would like to describe to you some schools that I visited yesterday in Nebraska.

PARENTAL PARTICIPATION

I went yesterday to a housing project where at the apartment of one of the occupants I picked up five children and we walked to

school, which was five or six blocks away. When you look at the home and the importance of the home—I was fortunate to be brought up by two parents who spent a lot of time on me—you see the need to invest in the things that make that home work.

Almost everyone concludes—even conservative business people conclude—that we are underfunding WIC, and that if we fully funded WIC it would provide a more solid foundation so that one of the goals that the President has by the year 2000 could be accomplished, that is, that all children arrive prepared, ready to go to school.

I saw, during this visit, a single parent, a woman who is fully employed. And she is going to be struggling to provide the foundation that those five children need.

I spent a great deal of time with the sixth grader on the way to school. His top subject is math. He is intensely interested in math. Choice does not mean crap to him. It does not mean anything to him.

He is going to go to a school that is in his neighborhood. But he is probably, fortunately for him, going to go to McMillan School, which is a magnet school with tremendous technical expertise.

MEETING NEEDS

But the Waconda Elementary School that he attends has a very weak PTA, has a very weak support base from the community itself as a consequence of being a low-income community. You go into the classroom, and they do not have the resources that my children have. They just simply are not there. And the parents are not able, through the parent-teachers association to generate the private support that we are able to generate in other neighborhoods.

And, frankly, I do not know how to reach Waconda. I am very much aware that if I just appropriate a little more money, I am not sure if it will ever get down to Waconda—by the time it goes through the U.S. Department of Education and the State Department of Education. These kids could be long gone by the time any money got to them.

So I do not have an answer as to how we are going to get the money there, but there is a clear and present need. I have a sixth grader with an interest in mathematics. Unless he gets a good mathematics teacher in the seventh grade, he is going to be one of these statistics that fall off the chart. He will not graduate from high school with that interest having been sustained.

I think the FCCSET group has done an awfully good job, as well. But I find my experience yesterday causing me to conclude that I cannot honestly say that I am doing all that I know works.

Do you find yourself with similar frustrations, where you know that if you had some additional resources it would work? It is not a question of now wondering whether or not a little more money would work. You know a little more money for a laboratory would work. You know that you could recruit, if you had a little more money, a gifted math and science teacher. You know you could do something a bit more, and yet it does not happen.

I assume, Dr. Sanders, that you have spent a fair amount of time on that question, and I would appreciate your response first.

MONEY ALONE DOESN'T MAKE CHANGES

Dr. SANDERS. Thank you, Senator. In fact, I have spent most of my life with those kinds of concerns. I am a mathematician by training, and a teacher by a change in profession. I spent almost 30 years of my life trying to make schools work. I have only been here a short period of time, and yes, I share your concerns.

But I would tell you out of my own experiences that simply getting additional resources to schools does not necessarily lead to the changes that you and I would desire to see happening at the school level. In fact, the experience of the 1980's speaks clearly to that.

Senator KERREY. May I interrupt you on that?

Dr. SANDERS. Sure.

HEAD START: AN EXAMPLE THAT WORKS

Senator KERREY. I do agree in general with what you are saying. But there are some specific exceptions. There are some specific exceptions where there is almost universal agreement—for example WIC and Head Start—where there seems to be very little debate. It seems to me if you really wanted boldness, that where we have got agreement that something works, we would fully fund.

PREPARING OUR SCHOOLS

Dr. SANDERS. Absolutely. As State superintendent of education in Illinois, I pressed for what was basically the creation and full funding of what would be a Head Start experience for all 3- and 4-year-olds, because those programs worked; they are very strong on strategies that prevent school failure. Being ready for school is very, very important.

You were talking specifically about schools, though, once the children arrive there. And what I was trying to say is that money alone is not the answer. It does not necessarily change the behavior or the climate or the approach that is taken in a particular school. Yes; oftentimes money does help, when the direction is right. But there is more to this equation. I visit schools regularly, and it is striking sometimes to see two different schools placed in almost identical kinds of circumstances, and one is functioning very, very effectively for its children, and the other is not. Many schools are not ready for the children that they are to serve.

And so a large part of the challenge before us is not just working in the community to create conditions to prevent school failure, but in making sure that schools are ready for children, that they are receptive to them, that they have high standards, that they have high expectations, that the teachers are actually prepared to work with and to support those children. And much of that boils down to strong leadership at the school-site level. That is the reason why not only training for teachers, but training for school leaders is very important.

Senator KERREY. I agree.

CHANGES IN AN INNER-CITY SCHOOL

Dr. SANDERS. Another fix on that. I was taken to an elementary school, probably not unlike the one that you visited, in the inner

city of Seattle, WA, just a few years ago, when a young woman by the name of Lavonne Bennett was appointed principal there, and looked at the conditions in that school, at students' performance, and so forth, and said, something has to be changed. We have to do something different, because this school is not serving its children. And what she did was call her faculty back early to school that year, 2 weeks ahead of the opening of school, violated the union contract, in fact, in doing that, and described to her faculty what she had seen in terms of the statistical evidence about their school, and asked them to join her in rethinking the approach that they would take. They literally redesigned their school. They decided that reading and mathematics were most important to their students, if they were going to be successful. They decided to concentrate all of their morning each school day on instruction in those two areas.

They decided that many of their classes were too large for teachers to be effective. And they could not go to the central office for more funds for more teachers. So they took the adults in the school and made every one a teacher and came to violate Federal law as a result of that because they misused chapter 1 funds and funds that we had provided for handicapped children. And while they produced the results, they were in trouble because they did not have the latitude to craft unique solutions for their own school—even though they produced results.

And so I think a large part of this is getting responsibility as well as authority back to schools, which means, yes, in many cases, resources. But it means also, other kinds of authority so that responsible people can act to respond to the needs of young children.

FUNDAMENTAL PROBLEMS TO BE ADDRESSED

Dr. BROMLEY. Senator Kerrey, it seems to me you have touched on two of the most vital aspects of the whole problem.

First of all, although I do not know the answer to this, I think that the fundamental problem that we face is getting parents reinvolved in the education of their children.

Second, I think all of us share the same kind of frustration that you do. We spend more per child in school than any other nation, with the possible exception of Switzerland. We can only conclude that we are not spending it in the right places. This whole question of systemic restructuring of our educational system is critically important in order to get funds liberated to do the kind of things that you are talking about. I do not think that we necessarily need to spend more on education, we just have to spend it in a substantially more sensible fashion.

Senator KERREY. I support alternative certification; I support choice. But what is going to happen, it seems to me, is the debate is going to focus upon those areas where we disagree and unfortunately where we agree, we are not doing all that ought to be done.

We have enough things to fight about around here, but where we have agreement, we are not following through, and we are losing children as a result.

We are bringing children into the school system that are not prepared, as a consequence of not fully funding WIC and Head Start. I am going to leave that alone, because that is a foundational argu-

ment, but it is an important one for me because if we can agree on that and then act upon it, it seems to me, then we would have a foundation of Republicans and Democrats that really wanted to get in and revolutionize our schools as a President talked about.

Another of the aspects of the revolution we are going to have to hit is TV. Back to my day yesterday, I start in this home with five children and they are on the television set when I arrive.

USE OF COMPUTERS IN EDUCATION

I end the day at McMillan Junior High School and thanks to NSF's investment in MIDNET, and thanks to the regional Bell Operating Co., we now have a group of seventh and eighth graders hooked up to MIDNET with tremendous access to information that they did not have before.

I am computer literate and I am able to understand a little bit, but I am 47 years old and my neurons are escaping me. So I do not really have the capacity to imagine what might be done if I put the same kind of energy into training an eighth grader to learn geography, to learn language, to learn science, that I do teaching a 21-year-old to fly an F–15 so he does not drop a bomb on a mosque over Baghdad.

In my judgment, one of the most destructive things we have done to American education and to American families, is to have them watching television at home.

It seems to me that we have to address communications technology and to take on the institutions. I just saw the big argument between the rich and wealthy over who was going to have access to the syndication of reruns. Now as far as I am concerned, they are both producing garbage. They are doing such a tremendous job of applied communication technology in the marketplace that I do not like my 14- and 16-year-olds to watch television.

It seems to me it is central to the argument of trying to revolutionize our schools, that we put in the home some kind of a tool that is consistent with what we are trying to do in the school, so that the education process does not end when the child gets home, which all too often it does.

I do not mean to beat you into silence here. I would like to have you talk a little about——

Senator MIKULSKI. Your neurons are doing all right.

DISTANCE LEARNING

Senator KERREY. I would like to have you talk a little about distance learning and the future you think distance learning has for American public and private education and for community education as well.

Dr. MASSEY. I will say a little bit about it, but if I might just start one step back on the issue you raised about things that work. What we often overlook, I believe, is that we do not take enough advantage of those things that are working. There are various models of schools, precollege, elementary to high schools around the country in very difficult circumstances, that have somehow made them work.

They have some common characteristics. If we could learn how to replicate those and use technology to bring those into networks, to places that would like to work but somehow do not have the resources, I think we could begin to make a difference.

I have been involved in three totally different kinds of schools in Chicago and they all work. One was starting the Illinois Math and Science Academy for Gifted Students; in 3 years it became one of the most prominent high schools in the country.

The other was a corporate school, a school started in a poor neighborhood, fully funded by corporate money, for children from 4 years to 8 years old. The school is 4 years old now, and it is working.

The other was a small one-room place in a house that you probably would not want to go into, run by two women who have a group of 30 black kids who stay about 8 hours a day. That is working in another way.

I think there are many of these different kinds of models around. There does not have to be just one kind. But I agree, if we can identify those, learn their characteristics and use the advances in technology to support them and communicate what they are doing, we could go a long way by building on what we already know.

We know a lot more than we may realize, I believe. But Luther has been more involved—Dr. Williams—in the distance learning.

Dr. WILLIAMS. First, I agree with all of the comments just made. But one comment on the more fundamental discussion——

Senator MIKULSKI. Dr. Williams, you need to use the microphone.

Dr. WILLIAMS. I will comment on the more fundamental discussion that you were having. I was struck by the fact that despite the conversation about a set of important variables—excellent leadership in the schools; teachers well prepared, et cetera—there was no mention of what it is that one desired to accomplish. What is missing from the equation is the outcome. One of the reasons that there has not been aggressive use and dissemination of programs that work is that we often do not answer that question. And it is not necessarily resource-driven.

With respect to distance learning, there are three reasons why there is very much to recommend it: First, it is an open-ended experiment that we should support—clearly I agree with you.

We have no idea today, from either cognitive or noncognitive modes, of its utility in terms of learning. We should have many experiments throughout the country in order to learn how to do it and how to do it cost effectively.

Second, as Dr. Massey pointed out, there are excellent models available, and there is a desperate need for them to be delivered to communities that will, in the short term, continue to be as you describe them. The elementary school you described is real, and while I would argue that in many other instances resources are not needed, that school is a representative of an historic unlevel playing field.

If you insist that teaching science requires a laboratory and a school does not have a laboratory, it does not have the resources to teach science well. It really does not matter what else you do, the outcomes will be limited by that fact.

But perhaps by use of distance learning, by use of an array of technologies, one could deliver a simulation of those laboratory experiences by alternative means. It is very important in that regard.

It is also important in another regard. If in fact, one really desires widespread comparability of outcomes—I did not say national standards or products—one way to get them is by taking advantage of technology and delivering the same unit concepts as a part of a course or modules to all students, quite independent of their local resources, and quite independent of their teachers.

So, we have an activity and a broad technology program that we very much value; we are very excited about it. One other thing I might add, it also offers us the possibility to link formal and informal education more effectively.

I am tempted to make one other addition—about something I thought was missing in the discussion about the fundamentals. I do not think, despite the discussion, that there has been agreement on an overall education plan, a subcomponent of which is a math, science education plan for a given community. As a consequence, one observes all of these disparate outcomes.

Mr. SANDERS. I would like to respond there too, because I think you are right on target. We do know some things about distance learning and its effectiveness. We have research data, for example, that will show that children who take calculus through a distance learning approach can achieve the same results as the student in a typical calculus classroom. It brings good teaching to students in remote settings.

I think we have not really given enough thought to how we bring technology into the homes so that there is a ready access to information in the more informal learning setting. We have begun thinking about and trying to look at the effects of the potential with digital transmission via satellite, as well as what may come whenever we have fiber optics into every home, so that there is the potential of linking technologies for learning, literally into every home.

SCHOOLDAY STRUCTURE

Senator KERREY. Let me in closing, Madam Chair, just make an observation.

There are 35 million students in school today in America, 2.3 million teachers. What I see us doing is we arrange eight meetings a day between those 2.3 million teachers and 35 million students. That is what we do.

We arrange eight meetings a day. Now I have a scheduling secretary that does that for me. She arranges my meetings all day long.

But I would hazard a guess that 75 percent of the effort of the boards is making it possible for those meetings to occur. They are not worrying about what happens after the meeting, but just making sure the damn meetings can happen.

They have to build a building, they have to operate and maintain the building. They have to provide food. In my visit yesterday, I was getting hit on by food people there. They got 9 million dollars' worth of food service done in the Omaha Public School. It makes them the biggest food service operator in the city.

They have a transportation system that they have to run.

Then there is the recordkeeping that has to be done. So there is a person doing a little checklist, making sure that each one of these children that is getting a breakfast is entitled to the breakfast, otherwise they have to pay.

And then the final little basket full of things is all the health and welfare requirements that increasingly, we are asking the schools to do.

So, we are arranging eight meetings a day between 35 million students and 2.3 million teachers, and then we hope during the meeting they get something done. They spend precious little time talking about the five core items and the curricula.

So it seems to me, perhaps the biggest dependent variable is the support the child gets from the parents, biggest dependent variable is home environment. If that is the case, that leads me inescapably to look at distance learning, particularly if I am willing to take on the vested interest, in the communications industry and say, look, boys and girls, you may be protecting your shareowners, but you are damaging American education.

Senator MIKULSKI. Back to me?

Senator KERREY. Yes.

Senator MIKULSKI. Thank you, Bob.

PARENTAL INVOLVEMENT

Senator Kerrey made some excellent points, as did the panelists. But I think what teachers and parents would encourage us to do is to get with the real world. First of all, when we talk about something called the home and parents' involvement, that is as pluralistic as our own society.

I think when we talk about parental involvement, we have to realize that in some communities, the parents themselves are children. The parents themselves are in school, the parents themselves ought to be in school; that in my own city of Baltimore, we have now probably a skyrocketing teenage pregnancy issue that defies solution.

And when you have 14- and 15-year-olds having children, it is a little hard to tell them to have a computer in their home.

We saw yesterday, Dr. Massey, some of the differences. In the science center in Maryland, I walked in one exhibit, an interaction exhibit and there were kids from the U.S. Naval Academy Elementary School, and lots of parental involvement.

And I had like a little town hall meeting with them and asked them what we could do to get kids interested in science. They had a whole program. They said put it on TV, like what you are doing and the Department of Education will not kick in and pay for.

They talked about experimentation. They talked about how they were willing to do the homework so they could get to do the experiments. They had a whole array.

Then in another exhibit there were children from the one of the poorest of the poorer schools, again with parental involvement. The parents were coming to learn. The parents were coming to learn because they themselves had never been inside of a science center.

They had never taken a field trip. They were getting something out of it, so that then they could go back home and be able to try to communicate. That is one issue.

And you talk to the teachers, the teachers are not only warn out, but they feel that they are being moms and dads by proxy. They are their social workers by default and very often when it comes to curriculum materials and so they are digging into their own pockets to pay the bill.

So these are the kinds of things I think we need to address—and this is a lot of what Senator Kerrey is saying. We do need computers. We have seen the dazzling things. It does even out some of the rural and urban issues, and even some of the class disparities in the counties.

But we have to get with the r al world here, as well as all these new programs like world class standards and so on. Also, we have to realize that not all learning occurs in the classroom. It does occur in the home and it does occur in informal education, but for a lot of kids the informal education is the street. It is not the museum or the science center.

CURRICULUM AND CURRICULUM MATERIALS

Let me get to the concrete question I have on curriculum and curriculum materials. The hour is growing late, but in regard to the Department of Education, we were very concerned at last year's hearing because the good science materials developed, like for Science Week, did not get out to the teachers.

We were very concerned about this so-called critical path for materials and model curriculums once they leave the National Science Foundation. Once it gets over to the Department of Education, there seems to b no clear, systematic way to get this material to the 16,000 school districts and then out to the individual schools and teachers within that district.

So last year when I took the science materials around just to talk to teachers that I see, they had not seen the materials even in a fairly well organized school system like Maryland.

My question is, Can you tell me what is the status now of the dissemination of materials? Have there been any improvements made by the Department of Education? What are your intentions to make sure distribution occurs after we develop all this innovation. We do not want it just sitting around in warehouses.

DISSEMINATION OF MATERIALS

Dr. SANDERS. Nor do we, Madam Chair; we want it in classrooms where it is impacting children also. One of the problems, as I understand, has been linking up programs and materials that are produced in NSF with our National Diffusion Network. We have worked collaboratively with NSF to improve the flow of their programs into that system. The NDN validation system does not quite match with the materials that NSF produces. Therefore, we are in the process of broadening and working on how best to disseminate information. In fact, we have been in the process of developing a new national dissemination center for the very purpose you describe.

I have Dr. Milton Goldberg with me, from our Office of Educational Research and Improvement. Milt works in this particular area. He may have other information that he might add for the committee.

Senator MIKULSKI. Dr. Sanders, the Department of Education is spending less than 1 percent of its math and science funds on the dissemination of materials. You are the only agency really linked to all 16,000 school districts, sir. And now what I hear is we are going to create a new national center. Well, what the hell does that mean? When are we going to receive the materials for Science Week? It seems like all we do now is invent new centers. Let us have a new national center on this, let us have a new national center on that, let us have an academy to do this. You are supposed to have a network in place to disseminate materials. Why do we need a new center, and is 1 percent of the budget adequate?

Science Week materials, a very simple thing that we know is coming, that is supposed to jump-start the thinking and be practical and creative tools—how do you disseminate Science Education Week materials?

Dr. SANDERS. May I defer to Dr. Goldberg?

Senator MIKULSKI. Sure.

Dr. Williams, would you trade places with Dr. Goldberg for a moment, please?

Dr. WILLIAMS. Sure.

Dr. GOLDBERG. It is clear, Madam Chairman, that there is an enormous gap between what we know about American education and what we actually do about it. The fact is, there are a number of activities now under way that are expanding on a rapid basis. For example, there is a regional laboratory in every section of our country, one of which serves, for example, the Middle Atlantic States, whose job it is to identify materials and programs that are working well and disseminate that information to all of the schools in its region. The Department's budget for those regional laboratories is expanding at a rapid rate now.

In addition to that, we have a number of research centers—at universities around the country, one of them at Johns Hopkins, for example. Our center at Johns Hopkins on the education of the disadvantaged is disseminating a variety of materials, including materials on math and science and materials——

Senator MIKULSKI. Dr. Goldberg.

Dr. GOLDBERG. Yes.

Senator MIKULSKI. I do not mean to be brusque, but let me ask you this. How long have you had this job and the responsibility for the dissemination of materials?

Dr. GOLDBERG. That is not my job, particularly. I am the Director of the Office of Research.

Senator MIKULSKI. Well, whose job is it to disseminate materials at the Department of Education?

Dr. GOLDBERG. There is no specific individual.

Senator MIKULSKI. There is no specific person?

Dr. GOLDBERG. No; most of the programs of the Department have dissemination imbedded in them as a responsibility.

Senator MIKULSKI. I understand. If I could just continue this. So there is no point person that Lamar Alexander can turn to and say,

how are we getting all this out. It is up to each little segment within the Department of Education, so you disseminate research, and somebody else disseminates something else, and somebody disseminates something else over there?

Dr. GOLDBERG. Well, it is not that—we support programs that do a lot of the dissemination, for example, these regional laboratories.

Senator MIKULSKI. I understand that.

Dr. GOLDBERG. That is right.

Senator MIKULSKI. But did you understand my question?

DISSEMINATION PROCESS

Dr. GOLDBERG. Absolutely. I do understand that.

Senator MIKULSKI. So how does that happen?

Dr. GOLDBERG. There is not a single individual.

Senator MIKULSKI. How does that happen, Dr. Sanders?

Dr. SANDERS. How does it happen that there is not a single person responsible, or——

Senator MIKULSKI. Well, yes. Who is the point person? How do you know that it is happening? What is the accountability built into the system?

Dr. SANDERS. The accountability is within each one of those separate and distinct programs that also have the responsibility of dissemination, Madam Chair.

Senator MIKULSKI. Well, we raised this issue 1 year ago, and nothing has happened. How did this week's science education information get distributed, and was it distributed to all 16,000 school districts?

Dr. SANDERS. I do not know for a fact that it was distributed to all 16,000 school districts. With all due respect, the Department of Education is linked with the States and with school districts in a variety of ways. There is no direct linkage between the Department and each of the roughly 16,000 school districts in the country. Those linkages are either through States or through other intermediate agencies like our research laboratories.

Senator MIKULSKI. All right. What was your methodology for distributing it to the 50 State departments of education?

Dr. SANDERS. Generally we use the mail service, Madam Chair.

Senator MIKULSKI. Really? And what were the plans for the dissemination? It has not happened. And then who checks to make sure that it gets to the proper department and that something useful has happened with the materials that the American taxpayer pays to develop?

Dr. SANDERS. I do not know what specific materials you are talking about. I will get you a full and complete answer to that.

Senator MIKULSKI. Well, let me tell you, Dr. Sanders, we heard that last year, as well. Now, we know there is a new team, but just know that we have now had, in my chairmanship, last year's materials that did not get out and this year's materials that I am not sure got out. I sense there is no clear direction—no one who checks across the board, with all the various components in the complex Department of Education, that materials developed are materials delivered and then materials utilized. Otherwise, why do it? If it is everybody's accountability, then it is nobody's accountability. I do

not say this to embarrass you. It is just part of exactly the kind of nitty-gritty we are talking about.

NSF'S DISSEMINATION OF MATERIALS

Dr. Massey.

Dr. MASSEY. I just thought I might let you know what has been done this year at the Foundation. The materials that you have seen are for National Science and Technology Week. And they have been distributed in a number of ways. We have distributed over 110,000 of these learning packets, which are packets that are used in the classroom by teachers and, in fact, are very good—I have just seen them myself this year. About 30,000 are distributed through teachers' workshops. About 20,000 go to the National Science Teachers Association. And another 25,000 go directly to State organizations.

Another way the material is distributed and reaches millions of people is through the magazine Learning. And I think we may have given you one. Inside each of these there is a pullout, a National Science and Technology Week poster which has games, puzzles, suggestions for teachers, and materials that they can develop.

Within the activities at the Foundation there is an effort to make sure these are disseminated. This is something that requires a lot more coordination and work.

Senator MIKULSKI. It certainly does, and we look forward to your leadership and that of Secretary Alexander to do this. We just cannot leave it to the regional this and the academic that and the center for this, and so on.

Let me ask my last question. I know we have kept you far beyond your own constraints, and we will be talking to the Science Foundation people tomorrow.

EVALUATION OF EISENHOWER PROGRAM

So let me have one more question for the Department of Education and how it interacts. As I understand it, the Eisenhower Program is the flagship program for teacher training at the Department of Education. At last year's hearing, education said it was too early to tell if it worked despite its existence for 6 or 7 years.

My question to you, Dr. Sanders, is, No. 1, is there an evaluation program going on for the Eisenhower Program, and if so, when will we have the results of that? And then, No. 2, how does the Eisenhower training differ from the National Science Foundation's highly popular workshops, and which of the two programs would you think is more effective, or do they have a synergistic effect?

Dr. SANDERS. Yes, Madam Chairman. First of all, we do now have an evaluation of the Eisenhower Mathematics and Science Education Program. It was done by SRI, and we will be happy to give you materials related to that evaluation. Generally, those results are very positive. The people who had participated in the training that was brought to them through the Eisenhower Program were positive in their response.

And I might note again that the program has touched roughly one-half of the math and science teachers in the Nation. It is, as you mentioned, short term. It averages about 6 hours per year per teacher as contrasted with the more extensive experiences that are

provided to teachers through other sources. There is a place for both.

In fact, one of the things that we found through the evaluation was that the program had been very effective in getting certain kinds of information out to teachers that they did not otherwise have. For example, the program gets information to mathematics teachers about the new standards being developed by the National Council of Teachers of Mathematics. So yes, there are results. They are very positive. In my judgment, there is a place for both kinds of programs.

Senator MIKULSKI. Dr. Massey, did you want to comment?

Dr. MASSEY. No; I agree with that statement.

Senator MIKULSKI. Well, there are many more questions that we could ask here. It is now 12:15. Again, the committee has stayed for some time.

I think since last year's hearing progress has been made. Maybe not in every detail, but these details are important. The fact that we have clear national goals, the fact that I think that there is a presidential and congressional commitment.

We now have this excellent report that is a guidepost. And also, I believe the Presidential appointments in the two mission agencies, Secretary Alexander and you, Dr. Massey, working with our able science advisor, will really accomplish a lot over the next 18 months.

So we now have, I think, the goal, the guideposts, and the people in place to really move a national agenda. I have found this hearing very informative.

Tomorrow, Dr. Massey, we will be talking with you and Dr. Bromley on your specific appropriations, which is really why we are waiting for larger goals to be implemented. What can we do now that is specific, immediate, and realizable to accomplish these goals?

And Dr. Sanders, though I am not on the Appropriation Subcommittee on Education, we will be working with Senator Harkin and our House counterparts on these issues. We thank you for your participation. You got some questions that were old questions that I know will get some new answers, because we have a lot of confidence in this Alexander team.

So I thank everyone for their cooperation, and we look forward to seeing you tomorrow.

ADDITIONAL COMMITTEE QUESTIONS

We will submit the balance of the questions for response in the record.

[The following questions were not asked at the hearing, but were submitted to the Department for response subsequent to the hearing:]

QUESTIONS SUBMITTED BY SENATOR MIKULSKI

Question: The Department of Education is spending less than 1 percent of its science and mathematics education funds on dissemination of materials. Why is this such a low priority?

Answer: The Department recognizes that dissemination must be a high priority. The Department's Task Force on Mathematics and Science Education recommended that programs in the Department that include substantial mathematics and science activities be asked to develop a plan for identifying, evaluating, and disseminating successful mathematics and science education efforts. This recommendation was accepted and the recently formed Steering Committee on Mathematics and Science Education is now devising a plan for implementing the recommendation.

We believe the Department devotes more than 1 percent of its mathematics and science spending to dissemination. Using the figures developed for the Education and Human Resources Committee of the Federal Coordinating Council for Science, Engineering and Technology, the mathematics and science budget for the Department is $329 million. Mathematics and science projects of the National Diffusion Network and the Education Resources Information Center (ERIC) represent more than 1 percent of this total. Further, there are many relevant dissemination activities carried out by projects within other Department programs, such as the education research and development centers, the regional education laboratories, and the Fund for the Improvement of Postsecondary Education. Also, the Eisenhower State Grants program conducts many dissemination activities through its State coordinators. No matter what exact percentage we are currently spending on dissemination, our investment will increase considerably with the establishment of a National Clearinghouse on Science, Mathematics and Technology Materials.

The Department is currently conducting a review of its dissemination efforts in mathematics and science education through a subcommittee of the Steering Committee for Mathematics and Science Education. Within 90 days the committee will prepare a report that describes the dissemination activities that are now being carried out and sets forth recommendations for making dissemination of mathematics and science materials more prominent and efficient. One aspect of this effort would obviously be the new clearinghouse.

Question: In preparing these creative materials, how is the Department of Education trying to help schools promote more "hands-on" curriculum, particularly since so many schools lack the necessary laboratory equipment for science?

Answer: The Department is very concerned about the need to encourage more "hands-on" learning. Research findings have indicated that the number of science laboratories in our Nation's elementary and secondary schools has actually decreased over the past decade while all of the reports on science education call for more direct involvement by students.

The Department has addressed this problem in several ways. First, it has supported the dissemination of projects that promote hands-on science learning in schools, in addition to the major national science reform efforts espousing this goal. For example, the Department supported the National Sciences Resources Center created by the Smithsonian and the National Academy of Sciences which focused on the distribution of hands-on materials. We also support a number of specific projects that foster teacher learning in how to implement hands-on science activities.

Second, the Department has encouraged the informal science system as a means to supplement offerings in elementary and secondary schools. Awards have been given to the Exploratorium in San Francisco, the Franklin Museum in Philadelphia, the Bronx Zoo, and others to devise means for students to experience science directly. A special initiative as the Exploratorium is now being supported to develop a handbook on creating inexpensive hands-on science materials that can be used in schools.

Third, the Department has supported distance learning through technology that enhances both the variety of science offerings in the schools and the quality of science experiences. For example, the Technical Education Research Center in Cambridge, Massachusetts developed hands-on science modules that provide opportunities for students to participate, through the computer, in national science studies. Other distance learning projects, both regional and national, provide means for schools to increase their emphasis on hands-on learning.

Question: While the Committee on Education and Human Resources report, "By the Year 2000" states that "dramatic change in educational structures" (p.35) will be needed to reach our goal of being first in the world in science and mathematics achievement, there are no programs for comprehensive reform from the Department of Education. Why not?

Answer: NSF has begun its statewide systemic initiatives program, which is designed to encourage comprehensive reform in the States. Instead of fracturing Federal resources by undertaking a duplicative initiative, the Department is working together with the NSF in anticipation of helping the States that are awarded grants under this program. We will encourage State Eisenhower Act coordinators to collaborate with State leaders engaged in the NSF initiative. In addition, the two agencies will work together to support increased cooperation with appropriate programs and agencies supported by the Department.

Under the Eisenhower National programs, the Department is also supporting, in conjunction with NSF, several national mathematics and science curriculum reform efforts, such as the American Association for the Advancement of Science Project 2061, and the National Science Teachers Association's Scope, Sequence, and Coordination program. These are intended to bring about comprehensive reform of mathematics and science curriculum.

As for the future, the President just recently announced his AMERICA 2000 education strategy, which sets out a comprehensive and long-range plan for reform and for moving the Nation toward all of the national education goals. Proposed legislation for those aspects of the strategy that require it will be submitted to Congress within the next several weeks. The strategy involves defining World Class Standards for performance of American students in all five core subjects, two of which are mathematics and science, standards that represent what young Americans need to know and be able to do if they are to live and work successfully in today's world; developing American Achievement Tests that could be used on a voluntary basis to assess students' achievement against the standards and that are designed to foster good teaching and learning as well as to monitor student progress; Governors' Academies for Teachers in the five core subjects to give teachers the knowledge and skills they need to help students attain the World Class Standards and pass the American Achievement Tests; and support for creating New American Schools, schools that are the best in the world, schools that enable their students to reach the national education goals and achieve a quantum leap in learning.

Question: If top-to-bottom change in America's 16,000 school districts is a key to reversing our scientific decline, why is less than 3% ($58 million) of the total federal science and mathematics education budget in 1992 going for this kind of organizational reform?

Answer: By itself, top-down change is not the entire answer. Teachers and administrators who are most directly involved in educating students must gain the knowledge and skills needed to implement "systemic reform" initiatives emanating from the States. The Department's primary role, through the Eisenhower State Grants program, has been to provide States and localities with a flexible resource for teacher enhancement activities. We will also encourage States to use Eisenhower funds to link up with the NSF systemic reform initiative.

Question: How do Eisenhower training programs for teachers differ from the NSF teacher enhancement training programs?

Answer: The Eisenhower State Grants program provides funds to virtually every school district in the Nation, resulting in a broad-based grass-roots approach to teacher enhancement. The recently completed national evaluation of this program notes that it occupies an otherwise unfilled niche among reform initiatives, complementing other programs, and providing what are often the only resources in a district for mathematics and science education improvement.

In contrast, the National Science Foundation's teacher enhancement program emphasizes the development of national role models in mathematics and science education through fewer but larger grants. The resources from the two programs are often used in conjunction with each other. For example, the Eisenhower program frequently provides the means to enable teachers in local districts to participate in activities sponsored by agencies like NSF and the Department of Energy.

Question: The Eisenhower program has been in operation for some years. How has it been evaluated? What is the result of that evaluation?

Answer: In 1988, the Department contracted for a two-year national study of the Eisenhower program by SRI International, the final report of which was issued in February of 1991. Highlights of the study are as follows (all figures apply to the 1988-1989 school year):

- The program serves as an implementation resource, providing "fuel" for existing reform efforts.
- It promotes a vertical integration of reform efforts so that both State and local efforts are working toward a common goal.
- Most of the funds are used for professional development initiatives--teacher training--both at the State and local level, that are often complementary to NSF programs.
- 67.5 percent of the resources go to local school districts, contributing to the program's extensive reach; at least one-third of the Nation's mathematics and science (including general elementary) teachers are affected each year.

- The program provides the opportunity for teachers to become aware of reform ideas and to form networks with other teachers.

- Program funds provide an average of half of the discretionary monies available to the States for improving mathematics and science education.

- Because it is a formula grant program, the flow-through funds at the local level are modest: the average per teacher expenditure is $30 and the average exposure per teacher is only 6 hours. In the higher education portion of the program, the average level of exposure is 60 hours per teacher.

The Eisenhower program has received a real funding increase of 50 percent since the time data collection for this study was completed. This means that the program is likely to be reaching even more teachers or to be providing more intensive training or both.

Question: The Department of Education and the National Science Foundation both have teacher enhancement efforts. Which of the two is more effective in retooling teachers? Why?

Answer: As shown by the national study on the Eisenhower State Grants program, Education's and NSF's programs play differing yet complementary roles in teacher enhancement. The advantage of the Eisenhower program is the high level of flexibility provided to each State and district, enabling them to address site-specific needs. NSF's program supports model projects, all of which are required to have national demonstration value. Both approaches are needed in effective reform efforts.

QUESTIONS SUBMITTED BY SENATOR KERREY

Question: We are now almost 20 months away from the Charlottesville Education Summit. I would like for each of you to tell me what you think the single most important action or effort undertaken by your department or agency during that time has been.

Answer: 1991 is the first year of operation for the Department's National Science Scholars program, which will provide awards to two students from each Congressional district. The Department is intending to make approximately 870 awards this year, at $1,119 per award. Our budget request for 1992 would raise the award level to $5,000. These prestigious awards will strengthen the leadership of the United States in the sciences, mathematics and engineering fields by attracting both men and women into these fields and by encouraging them to pursue teaching careers in these areas. I believe the Department's most significant achievement has been to obtain enactment and funding of this new program.

Question: Next fall, the 1991-1992 school year will begin. Those in the fourth grade and above are the ones who will have to bring achievement up to the stated goal, if it is to be done. What do you think the most important program or activity your department or agency will have in place at that time will be.

Answer: We consider teacher enhancement to be our primary means of addressing the national goal of being first in the world in

mathematics and science. The Department of Education is the single largest Federal supporter of teacher enhancement at the elementary and secondary level. The Department's flagship effort in mathematics and science teacher enhancement is the Eisenhower program which provides funds to virtually every school district in the country, affecting most of the Nation's mathematics and science teachers. These funds are often the only discretionary monies available to the districts for the improvement of mathematics and science education. The program received a 60 percent increase for 1991, and the request for this year represents an 18 percent increase, demonstrating the Department's and the Administration's continuing support for mathematics and science education.

Question: I want to thank you for the maps in the FCCSET report. Last year I had to do my own. I call attention to them because they illustrate a point that I make over and over: the uneven geographical distribution of federal facilities, federal research funds and even competitive K-12 funds. I would like for each of your to tell me what your department or agency is doing to redress this imbalance.

Answer: Eighty-six percent of the funds that the Department of Education puts into mathematics and science education (via the Eisenhower State Grants program) is distributed by formula, based partially on population and partially on poverty level. This ensures that the resources go to those who need it most. Discretionary funds (e.g. National Science Scholars, Eisenhower National Programs) are distributed on merit. Announcements for applications are published in the Federal Register which is accessible to schools across the country. These discretionary competitions are frequently discussed at the conferences and in the newsletters of educational associations. For example, the Eisenhower National programs fund a newsletter, distributed to all 57 Eisenhower State coordinators and interested members of the public, that discusses Federal programs of interest in mathematics and science education. This ensures that educators nationwide are aware of the availability of funding.

Question: The FCCSET report gives a number of significant and unfortunate figures regarding attraction and retention of teachers. The reports also indicates that a major emphasis--if not THE major emphasis--is on teacher preparation and enhancement. Young teachers seem particularly vulnerable to leaving the profession. These are years when their pay is lowest; they may get the least desirable of assignments; they are still in a learning mode, especially with respect to what works and what doesn't work in a classroom; they are often the last to be asked to participate in seminars, symposiums, etc,; they may owe on student loans.

Have you given any consideration to positive incentives to staying in teaching and enhancing skills at this point? Perhaps we could experiment with or try a demonstration program which would reward them for staying in teaching--give them a stipend for further coursework or research activity related to their subject.

I think many of our incentives tend to be somewhat negative although I've been a proponent. We'll give you scholarships but you have to teach in certain areas or schools; you have to teach, perhaps teach a specified subject for so many years. What about coming at this problem from a different angle?

Answer: Twenty-five percent of Eisenhower State Grants program funds go to institutions of higher education (IHEs)--this amount

will total $50 million in 1991. One of the activities allowed by statute is traineeship programs for both new and prospective teachers. The ultimate purpose of this part of the program is to increase the number of mathematics and science teachers and retain those who begin teaching, as well as those who are preparing to become teachers through alternative certification routes. In 1988-1989, for example, 21 percent of all the training done by IHEs was for preservice or uncertified teachers, and this figure does not include the number of new teachers who are served by inservice training.

QUESTIONS SUBMITTED BY SENATOR HATFIELD

Question: Now that the initial FCCSET report has been issued, what are the future plans and activities of the Federal Coordinating Council for Science, Engineering and Technology, Committee on Education and Human Resources? Will the Committee remain in existence and move to the next step of recommending action to both the Congress and the Administration to enhance the expenditure if federal funds in these areas? How will this report be used by the President in the federal budget process?

Answer: The FCCSET committee is in the process of a review of each agency's programs. A new report will be issued in early 1992, detailing the accomplishments of the present year. It is expected that this report will include budget recommendations for fiscal year 1993.
The Department has traditionally held the belief that the States and districts are those who can best improve their own schools. Our policy has therefore been to provide a high level of flexibility in all our programs. However, we realize that, in addition to providing resources to implement individual reform agendas, we must also provide exemplary programs to serve as models. The President's new initiative, "America 2000", provides that necessary combination of top-down and bottom-up reform initiatives that make for successful change. The Governor's Academies and the New American Schools will provide the leadership, training and demonstration programs needed, while "choice" and school-based management will give each district and school the flexibility and accountability that will encourage reform.

Question: I am interested in the reflections of the National Science Foundation and the Department of Education on the major areas of overlap between them in mathematics and science education and how Federal resources can be leveraged to enhance their interagency coordination.

Answer: The Department of Education and the National Science Foundation both operate programs to enhance the ability of teachers to help students achieve higher levels of performance in mathematics and science. The Department's Eisenhower Mathematics and Science Education State Grants program and NSF's teacher enhancement program play differing yet complementary roles in teacher training and improvement. The Eisenhower State Grants program provides funds to virtually every school district in the Nation, resulting in a broad-based, grass-roots approach to teacher enhancement. The recently completed national evaluation of the program notes that it occupies an otherwise unfilled niche among reform initiatives, complementing other programs, and providing what are often the only resources in a district for mathematics and science education improvement. In contrast, the NSF teacher enhancement program emphasizes the development of national role models in mathematics and science education through

fewe but larger grants. The resources from the two programs are often used in conjunction with each other. For example, the Eisenhower program frequently provides the means to enable teachers in local districts to participate in activities sponsored by agencies like NSF and the Department of Energy. This is a case of Federal funds being used in a coordinated manner to leverage greater impact at the local level.

Under the Eisenhower National Program, the Department is also supporting, in conjunction with NSF, several national mathematics and science curriculum reform efforts that are intended to bring about comprehensive reform of mathematics and science curricula, e.g., the American Association for the Advancement of Science's Project 2061 and the National Science Teachers Association's Scope, Sequence, and Coordination program. In one case joint funding was arranged, and in the other case each agency funded a different stage of the project. These are other examples of how Federal funds can be used to maximize impact.

Question: Public Law 101-589 included authorization for a National Clearinghouse on Science, Mathematics and Technology Materials. Congress provided $500,000 in fiscal year 1991 to begin design and implementation of this project. It is my understanding that the National Science Foundation has been consulting with the Department of Education on the design for the clearinghouse. Please provide me with an update on this project and the role of the National Science Foundation in assisting with its development.

Answer: The Department of Education has been meeting with the National Science Foundation to discuss the design and establishment of the clearinghouse. Those discussions have focused on how the newly authorized clearinghouse could be designed and operated to best serve the purposes of the authorizing legislation and the needs of both the Department and NSF given the existence of numerous other clearinghouses relating to mathematics and science. A three-step approach to implementation of the legislation has been defined. First, a fact-finding meeting was held with dissemination leaders from both the Government and the field to identify the issues. Second, approximately six papers will be commissioned on the implementation issues identified at the meeting and determined by the Department and NSF to be the key issues, and then a planning conference, sponsored by the Department and jointly organized with NSF, will be held to bring together the authors of the papers, key program representatives from the Department and NSF, and additional national experts on dissemination. Finally, following the conference the Department in consultation with NSF will develop a specific design or set of priorities for a competition for funds to establish the clearinghouse.

CONCLUSION OF HEARING

Senator MIKULSKI. That concludes the hearing. The subcommittee will recess and reconvene at the call of the Chair.

[Whereupon, at 12:20 p.m., Tuesday, April 23, the hearing was concluded and the subcommittee was recessed, to reconvene subject to the call of the Chair.]

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ISBN 0-16-037320-4