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Total Pages: 8*

LRM ID: CJB70

**EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
Washington, D.C. 20503-0001**

Monday, July 14, 1997

LEGISLATIVE REFERRAL MEMORANDUM**TO:**

Legislative Liaison Officer - See Distribution below

FROM:*Janet R. Forsgren*
Janet R. Forsgren (for) Assistant Director for Legislative Reference**OMB CONTACT:**

Constance J. Bowers

PHONE: (202)395-3803 FAX: (202)395-6148

SUBJECT:**EDUCATION** Testimony on Math and Science Education / Technology Initiative**DEADLINE:**

cob Monday, July 14, 1997

In accordance with OMB Circular A-19, OMB requests the views of your agency on the above subject before advising on its relationship to the program of the President. Please advise us if this item will affect direct spending or receipts for purposes of the "Pay-As-You-Go" provisions of Title XIII of the Omnibus Budget Reconciliation Act of 1990.

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*Comments to
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am.*

SUBJECT: EDUCATION Testimony on Math and Science Education /

_____ Concur
 _____ No Objection
 _____ No Comment
 _____ See proposed edits on pages _____
 _____ Other: _____

FAX RETURN of _____ pages, attached to this response sheet

Dept of Education - Secretary Riley

July 16 Hearing before House Science Committee

I am pleased to be here, along with National Science Foundation Director Neal Lane, to testify about our efforts to improve math, science and technology education.

In this internationally competitive Information Age, our Nation's economic future depends in large part on American workers' proficiency in math, science and technology. The knowledge content of work is increasing, and education -- particularly in these key areas -- is essential to maintaining a competitive edge. For example, the growth of the high-tech industry has been a powerful boost to the American economy. However, the continued growth of the industry will depend on skilled and knowledgeable workers. As you are aware, the Information Technology Association of America recently issued a report estimating that there are 190,000 high tech jobs going unfilled because companies cannot find applicants with the needed math, science and technology skills. This shortage is not just in the high tech industry. Another example of the increasing math, science and technology skills needed by today's workplace can be found in the work of the National Skills Standards Board. When it commissioned pilot projects to outline baseline skills in 12 industry sectors, 11 of the 12 recommended some form of advanced mathematics proficiency, such as trigonometry or geometry.

The recent results of the Third International Mathematics and Science Study confirm that our students are not learning the more advanced mathematics necessary for the new economy. TIMSS shows that U.S. students are generally learning the basics of mathematics, scoring above the international average at the 4th grade. However, by eighth grade U.S. students score below the international average. One reason for this is our low expectations for our students. While our students tend to study arithmetic through 7th or 8th grade, in high-performing nations students in these grades move from mastering arithmetic to using it in complex problems and learning the foundations of algebra, geometry, measurement, probability, and statistics.

Local schools, school districts and States are working hard to strengthen math, science, and technology education, aided by the National Science Foundation and the Department of Education. For example, most States have developed mathematics standards, most of them based on the challenging voluntary standards introduced by the National Council of Teachers of Mathematics in 1989. Some States are also far

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along in the process of aligning ^{their} assessments, teacher preparation and professional development to those standards. The Department's Eisenhower Professional Development Program, our largest program focused primarily on math and science, provides flexible formula funding that States and school districts are using to support a wide array of professional development activities tied to State standards. ^{And} ~~As a result,~~ we are seeing some progress ^(Math) Achievement on the National Assessment of Educational Progress is rising slightly for all three grades measured. Between 1990 and 1996, on a 500 point scale scores rose 11 points for 4th graders, 9 points for 8th graders and 10 points for 12th graders.

While this success is encouraging, more is necessary if we are to meet the challenges we face. That is why the President has proposed voluntary national tests in reading at fourth grade and mathematics at eighth grade. Let me take just a minute to explain the thinking behind these two voluntary tests, particularly the mathematics test at the 8th grade. My sense is that too many people just do not have any idea of what students should know and be able to do in mathematics. That is why we -- parents, citizens, business leaders, and educators -- allow our students to be short-changed and given a much less advanced curriculum than students in other nations. And that is why so many students enter high school unprepared to take the higher-level math and science courses that are the gateway to college and good careers. The voluntary national test will supply clear and concrete understandings of what students should know and what world-class performance looks like at the 8th grade.

The strong performance of our students at 4th grade in TIMSS shows that our students can do as well as any others in the world. Up until fourth grade, our expectations and curriculum are essentially the same as those in other nations -- we like other nations, expect our students to master arithmetic. I believe that if we raise our expectations of what students can do in 5th, 6th, 7th and 8th grade, and ^{upgrade} ~~provide~~ curriculum and improved instruction, our 8th graders will also perform near the top of the international rankings.

While the test will be important in raising the bar of expectations, it cannot stand on its own. The mathematics test must be a focal point of a national effort that engages parents, educators, State and local leaders, business, professional, mathematics and scientific organizations in an all out effort to help ensure that, by 8th grade, all students

In addition,
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funds under
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Title I
program to
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master challenging mathematics.

Review
In order to create a framework for this national effort, and to determine what role our agencies and other agencies can best play, the President asked Director Lane and me to convene an interagency working group to develop an action strategy for improving achievement in mathematics and science. We have done so, and I am pleased to say that after meeting with 11 other agencies, consulting with key organizations and reviewing current federal programs and activities, the working group is just completing that strategy. *will soon*

*and how we
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partners*

complete
The strategy identifies three key areas for national as well as federal focus: (1) equipping teachers with the skills and knowledge to teach challenging mathematics content effectively; (2) aiding the implementation of high-quality curriculum based on high standards; and (3) building public understanding of what challenging mathematics looks like and gaining public support for improving student achievement toward high standards. In each area the strategy lays out specific steps the two agencies *will take* *in concert to* achieve these aims. A key element of the strategy is to make best use of the strengths of the ^{Education NSF} two agencies' programs. As you know, the Department of Education generally provides flexible support for improving teaching and learning, coupled with technical assistance, while the National Science Foundation has a portfolio of programs targeted on math, science and technology education. The strategy combines those strengths and uses the NSF programs to help upgrade mathematics professional development and instruction in major Department of Education programs. *Let me give you a few examples.*

*the Federal
Government*

*action
while
working
on
important
NSF
initiatives*

As you know, Title I of the Elementary and Secondary Education Act, funded at over \$7 billion, is the Federal Government's largest elementary and secondary education program. It provides funds to States and school districts by formula to help educationally disadvantaged students, especially those in high-poverty schools, learn to high standards. While almost half of the 9 million students participating in Title I receive some mathematics instruction through the program, historically much of that instruction has been remedial and not linked to high standards. We began to change that with the reauthorization of Title I in 1994, which emphasized holding Title I students to the same high standards as other students. In order to help this change, NSF has agreed that it will use its portfolio of targeted math and science programs to provide incentives for

support

States and school districts to upgrade mathematics instruction in Title I schools. This effort will also ^{bolster the impact} expand the reach of NSF's programs by ^{bring together} leveraging other funds. To launch this effort, the two agencies will hold a national conference of State and local leaders of Title I, the NSF State and local systemic initiatives, and other programs to set the stage for more coordinated efforts. We are also working closely together to provide good information to Title I schools about ways to use Title I to support high quality mathematics education. *

Another example concerns professional development. Enhancing the skills of teachers in the classroom is critical if students are to learn more challenging mathematics. Yet, most experts told the working group that the nation does not have enough people who are able to ^{provide} exemplary professional development for classroom teachers. To meet this need, we are ^{develop} coordinating to support a short-term, intensive effort to train ^{plan} people to provide this professional development. ^{high caliber} expenditure in middle school math. ^{providers of}

A final example concerns curriculum. As you know, the Department is generally barred by law from developing or requiring any specific curriculum. But we can provide information that helps educators make intelligent choices among ^{many} all the different instructional materials, including software, that are available. We have convened an expert panel - including representation from NSF -- that is reviewing mathematics curriculum materials and will identify which are exemplary or promising. NSF is undertaking a complementary effort to provide guidance and assistance to schools in implementing new curriculum materials. We and NSF will then work closely together to ensure that schools have full access to this information. For example, we will ^{ask} encourage the Eisenhower Consortia -- the Department's 10 regional math and science technical assistance providers -- to disseminate this sort of good information about quality materials and best practices from both agencies.

As you can see, putting into practice this interagency action strategy will require on-going coordination. We are already making that a reality. My staff has already been meeting with NSF staff to ensure that our 1998 and 1999 program and budget priorities are complementary.

You have also asked me to speak about the President's technology initiative. There is no question that preparing our students for the 21st century includes improved

academic skills and higher order thinking and problem solving capabilities. Today's technologies are essential resources to carry out these tasks --- to engage students in a broader and deeper study of all subject matter areas, especially science and mathematics and to acquire the technological skills of the Information Age.

Increasing access to appropriate technology and high quality software and ensuring that teachers have the training to use it effectively in the classroom is a top priority. Our surveys show that schools' access to the Internet has increased by 15 percent each of the past three years, up to 65% of schools currently. However, only 14 percent of classrooms have access and only 1 out of every 5 teachers is using advanced telecommunications for teaching. In more than half the schools in the nation, teachers have to learn about technology on their own.

Nevertheless we are making progress in these efforts through the Technology Literacy Challenge Fund, a 5 year, 2 billion dollar effort to help States implement comprehensive strategies to address the goals of the President's Technology Challenge. I am pleased to tell you that all 50 States applied for and were approved for the first round of funding this year (\$200 million). In addition, the Technology Challenge Innovation Grants is an demonstration effort that supports consortia of schools, industry, higher education and others in creating cutting-edge and compelling applications of computer and telecommunications technology in math, science and other critical areas of the curriculum. This program has generated an unprecedented response, and we expect to award a third round of grants shortly, bringing the number up to more than 60. The President's FY1998 budget request doubles the funding for these two programs, with \$75 million for the challenge grants and \$425 million for the technology fund.

Finally, the new E-rate provisions of the Telecommunications Act should have a powerful impact on schools' access to technology. To help ensure that it is used to its full potential, we are working with the FCC and education groups to develop recommendations on effective implementation. This new E-rate is so important that I have sent information about it to every school superintendent in America and we are working closely with the Departments of Commerce and Agriculture to provide additional technical assistance to rural and poor schools. The Department's six Regional Technology Education Consortia are playing an important role in helping schools take full advantage of the E-rate. The E-rate, combined with our programs, will

go a long way in bringing the powerful tools of technology to teachers and students across America.

Working with the States and local communities, engaging the private sector as partners, focusing on high standards for all students and working with families to build stronger connections between home and school is the way we must proceed. We must expect more of our students in mathematics and science, we must give our teachers the opportunities to improve and change the way they teach, and we must use technology effectively.

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Total Pages: 1

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**EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
Washington, D.C. 20503-0001**

Monday, July 14, 1997

LEGISLATIVE REFERRAL MEMORANDUM

TO: Legislative Liaison Officer - See Distribution below

FROM: *Janet R. Forsgren*
Janet R. Forsgren (for) Assistant Director for Legislative Reference

OMB CONTACT: Constance J. Bowers
PHONE: (202)395-3803 FAX: (202)395-6148

SUBJECT: National Science Foundation Testimony on Math and Science Education

DEADLINE: 11:00 a.m. Tuesday, July 15, 1997

In accordance with OMB Circular A-19, OMB requests the views of your agency on the above subject before advising on its relationship to the program of the President. Please advise us if this item will affect direct spending or receipts for purposes of the "Pay-As-You-Go" provisions of Title XIII of the Omnibus Budget Reconciliation Act of 1990.

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William R. Kincaid
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Louisa Koch
Lisa A. Gaisford
Janet R. Forsgren

SUBJECT: National Science Foundation Testimony on Math and Science

**RESPONSE TO
LEGISLATIVE REFERRAL
MEMORANDUM**

If your response to this request for views is short (e.g., concur/no comment), we prefer that you respond by e-mail or by faxing us this response sheet. If the response is short and you prefer to call, please call the branch-wide line shown below (NOT the analyst's line) to leave a message with a legislative assistant.

You may also respond by:

- (1) calling the analyst/attorney's direct line (you will be connected to voice mail if the analyst does not answer); or
- (2) sending us a memo or letter

Please include the LRM number shown above, and the subject shown below.

TO: Constance J. Bowers Phone: 395-3803 Fax: 395-6148
Office of Management and Budget
Branch-Wide Line (to reach legislative assistant): 395-7362

FROM: _____ (Date)
 _____ (Name)
 _____ (Agency)
 _____ (Telephone)

The following is the response of our agency to your request for views on the above-captioned subject:

Concur

 No Objection

No Comment

See proposed edits on pages _____

Other: _____

FAX RETURN of _____ pages, attached to this reponse sheet

**Draft Testimony of Dr. Neal Lane
Director, National Science Foundation
Before the House Science Committee
July 16, 1997**

Mr. Chairman, I appreciate the opportunity to appear today, together with Secretary Riley, to discuss the role of the federal government in Science, Mathematics, Engineering and Technology (SMET) education. We have a long history of working with the Department of Education to sustain and improve our country's educational systems, and we are pleased to be recognized for the education reforms we have been stimulating for many years.

Educating for the Future: The Federal Role

America's system of higher education sets a world ~~leading~~ standard for excellence and inclusiveness. Yet even this outstanding system faces challenges in preparing students for dealing with the rapidly changing scientific and technological landscape. The continued involvement of the federal government in SMET education is important to instigate the major changes required for preparing U.S. students for the twenty-first century. States and local school districts evolve slowly and often are unable, on their own, to take the necessary difficult steps and accept the risks inherent in major systemic changes. By sharing the costs and disseminating vital information with respect to the development of new curriculum materials, assessment instruments, and models for reforming and renewing educational systems, the federal government stimulates and helps enable schools and school districts to provide world class education to all students. Furthermore, through human resource development in partnership with teachers, workers, state and local government, academia, and business, it ensures quality and equality of educational opportunity. These commitments are central to producing the finest scientists and engineers needed to maintain U.S. leadership across the frontiers of science, engineering and technology in the twenty-first century.

The National Science Foundation: A Catalyst for Progress

Guided by its long standing commitment to the highest standards of excellence in the support of discovery and learning, the National Science Foundation (NSF) aims to provide the leadership and stewardship necessary to achieve excellence in U.S. science, mathematics, engineering, and technology education at all levels. Proficiency in essential skills and understanding of basic concepts in mathematics and science will be critical to the earning power of individuals and to the nation's economic competitiveness and quality of life in the twenty-first century. NSF strives to assist in the development of such proficiencies in all disciplines of science and mathematics and at all levels of education through our long standing competitive processes based on

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expert peer review. Through catalytic, integrative investments in the work of a dynamic, creative and diverse community of researchers and educators, NSF can help the Nation meet the challenges of the twenty-first century.

NSF is specifically helping to address these challenges by supporting innovative, systemic approaches – improvements in the entire delivery system of – education and training at all levels. NSF funded science and mathematics education projects are conceived of and carried out by individual investigators – researchers, teachers and administrators representing higher education, school districts, states, and, occasionally, the private sector – and are selected by a competitive process using expert peer evaluation. NSF science and mathematics education programs support, as do all NSF programs, cutting edge, high quality experiments, designed to foster the natural connections between human learning and the process of inquiry and discovery. As these new ideas become the basis for broader based educational programs, successful new approaches to science and mathematics education, initiated through NSF support, can have a far reaching impact.

NSF has realized for many years the potential of technology to improve education at all levels, from pre-kindergarten through grade 12 (preK-12) and on through graduate programs. In line with one of the recommendations of the President's Committee of Advisors on Science and Technology (PCAST) in its Report to the President on the Use of Technology to Strengthen K-12 Education in the United State, the Foundation's new Knowledge and Distributed Intelligence initiative – or KDI – extends NSF's 15 year history of supporting research and implementation of high risk, high payoff initiatives designed to improve how we use learning technologies. One example of NSF's educational technology efforts, sponsored also by the Illinois State Board of Education/Eisenhower Program, the Learning through Collaborative Visualization (CoVis) project enables students to study environmental and atmospheric phenomena through networked, interactive visualization software – such as that used by weather forecasters – modified to aid student learning. CoVis also works one on one with schools and districts to help them establish physical connections to the Internet. Thus, NSF's educational technology programs aim to build new, systemic and lasting changes in the nation's educational infrastructure by increasing the use of educational technology and building a solid research foundation that helps us understand how students use technology to learn and that can point to the development of advanced learning technologies for the next century.

Reforming K-12 Education

NSF has long been recognized for its leadership as a federal partner in improving K-12 science and mathematics education. It has leveraged intellectual and fiscal resources and forged partnerships to meet emerging challenges and extend its impact nationally. Through its systemic reforms, NSF promotes sustained, intensive reform that focuses on substantive change in the classroom. NSF's teacher enhancement and teacher preparation programs are key pillars of systemic reform efforts. They strive to

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strengthen teachers' knowledge and pedagogical skills and create a network of teachers who are better able to foster reform. Moreover, NSF's Instructional Materials Development (IMD) Program promotes the development of materials and strategies to enhance learning and to encourage students' positive attitudes towards science, mathematics, and technology. By incorporating investigative, hands on science and mathematics, these materials facilitate changes in the basic delivery of classroom instruction. Finally, NSF is taking on the challenge of helping to develop a robust set of standards based assessment instruments and procedures.

In School Year 1996-97, NSF's 59 Statewide Systemic Initiatives (SSI), Urban Systemic Initiatives (USI), Rural Systemic Initiatives (RSI), and Comprehensive Partnerships for Mathematics and Science Achievement (CPMSA) provided direct benefits, such as professional development, curriculum changes, and new assessment procedures, to approximately 56,000 teachers serving 7.7 million students in about 13,000 schools in 38 states. Furthermore, NSF's FY 1997 funding of approximately \$115 million in systemic initiatives is being matched by over \$520 million in state and local funding, as well as indirect funding through local bond initiatives used to upgrade scientific and technological equipment and facilities. All sites use some or all of the resources provided by the U.S. Department of Education's Eisenhower Professional Development State Grants in support of their reform plans. They also make use of other funding sources, including the Department's Goals 2000, Title I and Carl Perkins funds, as well as state and local funds, to provide such support. Moreover, in most sites, major corporate partnerships have been established.

Systemic initiative projects have reported increasing enrollment in and completion of science and mathematics courses and increasing numbers of students participating in, and passing, advanced placement mathematics and science. Furthermore, they have demonstrated overall increase in student achievement and declining gaps in achievement between historically underserved students and their peers. Most of the state school systems supported by NSF through the SSI Program have developed and adopted standards based frameworks to guide local school district mathematics and science curriculum implementation. Many sites have integrated curriculum sequences so that the fundamental ideas of higher level science and mathematics are mastered at earlier grades than has occurred historically.

For example, the Miami/Dade Urban Systemic Initiative, using NSF and Eisenhower funds, provides professional development every year to about 4000 or over 50% of the school-based instructional and administrative personnel in the district. At almost all grades, student scores on the mathematics section of the Stanford Achievement Test have increased every year of the initiative. Furthermore, there are consistent increases in enrollment and completion of higher level mathematics and science classes among all ethnic groups every year of the initiative. In the third year of the initiative, there was an 89 percent increase for African Americans taking the chemistry advanced placement test.

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Improving Graduate and Undergraduate Education

As we approach the twenty-first century, our nation's need for cutting edge research and world class education standards has never been greater. These needs for excellence in research and education are not separate and independent -- they are linked and interdependent. The National Science Foundation has always recognized the importance of promoting synergy between the research and education missions of colleges and universities, and the Foundation continues to seek new ways to promote their integration at all levels.

NSF's close involvement with academic institutions gives it the ability to promote the closer coupling of research and education. The Foundation aims to engage researchers and educators in a joint effort to infuse education with the joy of discovery at every level. NSF's Recognition Awards for the Integration of Research and Education (RAIRE), made to ten research intensive universities earlier this year, were designed to stimulate new thinking at colleges and universities on how to better link research with education. One of the recipients, Carnegie Mellon University has established a Center for Innovation in Learning that encourages and supports faculty efforts to use problem solving as a vehicle for learning. Students are able to pursue independent research and study through courses, paid work-study, senior honors programs and internships. So, the students encounter and solve real world problems and learn science and engineering as a result.

Thus, through innovative, ground breaking, systemic approaches, NSF is changing the nature of how our education systems, at all levels, link learning with inquiry and discovery. NSF has stimulated reform of undergraduate curricula in mathematics, chemistry and engineering; fostered collaborations of two and four year colleges, and secondary schools to strengthen the science and mathematics preparation of students preparing for the advanced technological workplace; and instigated new models of teacher preparation that partner disciplinary and education departments. For example, NSF's Advanced Technology Education program has supported the cooperative efforts of the Eastern Iowa Center with the Partners for Environmental Technology Education, a national infrastructure of community colleges, industries and high schools. The Center is identifying knowledge and competency requirements for high school graduates entering environmental technology programs and has developed a profile of technical skills and a knowledge profile for the environmental technician through a national validation.

In FY 1998, NSF is moving to involve all of its directorates in a new venture to initiate systemic reform efforts at the undergraduate level. This new venture is designed to prompt a re-examination of institutional priorities and practices, including the allocation of resources and integration of research and education. It builds on previous NSF curriculum and institutional development activities, such as the Course and Curriculum Development Program, which has included calculus, chemistry and institution wide reforms and the Engineering Education Coalitions, which aim at reform of the entire

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engineering education process. The expected result will be significant improvements in the science and mathematics education received by all undergraduates.

Interagency Coordination of Federal SMET Education Activities

The National Science Foundation actively collaborates on science and mathematics education programming with several federal R&D agencies. As a member of the National Science and Technology Council (NSTC) Committee on Education and Training (CET), NSF participates in efforts to coordinate federal science education programs. For example, the Foundation aided in the design of the Technology Learning Challenge that forms the basis of the Administration's technology agenda. Likewise, NSF jointly designed, managed, and funded the Third International Mathematics and Science Study (TIMSS) of achievement and curriculum with the National Center for Education Statistics. Moreover, under several memoranda of understanding with agencies such as the National Institutes of Health, the National Aeronautics and Space Administration, the Department of Interior and others, NSF works closely with these agencies to ensure that its programs do not duplicate other agencies' programs, but rather complement, and link where appropriate, other efforts to maximize the overall impact of federal support for SMET education.

Education programs at NSF and the Department of Education (DoEd) are coordinated through an FY 1992 Memorandum of Understanding (MOU). The MOU, targeted primarily at efforts from pre-kindergarten through grade 12, formalizes interactions for planning, information exchange, and collaboration at a number of management levels. Moreover, at the program level, agency staff collaborate on common areas of interest especially in the areas of professional development of teachers and educational technologies. This collaboration ensures that programs effectively complement one another and enables a sharing of expertise that benefits both organizations. For example, NSF-supported instructional materials are examined by DoEd-established expert panels and included in information disseminated by the Department through means such as the Eisenhower Regional Consortia. Finally, staff from both agencies regularly participate in proposal review panels for each other's programs.

In a recent joint endeavor, the Department of Education and the National Science Foundation established a Working Group to Improve Mathematics and Science Education. This group meets regularly with staff of the Domestic Policy Council (DPC) and the Office of Scientific and Technology Policy (OSTP). The interagency group's mandate, by Presidential Directive, is to develop an action strategy to improve U.S. mathematics and science education in conjunction with a voluntary national test of mathematics achievement at grade eight.

Cooperation between the Department of Education and NSF in SMET education respects the different missions and approaches of the respective agencies. The bulk of the Department's funds are distributed to state and local educational agencies based on their meeting eligibility requirements for programs with very broadly based

Involved other federal agencies concerned with research and has to coordinate with science education

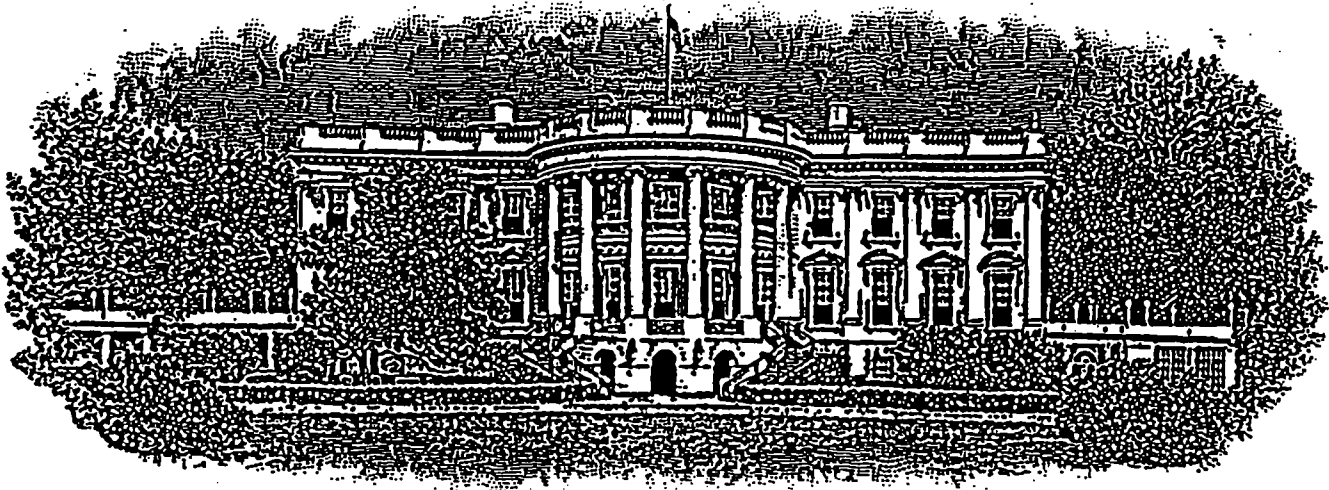
educational objectives. On the other hand, the National Science Foundation's projects result from unsolicited proposals from individuals or organizations that survive the test of rigorous competitive merit review process in which proposals are evaluated by expert peer reviewers according to specific criteria.

These differences in operational structure can be used effectively as the two agencies cooperate and coordinate their activities. NSF's competitive process can provide the spark that state and local educational agencies may require in order to initiate change in their use of the Department's funds. Likewise, the Department's capabilities for getting information into the hands of teachers, parents, school administrators, and the public can help NSF get its messages about SMET education to a much broader audience. The progress made by the current working group on improving mathematics and science education can be codified in real operational agreements through updating the MOU.

In a democratic society that is highly dependent on science, engineering, and technology for its well being, all federal agencies must collaborate to ensure that all Americans will have the knowledge and skills they need to succeed in an increasingly technological world. In SMET education, the link between inquiry, discovery and learning is omnipresent. By stimulating and sustaining ongoing professional development and teacher preparation, the National Science Foundation helps teachers across the nation to deliver the instruction necessary for an increasingly technological and competitive world. Furthermore, through building partnerships with educational institutions, businesses and industry, foundations, federal, state and local government, the Foundation leverages resources to ensure that the U.S. continues to improve at the K-12 level and remains the best in the world in higher education.

Through these innovative, systemic approaches to education and training at all levels, the National Science Foundation, by collaborating with the Department of Education and other agencies, has pushed the frontier of U.S. education, striving continually to ensure all students are proficient in all disciplines of science and mathematics and at all levels of education. Using our respected competitive review process, NSF will continue to hold to the highest standards in supporting efforts to make the catalytic and systemic changes needed to best prepare Americans of all ages for the challenges of the twenty-first century.

The White House



Domestic Policy Council
Old Executive Office Building, Room 220
Washington, DC 20502

Telephone Number: (202) 456-2857
Alternate: (202) 456-2216

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FAX COVER SHEET

TO: Judy Sunley, Tom Corwin, Judy Wurtzel
FAX: 703-306-0109; 401-6139; - 401-3045

FROM: BILL KINCAID

THIS FAX INCLUDES THE COVER SHEET PLUS 19 PAGES.

IF YOU DID NOT RECEIVE THE COMPLETE FAX, PLEASE CALL (202) 456-2857.

MESSAGE: I think there is lots of good material here.
Attached are my comments on the Appendix portion of the draft.
One key thing here is that the description of ED/NSF programs
should be handled in a more parallel fashion - the intros are
different, the kinds of information provided are different etc,
Also will there be any added portions of the
appendix listing other agency efforts that we learned
about from the meetings we held? Bill

Working DRAFT
6/20/97

APPENDIX 3

RELEVANT ACTIVITIES OF THE DEPARTMENT OF EDUCATION AND
THE NATIONAL SCIENCE FOUNDATIONDEPARTMENT OF EDUCATION*Professional development and curriculum enhancement:*

- ② **Eisenhower Professional Development State Grants**, currently funded at \$310 million, supports educator professional development in the core academic subjects. By statute, at least \$250 million of the Eisenhower funds must be spent on professional development in mathematics and science. A strength of the program is its reach -- funds flow to States and school districts by formula, and the vast majority of local educational agencies participate -- and the flexibility it provides to State and local administrators who can carry out program activities that meet particular State and local needs. ~~On the other hand, the program was sometimes criticized in the past for funding short-duration, one-time training experiences that were unlikely to have a significant impact. In response to that criticism, the 1994 program reauthorization established requirements that the program fund professional development that is tied to challenging State content standards and is of sufficient intensity and duration to have a positive and lasting impact on teachers' classroom performance. In fiscal year 1998, the program should reach almost 350,000 educators.~~

- ② **The Title I [Education for the Disadvantaged]** program is the Federal Government's largest program that supports elementary and secondary education, with current funding of almost \$7.2 billion for grants to local educational agencies. Title I provides supplemental programs to enable educationally disadvantaged children, particularly those attending schools in high-poverty areas, to learn the core subjects to high standards. With Title I, disadvantaged children have the benefit of, for example, more individualized and accelerated instruction, extended-day programs, and learning laboratories in mathematics, science, and computers. Mathematics has always been a major focus of the Title I program: according to the most recent data, 48 percent of 9 million participating children receive some instruction in math.

Schools that serve an area in which the percentage of children living in poverty exceeds 50 percent can use their Title I funds, in combination with other Federal, State, and local funds, to upgrade the entire instructional program; other schools use the money to help those children most in need of supplementary services. In addition, the Title I statute focuses significantly on educator professional development: every local educational agency participating in the program must provide high-quality professional development, geared to challenging State standards, to improve the teaching of academic subjects.

Should come (for) Needs some r w/ training - language - grants to LEAs

challenging

support

Goals 2000 is the primary Federal program supporting comprehensive, national reform in elementary and secondary education. *standards-based* All 50 States now participate. Goals 2000 provides flexible funding to the States to enable them to develop and implement their own strategies for achieving the National Education Goals (including the goal of becoming first in the world in mathematics and science). With funding from the program, States are establishing academic standards and coordinating their student assessment programs, teacher preparation and licensure requirements, parental and community involvement, and other aspects of their education systems with the standards.

Communities in

as well as State & local goals

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Professional development is an important component of Goals 2000. Each State ^{is} ~~is~~ required to use program funds to make competitive subgrants for activities to improve preservice teacher education and support continuing, sustained professional development for educators and other school personnel. Many States and school districts are also using Goals 2000 funds to support enhancements and improvements in educational technology.

The Eisenhower Math and Science Regional Consortia provide professional development assistance to help teachers teach to high standards. The Regional Consortia have three primary objectives: 1) To collaborate and form coalitions with other organizations involved in math and science education improvement; 2) To provide technical assistance and facilitate the use of technology as a tool for instruction and professional development; 3) To identify and disseminate materials on exemplary instruction in math and science.

The Eisenhower National Clearinghouse (ENC) supports professional development in math and science by collecting and making available a wide range of professional development materials, online and on CD-Rom. Each month, the Clearinghouse selects 13 of the most useful math and science Internet sites, which are then linked to the Clearinghouse's home page. Finally, the Clearinghouse works with the Eisenhower Regional Consortia to create demonstration sites throughout the country, where educators can interact with the latest technological developments.

The Eisenhower Professional Development ^{National?} (Federal) Activities program is in its last year of funding nine grants that support statewide reform in the area of preservice teacher professional development. ~~These projects do not focus on any specific subjects and will not be funded after this year.~~ The Eisenhower program also supports the National Board for Professional Teaching Standards (NBPTS), which establishes national standards of excellence in teaching and recognizes teachers attaining these standards.

The Telecommunications Demonstration Project (PBS Mathline) uses the professional teaching standards of the National Council of Teachers of Mathematics (NCTM) as the basis for its year-long professional development program for teachers, called the Elementary School Math Project (ESMP). Through videos and on-line communication, ESMP allows teachers to learn at times and locations they find convenient. Each video in a series of 20 is accompanied by a guide that includes lesson plans, ideas for extending the lesson, additional resources, and discussion topics relating the video content to the NCTM professional teaching standards. Teachers also enter into discussions as part of a year-long, online learning community of 25-30 fellow teachers, with an accomplished practicing teacher serving as mentor and facilitator.

Improving education through technology:

- ② The Star Schools program supports "telecommunications partnerships" that use distance learning technologies to improve instruction and serve disadvantaged students. These partnerships utilize a diverse array of technologies, such as computer networks, satellite and broadcast communications, the Internet, and interactive multimedia applications.
- ④ The Regional Technology Education Consortia (RTEC) program provides technical advice and training to educators about the use of advanced technologies to improve teaching and student achievement. The six consortia work closely with the Regional Education Laboratories and the Eisenhower Regional Consortia; their primary activities are technical assistance, dissemination of information and resources, and professional development.

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- ① The Technology Innovation Challenge Grants program supports collaborations between educators, local businesses, and community organizations to develop innovative, high-quality applications of technology, with an emphasis on improving access for disadvantaged students. Two currently funded projects focus specifically on math and science. The Technology and Learning Collaborative is using new technologies and project-based learning activities to improve student achievement in math and science. The Indianapolis Public Schools have collaborated with Ameritech, a cellular service provider, to create a network which provides curriculum, professional development, and technical support, to promote systemic change in teaching math and science.
- ② The Technology Literacy Challenge Fund provides formula grants to states to help build the infrastructure needed to integrate technology into classrooms. States are required to submit a technology plan and to explain how the plan will provide access to technology for students with the greatest need. Funds are intended to stimulate partnership and contributions from private entities. The Challenge Fund is in its first year of awarding grants.

should reference taking advantage of the new E-rate

Research, data collection and dissemination

The Regional Educational Laboratories and the National Center for Education Statistics (NCES) collect and disseminate high-quality data related to math and science education. Information is also disseminated through the National Library of Education and the Educational Resources Information Center (ERIC). Finally, the Office of Educational Research and Improvement (OERI) is in the process of establishing an expert panel to identify exemplary and promising practices in all subject areas. As mentioned above, the Eisenhower National Clearinghouse and Regional Consortia also disseminate information relating to math and science reforms.

Assessment

The National Assessment of Educational Progress (NAEP) measures the progress of the nation's students in core subjects, including mathematics. NAEP recently published its 1996 *Mathematics Report Card on the Nation and States*. NCES is currently reporting the results of the Third International Mathematics and Science Study (TIMSS), and providing follow-up information on those results. In addition, the Voluntary National Tests proposed in the 1998 budget will test reading in the fourth grade and math in the eighth grade; the first tests will be administered in the spring of 1999. OERI is actively involved in the development of these tests, as well as support for teachers, schools, and districts in preparing for the tests. OERI has established a Web site to provide information on the tests, and will distribute a toolkit that will aid educators in assessing teaching and curriculum and in preparing students to excel on the tests.

include math/science

Curriculum? instructional (?)

individual students in

bold

why name OERI repeatedly - why not just use "the Department"? ?

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NATIONAL SCIENCE FOUNDATION

Since its inception in 1950, the National Science Foundation (NSF) has served the Nation by investing in research and education in science, mathematics, technology, and engineering. NSF's goals for education and training require attention to needs at every level of schooling and access to quality science, mathematics, engineering, and technology educational opportunities for all ~~members of society~~. *AMERICANS (?)*

Is this
piece
needed?

The Education and Human Resources Directorate at NSF has most of the responsibility for activities in education for students and teachers at the preK-12 level. The *Elementary, Secondary, and Informal Education Division* houses the **Teacher Enhancement Program**, the **Instructional Materials Development Program**, and the **Informal Science Education Program**, building blocks of a comprehensive program in preK-12 mathematics and science education. The *Division of Educational System Reform* houses the large systemic initiatives: **Statewide Systemic Initiatives**, **Urban Systemic Initiatives**, and **Rural Systemic Initiatives**. The **Comprehensive Partnerships in Mathematics and Science Achievement Program** is in the *Human Resource Development Division*, and the technology projects are housed in the *Research, Evaluation, and Communication Division*, as is relevant research in teaching and learning. Teacher Preparation activities are housed in the *Division of Undergraduate Education*.

If so
should there
be a parallel
for ED? Why
is so much
detail needed on
agency structure?

PreK-12 Systemic Reform

Systemic refers to fundamental, comprehensive, and coordinated changes made in science, mathematics, technology, and engineering education through attendant changes in policy, financing, governance, management, content, instruction, and assessment. Systemic reform occurs when all essential features of institutions and systems are engaged and operating in concert; when policy is aligned with a clear set of goals and standards; when the improvements and innovations become an intrinsic part of the ongoing educational system for all participants and are incorporated in budgets.

Seems a bit too much
like a
manifesto.
Description
should focus
how tightly
on what the
program
does, rather
than
overarching
philosophy

PreK-12 systemic reform is supported through NSF state, urban, local, and rural systemic reform initiatives. The implementation of high-quality, standards-based instructional materials, assessment systems, and professional development are keys to success of all initiatives. Development and administration of coherent policies and legislation to support science and mathematics education; convergence of resources to support a single, unitary program; promotion of effective partnerships with the private sector and higher education institutions; achievement of support from the community, parents in particular; collection, interpretation and effective use of data, including student achievement; and cohesive, coherent strategic planning to ensure the improvement of all students' achievement are essential components to the immediate and long-term sustainability of reform activities. Since 1996, the systemic initiatives have begun to make the transition from building an infrastructure to supporting science and mathematics education reform to the classroom implementation of standards-based curricula, instruction, and assessment. Extensive leveraging of funds from business, industry and other federal agencies occurs in all systemic initiatives, in some case as much as 4 to 1 with NSF dollars.

The ~~Statewide Systemic Initiative~~ (SSI) Program has supported a total of 25 states and the Commonwealth of Puerto Rico to establish comprehensive changes in mathematics and science education through the implementation of K-12 standards-based instructional programs, professional development, and assessment systems; new policies, and effective partnerships. A total of 20 eligible cities with the largest numbers of school-age children

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living in poverty have been funded under the Urban Systemic Initiative Program (USI). A total of 4 rural, economically disadvantaged regions are implementing programs to promote high-quality science, mathematics, and technology education. RSI programs have focused on the implementation of instruction through the use of advanced telecommunications networking and distance delivery of quality programs and professional development.

write out
none

Building Blocks of System Reform:

Systemic reform is built on a foundation of quality instructional materials, initial education and professional development of teachers in both content and pedagogy, new strategies for the assessment of student learning, a diverse teacher population, and appropriate use of technology. Thus a major focus of activities and budget at NSF is assuring that these building blocks are available and in place.

Teacher Education: Teachers must have a high level of content knowledge and pedagogical skills and be prepared to utilize the most effective instructional materials, assessment strategies, and educational technologies. Teacher education includes both preservice and inservice education.

Over 40,000 teachers in 1,930 schools, impacting over 1.3 million students annually, participate in intensive professional development activities through the **Local Systemic Change (LSC) Initiatives**. K-8 in Mathematics and Science and 7-12 in Mathematics. These teachers receive a minimum of 100 hours for K-8 or 140 hours for 7-12 of professional development and receive ongoing support through the academic year. They implement quality standards-based instructional materials and reform the mathematics and science programs in their schools as a whole. Extensive leveraging of Title I, Eisenhower, district, and industry funds occurs in at least an amount equivalent to the NSF award in each LSC project. In addition to the Local Systemic Change projects, the Teacher Enhancement Program supports **leadership projects** that train teachers and other professionals to deliver quality professional development. ESIE supports the enhancement of approximately 60,000 teachers annually, of whom, at this time, fewer than half are teachers of mathematics. Only about 10,000 are middle school teachers of mathematics.

Fragment

Comprehensive Partnerships for Mathematics and Science Achievement projects provide students and teachers with standards-based curriculum reform for K-12, teacher enhancement, strategic use of resources, student enrichment activities, and summer research experiences and related activities. Approximately 5,000 teachers are impacted annually.

The **Collaboratives for Excellence in Teacher Preparation (CETP)** support efforts to achieve comprehensive change in the undergraduate education of future teachers and to increase the quality and number of teachers in science and mathematics. All of the activities are characterized by strong collaboration between discipline-based faculty in schools of science/engineering and faculty from schools of education. Participating institutions of higher education vary from seven tribal colleges in Montana to major research institutions such as Harvard. CETP projects will affect 78,000 future teachers in 110 participating institutions over a five year period, and approximately 30% of the CETP collective effort is focused on future teachers of K-12 mathematics.:

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Instructional Materials: Instructional and assessment materials influence what students are taught and how teachers and faculty teach. An innovative, comprehensive, and diverse portfolio of instructional materials and assessment tools that implement standards-based reform in mathematics, the natural and social sciences, engineering, and technology education are required for preK-12 education. These materials must be of sufficient quality to be widely adopted and used in schools nationally.

The development of sixteen sets of comprehensive standards-based mathematics instructional materials for K-12 students was begun in 1990. These materials were completed and became available for use beginning in 1996. A report describing the success of these materials in field test sites was released by the University of Chicago, The Success of Standards-Based Mathematics Curricula for all Students, a Preliminary Report in FY1996. Extensive evaluation data of student achievement in the field testing of these new materials demonstrates improved performance for students using them.

Assessment: ESIE supported research and development in assessment of student learning during the middle 90's through 20 projects. Each of these projects has come to completion and the tools developed and understandings about student learning are being implemented in schools throughout the country. Additional assessment projects continue to be funded. The Balanced Assessment in Mathematics Project was among the projects funded in the middle 90's to develop assessment tools for middle school mathematics. These tools and test items have become the central component of the New Standards Mathematics assessments now used in numerous schools throughout the country.

Technology: Research efforts in technology are developing new methodology and pedagogy for improving the ability of students in science and mathematics, especially those who have not been well served by the education system. The new methodologies will make use of scientific advances in technology (visualization and simulation, for example) that build on different learning styles among students. Funded projects successfully create new forms of visualization of scientific and mathematical concepts. NSF has supported more than 20 projects that successfully create new forms of visualization such as graphics, and simulations. Full and sustainable integration of technology into the fabric of the educational system is required for these to have wide impact on education systems.

Informal Science Education: The Informal Science Education sector reaches out to all segments of population to engage them in self-directed learning in the areas of science, mathematics, and technology. Because, over a lifetime, people spend more hours learning out of school than they do in school, a strong informal science education program is critical in the comprehensive education of our citizens. Members of the public who participate in informal science education learn about the process of science and scientific thinking; are motivated to participate in science and mathematics activities; are aware of the relevance of science, mathematics, and technology in their everyday lives; and increase their knowledge about specific topics and about scientists and careers in the sciences.

Support is provided for informal learning science, mathematics, and technology projects designed to reach large numbers of the general public through television and radio series; public films on the process and substance of science and mathematics; exhibits or other educational activities at science and natural history museums, science-technology centers, aquaria, nature centers, botanical gardens, arboreta, zoological parks, and libraries; and educational programs and activities at community and youth centers. Approximately 40% of the funding went to museum activities, 40% to media activities, and 20% to community activities.

Again
descriptions
should focus on
what programs
do - the
main body
of text
adequately
lays out
key principles
to effectively
math/sci
education
improvement

Standards-based Education Activities within the Department of Defense: DoD Dependents Schools and the National Security Agency.

Two agencies within the Department of Defense (DoD) ^{emphasis} ~~represent contrasting approaches to~~ ^{have placed a strong focus on} introducing rigorous national standards in their education activities.

^{BI A schools?} ~~Unique among the agencies~~ ^{to mathematics} are the DoD Dependents Schools (DoDDS), which run as essentially autonomous school systems overseas and on military bases in the U.S. They certify teachers and develop leader-teachers, tutors, and mentors who, like the DoDDS math curriculum used world-wide (K-8 and 9-12), embrace the NCTM standards. ^{# served.}

The National Security Agency established a Mathematics Education Partnership Program (MEPP) in 1991. MEPP was established "so that the mathematical expertise of the National Security Agency technical staff and the excitement of the application of mathematics at the National Security Agency can encourage more Americans to study mathematics longer, more deeply, more enthusiastically, and more effectively." MEPP provides over a thousand talks per year to schools and colleges through its Speakers Bureau. It donates excess computers to classrooms, sponsors seminars and inservice teacher training, and conducts extended summer workshops for teachers at all levels (for a description, see www.nsa.gov.8080/programs/mepp).

These MEPP activities, including projects such as collaboration with the University Corporation for Atmospheric Research's Project SkyMath, are all informed by the NCTM Standards, which are an explicit subject of study and reference at MEPP's Summer Institutes for Teachers. The preface to the collection of standards-based learning units developed at the 1996 session begins, "Mathematics R Us" is a sign you haven't seen, but it could be placed outside of the National Security Agency at Fort George G. Meade, Maryland. NSA is the largest employer of mathematicians in the United States, and mathematics is the foundation of NSA's core disciplines: cryptology, speech research, signals and analysis and computer science. Despite a general public misconception, mathematics is not a dead science; it is alive, vibrant, and constantly advancing. MEPP specifically provides grants "to encourage students' continuing interest in mathematics and the adoption of the National Council of Teachers of Mathematics Standards in the nation's schools."

In addition to these specific programs, there are education-oriented activities throughout DoD. Research on and use of technology in education and training applications is a major area of emphasis.

Needs to be
shortened,
esp
relative to
DoD
description

Texas Statewide Systemic Initiative

also
~~Early in its history,~~ the Texas Statewide Systemic Initiative (SSI) ~~secured the contract to~~ operate the U.S. Department of Education's Comprehensive Assistance Center for Elementary and Secondary Act Programs in Texas. This brought into one unit the state's leadership both in science and mathematics education and in Title I technical assistance. In the past two years, the SSI has provided incentive grants and technical support ~~in~~ ^{for} integrating ~~with~~ Title I, Eisenhower, and professional development activities in mathematics and science to more than 100 Title I schools serving more than 100,000 Title I students. In July, 1995, the SSI held an intensive summer institute designed to support Title I schools in (1) reconceptualizing the use of entitlement funds, (2) adopting standards-compatible mathematics curricula, and (3) adopting effective schoolwide program models. As a result of the SSI/Title I collaboration, state mathematics and science leaders are now active members of school support teams engaged in mentoring over 700 Texas Title I schools. At the same time, increasing numbers of teachers in high poverty/high minority schools are being trained as SSI mathematics, science, and technology specialists.

→ formula
grant

TIMSS Benchmarking Toolkit *for states & school districts*

The release of results from the Third International Mathematics and Science Study (TIMSS) have *? unfin*
 has generated a strong interest among policymakers to use TIMSS as a benchmark to
 compare their systems to those of other countries. The Department of Education has
 supported development of tools (expected completion: July 1997) to assist officials in
 answering the question: How do mathematics and science achievement, teaching,
 curriculum, and assessment frameworks in my state or district compare to other countries?

*4th grade or
8th grade?*
 The toolkit will contain an overview of the TIMSS project and four modules (Achievement,
 Teaching, Curriculum, and Assessment Frameworks) for study. The overview will
 include the fourth-grade U.S. TIMSS report, TIMSS: The Movie, a set of overheads on the
 TIMSS study findings, and an annotated bibliography of TIMSS-related resources. The
 Achievement Module describes how states and districts can participate in the 1998 TIMSS
 survey and compare their mathematics and science results with those of other countries.
 The Teaching Module includes a 75-minute videotape of eighth grade mathematics lessons
 filmed in conjunction with the TIMSS project, a discussion guide, and background
 information to facilitate discussions about teaching practice. The Curriculum Module
 includes analysis models (including that used in TIMSS) for evaluating mathematics and
 science curriculum materials. The Assessment Frameworks Module provides information
 on the performance expectations underlying TIMSS and the related U.S. National
 Assessment of Educational Progress (NAEP) examinations to stimulate discussion of
 national and international expectations for student learning.

PRIME in Pittsburgh

The Pittsburgh Reform in Mathematics (PRIME) project supports teachers in the classroom implementation of standards-based mathematics instruction and assessment in grades K-12 through the use of exemplary materials (e.g., *Everyday Mathematics* in grades K-5 and *Connected Mathematics* in grades 6-8). PRIME provides teachers with a broad knowledge base in both the mathematics content and the successful mathematics pedagogy needed to implement the new materials successfully.

Funded under National Science Foundation guidelines as a project of *Local Systemic Change through Teacher Enhancement in Mathematics*, PRIME provides all 924 Pittsburgh Public School teachers of mathematics with a range of experiences that include summer workshops; release-day professional development workshops; and individualized, in-class support provided by demonstration teachers within each school. Teachers of grades 6-12 receive 234 hours of professional development, and teachers of grades K-5 receive 102-132 hours. By equipping all Pittsburgh mathematics teachers with the knowledge, skills, and support necessary for using exemplary materials and assessment, PRIME will ensure that all students experience a coherent mathematics program that is expected to yield high achievement at all levels.

This four-year project, funded for over \$ 3 million, is a model for its ability to leverage an additional \$ 6.7 million in cost-sharing from district funds and commitments from Eisenhower and other Federal dollars.

} realistic?
see also data
Pittsburgh

Quantitative Literacy Program for Alabama K-12 Teachers

The Quantitative Literacy Program for Alabama K-12 Teachers, a project administered by the University of Alabama, assists elementary and secondary teachers in implementing the probability and statistics goals for grades K-12 as outlined in the National Council of Teachers of Mathematics standards. The program's workshops teach quantitative concepts in the context of solving meaningful problems, with content taught in reference to teaching strategies that participants use when they return to their classrooms. The program includes a pre-workshop orientation, an intensive one-week training workshop, and two follow-up sessions. In the follow-up sessions, teachers describe how they planned, taught, and assessed their own Quantitative Literacy units. They also present examples of their students' projects.

This is an exemplary Eisenhower Professional Development Program higher education project. Such projects provide an average of 40 to 80 contact hours of high-quality professional development. The Eisenhower Program provides about 63% of the total budget. The balance of funding is provided by the University of Alabama. Local school districts have indicated an interest in supporting the workshop by paying for substitute teachers, and expenses for travel, room, and meals. The project is currently operating in 14 of the 67 counties of the State.

Not clear how
this matches
up w/ lists
of ED
programs
at front of
appendix.

As written this is not
especially compelling.

Montana's Systemic Teacher Excellence Project

The *Systemic Teacher Excellence Project* is preparing its students to teach the Montana-developed, calculator-based mathematics program for middle school students. ^{aligned} ~~Aligned~~ ^{Allied} with this program is another to support redesign in the way the state prepares the teachers who will use these new techniques for teaching. On a bright fall day a busy class of students at Montana State University calculates how long a caged bird can withstand the freezing temperatures of a Montana winter. They argue excitedly before their computers. Finger smudges decorate the screens before them as they move through some complex mathematics concepts with surprising ease. A group of student interns works alongside master teachers in a special summer mathematics program for American Indian high school students. The teachers comment that the student interns display an impressive command of mathematics. All public institutions within the state of Montana, including all the tribal colleges, are part of this project, with over 52 courses affected. ?

middle -
school
(grade 7)

little
over-
done

If we are going to
offer up an example that
specifically features
calculators, it should be
much stronger than this.

Maryland Collaborative for Teacher Preparation

A unique program in Maryland, the *Maryland Collaborative for Teacher Preparation*, is concentrating on improving the ability of ~~the nation's~~ future middle and elementary school teachers to teach mathematics and the sciences. It is challenging students preparing to teach middle school and upper division elementary school with a wide range of required mathematics courses, each taught in ways that encourage students to work together on problems related to the real world. In such courses as Elementary Calculus (yes, elementary calculus required for elementary teachers) at the University of Maryland College Park; Introduction to Mathematical Modeling at the University of Baltimore County; and Number Systems and Functions and Geometric and Quantitative Reasoning at Towson State University, students are using mathematics to explore such problems as traffic flow; spread of pollutants in a river, and propagation of an infectious disease. Journals, formal project reports, use of graphing calculators and computers, and group approaches to solving problems are features that participating future teachers will now be prepared to incorporate into their teaching techniques. Integrated mathematics/science capstone courses have been introduced to enhance understanding of both subjects. As requirements have increased (double the number of courses required at the beginning of the project) and course content has become more challenging and more related to real world problems, the number of students preparing to be elementary teachers who have opted for a mathematics or science concentration has increased. The legacy of this project will be enthusiastic and skilled teachers of mathematics and science in the middle and upper elementary grades and a set of courses and practices which will ensure continued production of outstanding teacher candidates.

inspired?

teacher preparation candidates?

Maryland

expected

Example of ~~the~~ Advanced Curricula Materials:

Everyday Mathematics

The University of Chicago's *Everyday Mathematics* materials for K-6 classrooms are designed to promote the success of all students. They are based on research showing that students can learn much more mathematics than ~~traditional curricula~~ ^{challenging} ^{standard} ^{previous} ^{have} contained. Students explore mathematics concepts, experiment with ways to solve everyday problems, learn essential skills, and perform mental mathematics. ^{younger}

why highlight that? → The materials are published by the ~~Everyday Learning Company, which is owned by the Chicago Tribune.~~ They are being used in over 50,000 classrooms nationwide, affecting over one million students. Extensive evaluation with standardized tests shows that students using these materials outperform their peers using ~~traditional~~ materials. For example, a recent study, based on items developed for an international comparison of elementary school students in 1990, showed that students in today's *Everyday Mathematics* classes score significantly higher than did the U.S. students in the 1990 study and performed as well as the 1990 students from Japan and Taiwan on a majority of the questions. ^{less advance}

Improving Teaching Through Distance Learning

The Department of Education's Star Schools Program provides quality, cost-effective instruction through distance education technologies to more than 1,640,000 learners annually in 50 states and U.S. territories. Although the program began with small rural schools in 1988, it is now equally valuable to schools in large urban areas.

The *Star Schools: The Next Generation* project of Oklahoma State University and Northern Arizona University delivers the "Getting Ready for Algebra" program, a series of simultaneous student instruction and teacher training, to middle school students and teachers. It uses student-centered, learn-by-discovery, and activity-oriented units to focus on the big ideas common to arithmetic and algebra. The United Star Distance Learning Consortium project led by Education Service Center—Region 20 in San Antonio (TX) offers the *Algebra and Geometry Applications for Teachers* program, inservice training that models worthwhile mathematical tasks and helps teachers improve their ability to develop these tasks. Focus is on mathematical topics that illustrate connections to real-life problems and exciting mathematics.

The focus of
the project

Eisenhower Regional Consortia for Science and Mathematics Education

The mission of the ten consortia projects is to provide ~~a field-based national infrastructure for systemic improvement of science and mathematics education. Projects provide~~ information on curriculum, assessment, and teaching practice; conduct workshops and training; and serve as advisors to the field.

too technical
clarify

^{one Consortium}
In 1996 the project located at WestED published Tales From the Electronic Frontier, a collection of ten teachers' narratives regarding their use of the Internet to enhance science and mathematics instruction and create opportunities for their own professional growth. The accounts describe using this resource for project-based learning, for making abstract scientific principles more concrete, and for promoting deeper understanding. Each story provides information on related resources and programs, and concludes with a section of questions and issues to stimulate further thought and discussion.

of key
math
science
concepts

"Hoop Happenings" was the story of a math communication project between students at the Drexel Hill School in Philadelphia (PA) and senior education majors at Iowa State University. During their teaching methods class for elementary mathematics, each student is paired with a group of students at an elementary school with whom she interacts (via e-mail) over a math problem she defines each week. The interactive discussion provides the education majors with insight into children's thinking; for the children the project strengthens their abilities to solve problems and to discuss their problem solving approaches.

Tales can be found on WestED's WWW site at <http://www.wested.org/tales>.

should
explain
what
"WestED"
is.

A New Federal Education Partnership Program at the Department of Transportation

Magnetic levitation trains, highways that provide constant updates on traffic conditions ahead, tollbooths subtracting tolls automatically from encoded stickers on cars, and geopositioning satellites that enable travellers to determine where they are anywhere on earth at any time: these are transportation "dreams" well on their way to becoming realities, dreams that can lead to highly-paid jobs for those with the appropriate skills. Too many students, ill-prepared for such jobs, must leave the dreaming to others.

The Department of Transportation (DOT) is a relative newcomer, among the Federal agencies, to education. Through the new Garrett A. Morgan Technology and Transportation Futures Program, DOT will undertake a series of public-private partnerships dedicated to mathematics, science, and technology literacy (K-12). Activities will include:

- encouraging the transportation community to participate in the Department of Education's America Goes Back To School program, with a focus on mathematics, science, and technology achievement;
- building upon DOT's 300+ adopted schools to provide mentors, tutors, career information, and other forms of support for math literacy;
- helping educators integrate transportation components into the curriculum for each grade level while expanding the availability of curriculum enrichment programs that engage students in solving real world problems with a transportation focus;
- bringing together curriculum development specialists and private sector sponsors to develop "math kits" analogous to the reading kits currently distributed to schools throughout the U.S.;
- and contributing expertise and/or equipment to help America's schools get on-line, by participating in "Net Days."

Saturday Schools Provide Tutoring Boost

The George B. Thomas Sr. Learning Academy Inc. (known as Saturday School) has provided free tutoring and mentoring to minority students in Montgomery County (MD) for nearly 11 years. Spearheaded by members of the Mu Nu chapter of the Omega Psi Phi fraternity, the program began in a public housing community's day-care center, but is now located at Sherwood High School (Olney, MD) and Springbrook High School (Silver Spring, MD).

May/97
About 180 students and 100 tutors--engineers, mathematicians and others (including high school students fulfilling the community service graduation requirement)--are registered at the centers; there is often a waiting list of pupils because there aren't enough tutors. Saturday School views itself as a partner with the students' schools; principals refer students to the program and teachers advise tutors on where students need help. Montgomery County Public Schools contributes classrooms, supplies, and training for tutors and parents. The sessions last 2 or more hours; tutors work with students on a wide range of mathematical topics and help students prepare for the Scholastic Assessment Test. Parental participation is required: about one-fifth of the parents tutor.

NASA's Mission Mathematics

The recent production of "Mission Mathematics" by NASA demonstrates how an agency can base its educational work on national standards. These three volumes of problems and activities are the descendants of NASA's first mathematics curriculum supplement, "Space Mathematics: A Resource for Teachers," published in 1972. That popular title was updated repeatedly over the years. "Mission Mathematics," however, is totally revamped to accord with national standards. Indeed, the subtitle is now "Linking Aerospace and the NCTM Standards." The three volumes are divided into K-⁶5-8, and 9-12 to accord with the Standards, and the contents of each are keyed not only to NCTM's curriculum standards, but also to those for teaching and for student assessment. Examples include calculating orbits, collecting and analyzing specimens, planning for spaceflight needs, etc. ?

This linking to standards was accomplished by making "Mission Mathematics" a joint project of NASA and NCTM. Writing teams included teachers, supervisors, and university professors working in consultation with NASA representatives. Their drafts were field-tested by classroom teachers and reviewed by NCTM's Educational materials Committee. The results are attractive and modestly priced, with publicity, marketing, and distribution through NCTM's established network. engaging

The action strategy should include recommendations for the use of federal resources to help states, local school districts and schools to improve teaching, upgrade curriculum, integrate technology and high-quality instructional materials into the classroom, as well as motivate students and help them understand how math concepts are applied in the real world. The strategy should identify significant federal programs, activities, and partnerships available to improve teaching and learning, ensure that these resources are appropriately focused on helping students reach challenging math standards, and determine how these resources can best support state and local reforms. In developing this strategy, the inter-agency group should review the current status of improvements in math education, and identify and address critical areas of need, drawing on research and input from educators and professional organizations.

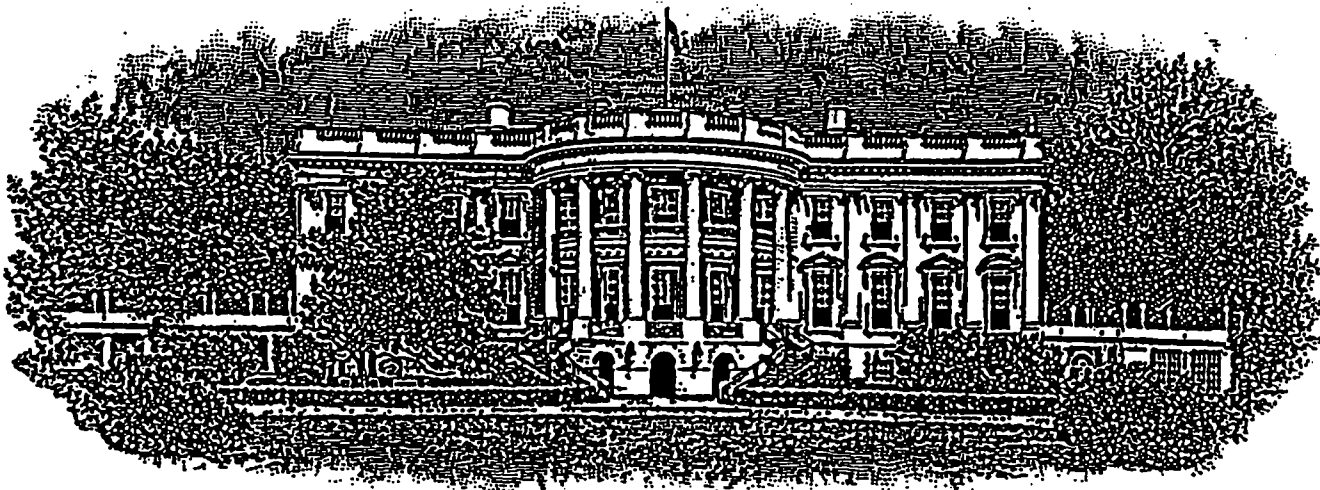
Because teaching and learning in math and science are so integrally related, and because success in both subjects is vitally important in this information era, the working group should also review how federal resources and partnerships with other organizations can help improve student achievement in science.

The working group should make its recommendations and submit its action strategy to me within 90 days.

WILLIAM J. CLINTON

cc: ASSISTANT TO THE PRESIDENT FOR DOMESTIC POLICY
ASSISTANT TO THE PRESIDENT AND DIRECTOR OF THE OFFICE OF
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The White House



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FAX COVER SHEET

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FROM: **BILL KINCAID**

THIS FAX INCLUDES THE COVER SHEET PLUS 13 PAGES.

IF YOU DID NOT RECEIVE THE COMPLETE FAX, PLEASE CALL (202) 456-2857.

MESSAGE:

Suggests ed.77 / comments on latest iteration
of main part of action strategy. This keeps
getting better. Need to clarify whether the new website
web site will include things like instructional units
for teachers, or whether that will be separate. Also
on the teacher preparation piece - could we announce
that we will hold a competition or conduct a study?
It would be good to make that more concrete.

Working DRAFT; 6/23/97

AN ACTION STRATEGY FOR IMPROVING ACHIEVEMENT IN MATHEMATICS AND SCIENCE

On March 6, the President issued a memorandum (Appendix 1) directing the Secretary of Education and the Director of the National Science Foundation to form an interagency working group to develop, within 90 days, an action strategy for using Federal resources to assist States and local school systems to meet challenging mathematics standards in the eighth grade, and for involving the mathematical, scientific, and technical communities in support of those efforts.

The Presidential directive specified that the action strategy include recommendations for the use of Federal resources to help States, local school districts, and schools improve teaching, upgrade curriculum, integrate technology and high-quality instructional materials into the classroom, and motivate students to help them understand how mathematical concepts are applied in today's global workplace. It called for the interagency group to review the current status of improvements in mathematics education and identify and address critical issues of need, drawing on research and input from educators and professional organizations. In addition, it called for the working group to review how Federal resources and partnerships with other organizations can help improve student achievement in science.

One of the immediate inspirations for this attention to high standards in mathematics and science education in eighth grade is the Third International Mathematics and Science Study (TIMSS), involving 500,000 students in 41 nations, including 30,000 in the United States. Results released in the Fall of 1996 show lackluster performance by U.S. 8th graders, with scores a bit above the international average in science but below the international average in mathematics. On the other hand, recent TIMSS data show that our 4th graders are above the international average in both math and science -- and in science are outperformed only by Korea. These results clearly indicate that mathematics education in the middle school years should be an important focus for national efforts to help ensure that our students meet world class standards. (sidebar on TIMSS)

Beyond indicating a need to focus emphasis on grades 5 through 8, TIMSS also provides a wealth of data on how and what we teach our students -- and important clues about ways to improve both. TIMSS researchers collected not only achievement data in each participating country, but also much information about teachers and teaching, about curricula and instructional materials, about classroom lessons and interactions, and about student attitudes and habits outside the classroom. Thus, TIMSS results have become a source of constructive motivation for mounting an action strategy, taking the issue well beyond the simple comparison of scores in international test taking.

Eighth grade is a critical point in mathematics education, as achievement at that stage paves the way for students to take the advanced high school mathematics and science courses that are keys to college entrance and well-paid jobs. Today, too many students enter high school without this solid grounding in mathematics and never gain it, closing doors to opportunities for further education and careers. Often, students and their families do not even know that the doors are closing. For example, a 1995 survey conducted by the National Action Council for Minorities in Engineering found that over 70 percent of minority 9th and 11th graders viewed being a scientist or engineer as an interesting career, with 78 percent showing interest in taking college level mathematics. Yet 60 percent of the students planned to drop high school mathematics as soon as possible.

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The President has proposed a voluntary national test in mathematics, to be taken near the end of eighth grade, as a very visible part of an ambitious, sustained drive for higher, more challenging standards of learning for all students. The test will be available by the spring of 1999 for those States and districts that wish to participate. Parents and teachers will receive an individual score for each student who takes the test. That score will be linked to national and international benchmarks, which will provide additional context. States, districts, and schools will be able to use data from the test in combination with other information on curriculum and teaching practice and with the results of other assessments to create a more complete picture of individual and aggregate performance.

The test is only one element of the comprehensive effort needed to accomplish the objective of having all students achieve challenging national standards for performance in eighth grade mathematics. This effort will require many individuals -- parents, students, teachers, and community leaders -- working in concert with a common understanding of what they are trying to accomplish. All parties to the effort will need a clear picture of what students should know by the end of eighth grade and what world-class performance looks like. Then students, parents, and teachers can begin to aspire to the high standards that a significant number of our students do not yet reach.

TIMSS results for the 4th grade are much more positive than the results of similar international comparisons in the past. They demonstrate that it is possible to make significant progress in international comparisons over time, and that US students can compete favorably with those of other nations in mathematics and science achievement. Our National Education Goals proclaim our intent that US students will be first in the world in mathematics and science achievement by the year 2000. In the early grades, we are making demonstrable progress toward that goal.

The voluntary national test in grade eight combined with a national effort to boost achievement will provide a powerful lever to amplify the effects of existing efforts at local, State and national levels to improve K-8 mathematics and science education. This action strategy is aimed at laying the basis for such a national effort, using the national test as an effective tool and concentrating, for the near term, on mathematics in grades 5-8, where the TIMSS results tell us we need to focus.

Response to the Presidential Directive

In response to

Pursuant to the memorandum from the President, the Department of Education and the National Science Foundation promptly formed an interagency working group comprised of staff experienced in the areas under review. Officials of the White House Offices of Science and Technology Policy, Domestic Policy, and Management and Budget, provided oversight. (A listing of the members of the interagency group is attached as Appendix 2).

Consistent with the directive, the interagency group immediately began a review of current Federal efforts in mathematics and science education with particular attention to mathematics education in kindergarten through eighth-grade. (See Appendix 3 for a summary of relevant programs in the two agencies.) In addition, consistent with the memorandum's instructions for the interagency group to draw on research and input from educators and professional organizations, the group reached out to the broader mathematics and educational community for advice and guidance. (See Appendix 4 for a summary of these outreach efforts, including a list of organizations with which the working group consulted.) The interagency group also consulted with appropriate staff in other agencies that have, or are interested in establishing, activities in elementary and secondary-level mathematics or science education. (See Appendix 5 for a list of the agencies consulted and a summary of their input.)

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Excellence in Eighth-Grade Mathematics as the Core of a National Action Strategy for Improving Achievement in Mathematics and Science

Our vision is that all American students leave eighth grade prepared to pursue the higher-level mathematics and science courses that are the gateway to college, citizenship, productive employment, and lifelong learning. Whether rich or poor, all of our students deserve an education that will help them prepare for a successful future.

Reaching this vision will require:

- High expectations, held by educators, parents, and students themselves, for student performance in mathematics and science;
- Challenging standards for content, materials, teaching, assessment, and achievement;
- Instructional materials and technology of high quality that incorporate these challenging standards;
- Teachers with the pedagogical skills and rigorous knowledge of mathematics and science needed to teach these subjects effectively; and
- Activities outside the classroom that reinforce the classroom experience by drawing on the support of parents, the professional community of mathematicians, scientists, and engineers, business, and the broader public.

While achievement of our national objectives in mathematics and science education will rely on each of these elements, progress in one area will often depend on and demand improvement in others. For instance, the introduction of high-quality instructional materials will have little impact if teachers are not trained to use those materials effectively. Effective instruction during the school day will have limited results if parents (and, indeed, the entire community) do not support student achievement and let students know how important success in mathematics is to their future opportunities for college and careers. In short, K-12 education improvement based on high expectations with everyone working together toward challenging national standards and aligning resources with this aim should remain the guiding principle behind Federal activities in the area of mathematics and science. We should be working on all fronts – high standards, effective curriculum, technology in the classroom, teacher training and licensure, assessments, and support from parents and the public – to make progress towards this critical goal. *which?*

Achievement in mathematics by the end of the eighth grade is a critical factor in the ability of students to pursue advanced work in mathematics and science in high school and beyond. This action strategy is focused on aligning resources so as to enable students to meet challenging national standards in mathematics toward the end of eighth grade, using the proposed national test as an indicator of accomplishment. It is one piece of the broader, sustained effort to improve achievement in K-12 mathematics and science.

Voluntary

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Improving Mathematics Education: Building on Strength

The action plan builds on the considerable efforts underway ^{across the country} to improve elementary and secondary mathematics and science education. Some of these activities began more than a decade ago in ^{the} schools, colleges, States, and professional organizations. They were given impetus by the establishment of National Education Goals, including the goal of being first in the world in mathematics and science educational achievement by the year 2000. Taken together, they provide a solid foundation for focused attention to mathematics in grades 5-8 that can catalyze improvements in K-12 mathematics and science education. Some of the most important current or completed activities include:

- The National Council of Teachers of Mathematics (NCTM) introduced standards for mathematics curriculum and evaluation in 1989, followed by standards for teaching and assessment in mathematics. States and communities have made these voluntary standards the basis of many of their efforts to improve mathematics education. (As is appropriate in any effort to raise standards, NCTM is now reviewing the mathematics curriculum and evaluation standards and plans to update them over the next few years.)
- A new generation of rigorous mathematics curricula geared to the NCTM standards is beginning to appear in classrooms. By the fall of 1997, these materials will account for about 25 percent of all new textbooks purchased, and that figure should grow in succeeding years.
- TIMSS and other new assessments, coupled with in-depth research, are providing valuable information about how and what we are teaching and how students learn, and point to critical factors for improving achievement in mathematics in grades 5-8.
- Approximately 65 percent of all schools are now connected to the Internet, providing the opportunity for communication on improving mathematics education and for the use of distance learning and advanced technologies. Federal support has helped to make this possible, and the newly enacted "E-rate" will substantially reduce the cost of Internet connections for schools and allow more schools to take advantage of this learning tool.
- Many States, with support through Goals 2000, the reauthorized Elementary and Secondary Act, systemic initiatives, and other Federal programs, have undertaken comprehensive systemwide education improvements geared to high standards in mathematics and science. ^{Performance} States that were in the forefront of reforms are now beginning to enjoy the benefits in improved student outcomes.

Critical Areas for the Strategy

Consistent with the President's directive, this action strategy ^{identifying steps} ~~is grounded in actions~~ Federal agencies, along with other partners, can take to help students reach challenging mathematics standards and to ensure that Federal resources will effectively support State and local reforms, with a special focus on mathematics in grades 5-8. Through its consultation with outside organizations and its review of Federal programs, the working group has identified three priority areas:

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- Equipping teachers in grades 5-8 with the skills and knowledge to teach challenging mathematics content in effective ways, with high expectations for their students:
- Implementing high-quality, standards-based curricula and instructional materials (including effective use of educational technologies) in grade 5-8 mathematics classrooms; and
- Building public understanding of what challenging mathematics looks like in grades 5-8, and gaining public support for improving student achievement toward high standards.

although a national priority
The core of this action strategy is making more effective use of Federal resources in addressing these areas in light of the Federal Government's limited role in education -- which properly is a *primarily* State and local responsibility. The Federal role is to provide good information, effective tools, and financial support that will assist States and local communities in ensuring that all of their students have the mathematical skills they need to succeed in the workplace as productive citizens. This includes promoting effective partnerships that mobilize support from the community -- students, parents, educators, business, volunteers, and concerned citizens from all walks of life -- to that end. *people*

Strengthening the Impact of Federal Resources on Mathematics Achievement in Grades 5-8

three priority
Clearly, strategies for use of Federal resources in addressing these critical areas are interrelated and overlapping. The bulk of the Federal resources for improvement in K-12 mathematics and science education are in the programs of the Department of Education and the National Science Foundation. The programs, both within and across the agencies, take different and complementary approaches. (See Appendix 3 for a summary.) Developing a coherent, coordinated approach to strengthening the impact of Federal resources used to improve mathematics achievement in grades 5-8 requires taking these differences into account.

In FY 1997, the National Science Foundation is investing \$377 million in K-12 science and mathematics education, including undergraduate preparation of teachers. The funds go largely to colleges and universities, State and local educational agencies, and nonprofit organizations. They are awarded through competitive review of proposals for funding of specific projects. Over the past few years, the Foundation has placed a high priority on reform of mathematics and science education in educational systems. It asks local and State educational agencies to align resources of all types, including those obtained through other Federal programs, to effect change. The Foundation highlights specific areas of emphasis within broader programming, establishes clear priorities for funding within the criteria for selection of awards, and holds grantees accountable for performance. Projects in mathematics education are grounded in the NCTM standards. Experience shows, however, that projects aimed at mathematics in grades 5-8 are scarce in comparison to those in science or to those in mathematics aimed at other grade levels.

districts to
The Department of Education will allocate approximately \$8.0 billion in FY 1997 through three *primary* large, formula-driven programs (Goals 2000; Eisenhower Professional Development State Grants; and Title I: Education for the Disadvantaged) that include improved achievement in mathematics and science education among their objectives. Goals 2000 is aimed at aiding States and schools to *aids* develop and implement challenging academic standards and reform teaching and learning in order to reach the National Education Goals, including the goal of becoming first in the world in mathematics and science. The Eisenhower program is the only one of the three with any explicit *upgrade*

5 places an explicit

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subject focus on science and mathematics; At least \$250 million out of the FY 1997 appropriation of \$310 million must be spent in these areas. The 1994 reauthorization of the program requires that States and localities use Eisenhower funds for sustained professional development that makes a difference in classroom practice. The 1994 reauthorization of Title I places new emphasis on helping disadvantaged students meet the same challenging academic content and performance standards expected of all children. States are currently developing standards and plans for moving toward them. These funds are distributed to State and local educational agencies by formula. The Department of Education works actively with States and school districts on identifying actions that can be taken to achieve significant change, provides information and examples, and makes technical assistance available as needed.

The Department of Education and the National Science Foundation are committed to working together in order to increase the impact of Federal resources by creating synergy among these programs and realizing a significant concentration of resources for improving mathematics achievement in grades 5-8. The work of improving achievement must be done at the State and local level, and, most fundamentally, within individual schools. State and local educational agencies can strengthen the impact of Federal resources by choosing to use them in a coordinated, concentrated way. Thus, the National Science Foundation and the Department of Education must stimulate the desire for change, support the coordinated use of all types of Federal, State and local funds toward improving mathematics achievement, provide examples of effective coordination in the use of such funds, and provide incentives to initiate change at the State and local levels.

- The Department of Education will demonstrate the priority it accords this effort through *provide* providing information and technical assistance and through its encouragement and actively encourage support of State and local educational agencies in their coherent use of all types of Federal funds in efforts to meet the high content and performance standards for mathematics in grades 5-8 that they have established under Goals 2000 and Title I. *grades 5-8 make*
- additional* • The National Science Foundation will give high priority to supporting implementation of State and local strategies for improving mathematics education in grades 5-8 and, through its competitive awards, will provide incentives for effective, targeted use of Title I and Eisenhower funds in projects it supports. In particular, the Foundation will provide competitive planning grants to jump-start the creation of coherent efforts to upgrade mathematics instruction that use Federal, State, and local funds to sustain long-term improvements. *incentive,*
- School and district implementation of improvement strategies are particularly important for long-term change. Thus, the agencies will initially focus their cooperative activities on middle schools with schoolwide Title I programs and districts with many such schools, working with principals and superintendents to address the importance for their students of high-quality mathematics instruction aimed at challenging national standards; to help make more concrete their understanding of what such a program of instruction means for students and teachers; and to consider mechanisms to implement such instruction in their schools.
- The two agencies will convene a national conference of State and local leaders of Eisenhower, Title I, Goals 2000, and State, urban and rural systemic initiatives, and other key actors to set the stage for focused, coordinated efforts to improve mathematics education in grades 5-8. *help participants maximize the impact of Federal - funds*

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- The two agencies will undertake a coordinated set of research and informational activities around mathematics in grades 5-8. These activities will include release of a TIMSS Toolkit that contains specific tools for professional development, curriculum analysis, and achievement benchmarking; follow-up with future international comparisons like TIMSS ^{an interactive} program of research informing evolution of the eighth grade national test over time; and a sustained agenda of basic research in teaching and learning of mathematics. ^{clarify}
- ^{Department of the Foundation with other agencies} The two agencies will challenge their sister agencies to contribute to enhancing the impact of Federal resources by joining in this effort to promote ^{achievement-based on challenging} standards for mathematics in grades 5-8 and by aligning their activities to reinforce a standards-based approach ^{for math in grades 5-8} ^{upgrading}

[Sidebars for this section include: Texas Statewide Systemic Initiative; Title I schoolwide; DOD activities.]

^{urgent need to}
^{raise} Each of the specific items above will be aimed at mathematics in grades 5-8, reflecting the ~~priority~~ that the Department of Education and the National Science Foundation accord to addressing improvement in achievement at this stage of the educational process. However, the coordinated coherent activities described above can also serve as models for more effective approaches to educational change in the broader arena of mathematics and science education. The working group strongly endorses the idea of future efforts that would encompass all of K-12 mathematics and science education.

Equipping teachers in grades 5-8 with the skills and knowledge to teach challenging mathematics content in effective ways, with high expectations for their students

In grades 5-8, students should begin to move from mastering arithmetic to using arithmetic in complex problems and learning the foundations of geometry, algebra, probability, and statistics. Teachers must know substantial mathematics and have strong pedagogical skills if they are to be effective in helping their students make this transition and meet high standards. Practices in teacher education, licensure and certification, and in-service teacher enhancement do not always reflect these needs.

Over the next ten years, approximately 2 million teachers will enter the workforce. It is essential that these new teachers receive adequate preparation in mathematics content and pedagogy before they enter the classroom. And many of the approximately 350,000 teachers who are already teaching mathematics in grades 5-8 could use extra support in upgrading their math content knowledge and teaching skills in order to better help the Nation's students achieve high levels of excellence in mathematics.

Because of these critical needs, this action strategy addresses both the professional development of teachers who are already in the classroom and the preparation of new teachers. In order to assist current teachers, the strategy promotes sustained and intensive professional development activities that are based on mastery of mathematical content and tied to high-quality instructional materials and technology. Teacher preparation activities will aim at preparing future teachers of grades 5-8 to teach effectively challenging mathematics content geared to national standards of excellence, such as the NCTM standards.

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greater The coordinated efforts of the Department of Education and the National Science Foundation described above should stimulate ~~the~~ ^{greater} use of Title I and Eisenhower resources for high-quality professional development for grade 5-8 teachers of mathematics. However, the increased demand for high-quality professional development ^{will} ~~will~~, without action now, exceed the capacity of those individuals and organizations currently supplying it. Thus, an essential component of equipping teachers ~~as we envision~~ ^{will be} will be ensuring the presence of a sufficient ~~number~~ ^{number} of individuals and institutions skilled in providing ~~exemplary~~ professional development. The two agencies will work with the mathematics communities, institutions of higher education, and other Federal agencies to help ensure the capacity to respond effectively, particularly by supporting the development of exemplary materials and by providing training opportunities for those who will become leaders in teacher professional development and teacher preparation. *hllg*

To address professional development needs of current teachers, the National Science Foundation and the Department of Education will:

- Make sustained, intensive, high-quality professional development of teachers of mathematics in grades 5-8 the cornerstone of their cooperative efforts to enhance the impact of Federal resources. These efforts will focus on professional development for all teachers in schools and districts, with an emphasis on middle schools with Title I schoolwide programs and districts with many such schools. This focus will permit professional development for a significant fraction of the approximately 350,000 teachers of mathematics in grades 5-8, with particular attention to those who teach the largest numbers of disadvantaged students.
- Support a short-term, intensive effort aimed at strengthening the pool of talented, committed individuals able to provide exemplary professional development for classroom teachers. *what does this mean?*
- Support the creation of materials for professional development of teachers of mathematics in grades 5-8 that are grounded in the NCTM standards and tied to newly emerging instructional materials and educational technologies.
- Support opportunities for teachers to help one another with content knowledge and teaching skills through activities such as dissemination of information about effective forms of professional development; encouraging the development of master teachers (including those recognized through Presidential Awards for Excellence in Mathematics and Science Teaching or National Board Certification), mathematics specialists, and teacher networks.

for Professional Teaching Standards To promote improved preparation of future mathematics teachers for grades 5-8, the Department of Education and the National Science Foundation will:

- Prepare and disseminate widely a study on State licensure requirements, focusing particularly on requirements for middle school teachers of mathematics, comparisons to other nations, and the impact of licensure requirements on the knowledge of mathematical concepts that teachers bring to their work in the classroom.

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- Encourage and support the development of teacher preparation approaches *that*:
 - more tightly link ^{college} departments of mathematics and schools of education; *that*
 - include mathematics courses focusing on the mathematical content ^{future} teachers of mathematics in grades 5-8 need to know;
 - model effective classroom practices; and
 - involve participation of local K-12 schools in the design of teacher preparation requirements.
- Support the development of materials for preparation of K-8 mathematics teachers that are grounded in the NCTM standards and tied to newly emerging instructional materials and educational technologies.

[Sidebars for this section include: PRIME in Pittsburgh: Quantitative Literacy Program for Alabama K-12 Teachers; Montana's Systemic Teacher Excellence Project; and Maryland Collaborative for Teacher Preparation.]

} probably just need a couple of them.

Implementing high-quality, standards-based curricula and instructional materials (including curricula that use educational technologies) in grade 5-8 mathematics classrooms

The TIMSS results showed that the content of curricula and instructional materials used in US classrooms in the middle school years in 1995 differed from those in high performing countries in significant ways. The content taught in most U.S. eighth-grade mathematics classrooms would be found in the seventh grade in high-performing nations. Our low expectations for student performance are also shown by the fact that only about 25 percent of U.S. eighth grade students are enrolled in algebra courses, while in high-performing nations virtually all students have the opportunity to master the foundations of algebra and geometry by the end of eighth grade.

In addition, TIMSS noted that middle school mathematics materials covered more topics and were less focused in the U.S. than in leading countries. For example, typical American eighth grade mathematics textbooks in 1995 covered as many as 35 major topics compared to as few as 10 such topics in Japanese textbooks, leaving little time for teaching for student mastery and depth of understanding in the U.S.

In a nation as diverse as ours, it is not surprising that there is a very large number of different text books and other instructional materials available to schools or that textbooks tend to be inclusive in order to appeal to the greatest number of teachers and schools. However, ^{more, because} alternatives to these widely used ~~additional~~ materials are now available. New, comprehensive mathematics instructional materials, linked with high standards for mathematical content and pedagogy and aligned with the NCTM standards, are now emerging from development and reaching the market. These newer materials provide a range of different approaches to classroom instruction, generally focusing on 15 or fewer topics per year.

include a wide array of topics

Many schools supplement their comprehensive instructional materials -- incorporating, for example, the use of instructional technologies -- in ways that permit teachers to tailor instruction to particular classrooms. In schools where traditional instructional materials are still being used, ^{help} supplementary materials ~~that~~ facilitate a transition to the newly emerging comprehensive materials or ~~that~~ take advantage of new and emerging learning technologies are essential, especially in grades 5-8 where students develop the conceptual foundations for the study of more advanced mathematics.

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To assist schools, districts, and States in choosing and implementing effective curricula and instructional materials, the National Science Foundation and the Department of Education will:

- Make upgrading of mathematics instruction easier, particularly for middle schools with Title I school-wide programs, through encouragement and support for coordinated planning and action aimed at
 - purchase of appropriate new instructional materials;
 - necessary professional development aimed at their implementation; and
 - employment of highly skilled mathematics specialists who are prepared to teach the new materials and guide others in their implementation.
- Develop and disseminate guides to help schools and school districts select instructional materials and software most appropriate for their local needs and undertake the necessary steps to effective implementation. This effort will include reviews of instructional materials and software designated by experts as promising or exemplary.
- Provide technical assistance for schools and school districts in implementing new mathematics instructional materials in grades 5-8 through linkage of sites dedicated to providing ~~technical~~ ^{putting updated} ~~implementation assistance~~ ^{making} for such materials with broader technical assistance providers, including the Eisenhower National Consortia ^{to} ~~and~~ ^{Regional} ~~National~~ ^{and National Clearinghouse} ~~Consortia~~ ^{support the development of}
- Continue to ~~develop~~ ^{support the development of} supplementary materials, with new priority for efforts aimed at mathematics in grades 5-8, to assist schools and districts in making the transition to standards-based comprehensive materials.
- Seed research and development of powerful models for integrating technology, including support for critical expansion and evaluation efforts preceding commercialization of these models. K-8 mathematics will be a high priority in the near term.
- ^{in math/science} ~~few~~ ^{Federal} other agencies have, in the past, contributed to the development of instructional materials. This is changing, and the ^{standards-based} ~~working group~~ ^{standards-based} feels there are significant contributions that other agencies can make in this area, particularly in the development of supplementary materials and the delivery of such materials through technology.
- Agencies will work in cooperation with NASA and NCTM to develop materials along the lines of NASA's "Mission Mathematics." These materials illustrate the use of mathematics in real world examples related to the agency mission. ^{standards-based}
- The Department of Education is ^{has} ~~chairing~~ ^{has} a Federal Government-wide working group that has already begun to promote and develop -- and make it easier for teachers and others to find -- high-quality educational materials, including instructional units and related materials, for use on the Internet. ^{the first priority of this group will be to identify materials that support teaching of challenging mathematics.}
- The Departments of Defense and Education and the National Science Foundation are leading an interagency review of Federal activities related to research in learning technologies.

has this been agreed - to yet? 10

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Each of these efforts could make new types of materials and capabilities possible in the future. Activities that enable students to achieve to high standards play an important role in all these Federal activities. *redundant*

[Sidebars for this section include: *Everyday Mathematics*: Improving Teaching through Distance Learning; Eisenhower Regional Consortia for Science and Mathematics Education; and NASA's Mission Mathematics.]

Building public understanding of what challenging mathematics looks like in grades 5-8, and gaining public support for ^{raising/lifting} improving student achievement toward high standards.

Our vision is that all American students leave eighth grade prepared to pursue the higher-level mathematics and science courses that are the gateway to college, citizenship, productive employment, and lifelong learning. In realizing this vision, it is also essential that educators, parents, and students themselves understand what high standards in mathematics look like and why they are important. This outcome requires activities and information that reinforce the classroom experience and convey the importance of mathematics achievement. Such activities might draw on the support of parents, the professional community of mathematicians, scientists, and engineers, business, and the broader public.

This section of the action strategy includes two complementary pieces. The first consists of efforts to make standards fully and clearly understood. If you don't know where you are trying to go, it is hard to get there. This is true if you are driving a car, building a house, or running a small business. To succeed, you need a vision of what success looks like so you know how to work to achieve it. The same is true in education. If parents and students and teachers don't know where they should be headed -- what they agree students should know and be able to do -- it is hard to pull together to get there. *As most students and parents get their information from teachers, there must be a good sense within schools of what they do and why they do it and an ability to convey that effectively. Schools must have a clear sense of what they are doing and be able to communicate effectively with parents as well as work hard to invite active parental participation.*

The second piece builds on the first by *creating a platform* for partnerships that bring together the many groups that can contribute to the effort of helping students achieve high standards in mathematics. The partnerships will elevate the importance of mathematics achievement and provide clear avenues for interested members of the mathematics, science, business and education communities, as well as parents and interested citizens, to contribute to efforts to raise mathematics achievement.

The Federal government will support the partnerships by promoting a national dialogue on improving mathematics, acting as a clearinghouse for information and proven approaches to action, working with various elements of the partnerships to develop exemplary materials that *partners can be use in their State and local efforts, and mobilizing its own staff and resources to join in local support partnership efforts.* *Because these partnerships must build upon and complement what goes on in the schools, teachers and school administrators will be important participants, either formally or informally.* *vital*

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In order to support these strategies, the Department of Education and the National Science Foundation will:

- Convene a national convocation on middle school mathematics to initiate a continuing national dialogue on:
 - what we should expect our students to be able to achieve in mathematics by eighth grade and beyond;
 - exemplary practices in professional development, curricula, instructional materials, and technologies; and
 - opportunities for parental involvement and community support to help students meet high expectations.
- Seed the continuing national dialogue by providing a wide variety of sample items illustrating the level of standards, examples of student work, and information on curricula, instructional methods and technologies that support high standards.
- Make widely available materials on how teachers and other educators can use assessment in planning instructional improvement strategies. These materials will include information on how best to use student, school building, and district results from the voluntary national mathematics test in efforts to interpret results to students and parents, place results in appropriate context, and improve mathematics instruction.

an easy-to-use

• Create a mathematics Web site providing information on the national test, including sample problems, examples of student solutions, and all the other materials developed pursuant to this action strategy.

as well as instructional units for teachers? or identified as a part of

The planned partnerships would be focused at State and local levels, with the Federal Government providing a platform for some types of activities and of drawing in national organizations that would then work through State and local affiliates. Examples of partnership options that currently exist, might be expanded, or might be incorporated in newly forming partnerships at local, State, or national levels include:

Institutions of higher education or Federal agencies partnering with local K-12 schools and their parent organizations to build understanding and support for teachers and administrators implementing reform activities:

- Professional societies in mathematics, science, and engineering providing guidance for their members on interacting with schools and teachers productively.
how to work with local *to help raise standards in math.*
- Summer mathematics efforts that keep students growing mathematically, modeled after the Department of Education's successful summer reading effort:
Read & Write & Now
- Public service information campaigns:
activity groups
- Mathematics fitness circles or networks with weekly problems, discussions of how these problems illustrate the standards, and discussions of the importance of mathematics for future education and work:
for students & teachers having interests & challenges
- Support for students via telementoring by adults actively using mathematics in their work:

Working DRAFT; 6/23/97

- g* *and water*
- After school ~~and~~ evening use of facilities (such as space or computers) of local businesses, academic institutions, local government, and community organizations for mathematics-oriented activities for students and their parents

help Partnership activities should be aimed at drawing together the broad resources of the local community, engendering a community understanding of the importance of challenging mathematics standards for the children of the community, and providing support to the schools ~~outside the~~ *with a second* ~~direct confines of the school system~~. In addition, partnership activities can help address considerations of equity, particularly in the use of technology.

[Sidebars for this section include: Saturday Schools Provide Tutoring Boost; A New Federal Education Partnership Program at the Department of Transportation.]

- Boxer
- Other Agencies
- ~~Chick~~
- Internet direct

DOEd-NSF Working Group on Improving Math and Science Education

FAX COVER SHEET

Date: 6-16-97

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FROM: Judy Sunley

Number of pages including this Cover Sheet 13

Remarks:

**AN ACTION STRATEGY
FOR IMPROVING ACHIEVEMENT IN
MATHEMATICS AND SCIENCE**

On March 6, the President issued a memorandum (Appendix 1) directing the Secretary of Education and the Director of the National Science Foundation to form an interagency working group to develop, within 90 days, an action strategy for using Federal resources to assist States and local school systems to meet challenging mathematics standards in the eighth grade, and for involving the mathematical, scientific, and technical communities in support of those efforts.

The Presidential directive specified that the action strategy include recommendations for the use of Federal resources to help States, local school districts, and schools improve teaching, upgrade curriculum, integrate technology and high-quality instructional materials into the classroom, and motivate students to help them understand how mathematical concepts are applied in today's global workplace. It called for the interagency group to review the current status of improvements in mathematics education and identify and address critical issues of need, drawing on research and input from educators and professional organizations. In addition, it called for the working group to review how Federal resources and partnerships with other organizations can help improve student achievement in science.

One of the immediate inspirations for this exploration of means for achieving high standards in mathematics and science education in eighth grade is the Third International Mathematics and Science Study (TIMSS) involving 500,000 students in 41 nations, including 30,000 in the United States. Results released in the Fall of 1996 show lackluster performance by U.S. 8th graders, with scores above average the international average in science but below the international average in mathematics. On the other hand, TIMSS data also show that our 4th graders are above the international average in both math and science -- and in science are outperformed only by Korea. These results clearly indicate that mathematics education in the middle school years should be an important focus for national efforts to help ensure that our students meet world class standards.

Beyond indicating a need to focus emphasis on grades 4 through 8, TIMSS also provides a wealth of data on how and what we teach our students -- and important clues about ways to improve both. TIMSS researchers collected not only achievement data in each participating country, but also much information about teachers and teaching, about curricula and instructional materials, about classroom lessons and interactions, and about student attitudes and habits outside the classroom. Thus, TIMSS results have become a source of constructive motivation for mounting an action strategy, taking the issue well beyond the simple comparison of scores in international test taking.

Eighth grade is a critical point in mathematics education, as achievement at that stage paves the way for students to take the advanced high school mathematics and science courses that are keys to college entrance and well-paid jobs. Today, too many students enter high school without this solid grounding in mathematics and never gain it, thus closing doors to opportunities for further education and careers. Often, students and their families do not even know that the doors are closing. For example, a 19xx survey of low-income high school students conducted by the National xx of Minority Engineers found that xx% of low income students wanted to be engineers, scientists and doctors, but only xx% were taking the rigorous mathematics courses needed to pursue those careers.

Reading - good start

**
[early on /
shaded /
include /
boxes /
4th grade /
8th grade /
TIMSS /
results]*

*What about
Algebra II
course?
July
(works)*

The President has proposed a nationwide, voluntary test in mathematics, to be taken near the end of eighth grade, as a very visible part of an ambitious, sustained drive for higher, more challenging standards of learning for all students. The test will be available by the spring of 1999 for those States and districts that wish to use it. Plans are to provide parents and teachers with an individual score for each student who takes the test. That score will be linked to national and international benchmarks. States, districts, and schools will be able to provide additional context for the scores at their discretion.

The test by itself will be insufficient to accomplish the objective of having all students achieve challenging national standards for performance in eighth grade mathematics. That will require many individuals working in concert with a common understanding of what they are trying to accomplish. Materials created to accompany the test will supply all interested parties with readily identifiable, accessible, and concrete understandings of what students should know by the end of eighth grade and what world-class performance looks like. Such materials will help students, parents and teachers begin to aspire to the high standards that a significant number of students in our do yet not reach. *Spencer* *Kidd*

TIMSS results for the 4th grade have shown that it is possible to make significant progress in international comparisons over time, and that US students can compete favorably with those of other nations. The voluntary national test in grade eight and the materials accompanying it will provide a powerful lever to amplify the effects of sustained, coordinated efforts at local, State and national levels to improve K-8 mathematics and science education. This action strategy is aimed, in part, at using that tool effectively, with particular attention to mathematics in grades 5-8, where the TIMSS results tell us we need to focus.

Response to the Presidential Directive

Pursuant to the memorandum from the President, ED and NSF promptly formed an interagency working group comprised of ED and NSF staff experienced in the areas under review. Officials of the White House Offices of Science and Technology Policy and Domestic Policy, as well as the Office of Management and Budget, provided oversight. (A listing of the members of the interagency group is attached as Appendix 2).

The interagency group immediately began a review of current Federal efforts in mathematics and science education -- primarily, consistent with the directive, in mathematics education at the kindergarten through eighth-grade level. (See Appendix 3 for a summary of relevant programs in ED and NSF.) In addition, consistent with the memorandum's instructions for the interagency group to draw on research and input from educators and professional organizations, the group reached out to the broader mathematics and educational community for advice and guidance. (See Appendix 4 for a summary of these outreach efforts, including a list of organizations with which the working group consulted.) The interagency group also consulted with appropriate staff in other agencies that have, or are interested in establishing, activities in elementary and secondary-level mathematics or science education. (See Appendix 5 for a list of the agencies consulted and a summary of their input.)

Central Focus of
Central Focus

Working DRAFT; 6/16/97

Excellence in Eighth-Grade Mathematics as the Context for a National Action Strategy for
Improving Achievement in Mathematics and Science

Our vision is that all American students, ^{should} leave eighth grade prepared to pursue the higher-level mathematics and science courses that are the gateway to college, citizenship, productive employment, and lifelong learning. Whether rich or poor, all of our students deserve an education that will help them prepare for a successful future.

Reaching this vision will require:

- High expectations, held by educators, parents, and students themselves, for student performance in mathematics and science;
- Challenging standards for content, materials, teaching, assessment, and achievement;
- Instructional materials and technology of high quality that incorporate these challenging standards;
- Teachers with the pedagogical skills and knowledge of mathematics to teach challenging mathematics effectively; and
- Activities outside the classroom that reinforce the classroom experience by drawing on the support of parents, the professional community of mathematicians, scientists, and engineers, business, and the broader public.

While achievement of our national objectives in mathematics and science education will rely on each of these elements, progress in one area will often depend on and demand improvement in others. For instance, the introduction of high-quality instructional materials will have little impact if teachers are not trained to use those materials effectively. Effective instruction during the school day will have limited results if parents (and, indeed, the entire community) do not support student achievement and let students know how important success in mathematics is to their future opportunities for college and careers. In short, K-12 education improvement based on high expectations with everyone working together toward challenging national standards and aligning resources with this aim should remain the guiding principle behind any new activities in the area of mathematics and science. We should be working on all fronts -- high standards, effective curriculum, technology in the classroom, teacher training and licensure, assessments, and support from parents and the public -- to make progress towards this critical goal.

A critical factor in the ability of students to pursue advanced work in mathematics and science ^{in high school beyond} beyond eighth grade is their achievement in mathematics. This action strategy is focused on aligning resources so as to enable students to meet challenging national standards in mathematics toward the end of eighth grade, using the proposed national test as an indicator of accomplishment and a tool for gaining the attention of the public. ^{by 8th to 8th grade kids} It is one piece of the broader, sustained effort to improve achievement in K-12 mathematics and science.

This study is one piece

of
the national test is an important

Improving Mathematics Education: Building on Strength

The action plan builds on the considerable efforts underway, ^{largely outside but also within} both within and outside of the Federal Government, to improve elementary and secondary mathematics and science education. Some of these activities began almost a decade ago in schools, colleges, States, and professional organizations. Taken together, they provide a solid foundation for focused attention to mathematics in grades 5-8 that can drive improvements in K-12 mathematics and science education. Some of the most important current or completed activities include:

- The National Council of Teachers of Mathematics (NCTM) introduced standards for mathematics curriculum and evaluation in 1989, followed by standards for teaching and assessment in mathematics. States and communities have made these voluntary standards the basis of many of their efforts to improve mathematics education. (As is appropriate in any effort to raise standards, NCTM is now reviewing the mathematics curriculum and evaluation standards and plans to update them over the next few years.)
data on # of States have adopted new standards
- A new generation of rigorous mathematics curricula geared to the NCTM standards, with development funded largely by NSF, is beginning to appear in classrooms. By the fall of 1997, we project that these materials will account for 25 percent of all new textbooks purchased, and that figure should grow in succeeding years.
we expect to
- TIMSS and other new assessments, coupled with research, ^{in-depth are} provide ^{very valuable} substantial information about how and what we are teaching and how students learn, and point to critical factors for improving achievement in mathematics in grades 5-8.
- Approximately 65 percent of all schools are now connected to the Internet, providing the opportunity for communication on improving mathematics education and for the use of distance learning and advanced technologies. Federal support has helped to make this possible, and the newly enacted "E-rate" will substantially reduce the cost of Internet connections for schools and allow more schools to take advantage of this learning tool.
- Many States, with support through the NSF systemic initiatives, Goals 2000, the reauthorized Elementary and Secondary Act, and other ED and NSF programs, have undertaken comprehensive systemic reforms. States that were in the forefront of reforms are now beginning to enjoy the benefits in improved student outcomes.
Systemic Education Improvements

Critical Areas for the Strategy

Consistent with the thrust of the President's memorandum, this action strategy ^{identified} is grounded in actions Federal agencies, along with other partners, can take to help students reach challenging mathematics standards and ensure that Federal resources will effectively support State and local reforms. It is focused on mathematics in grades 5-8 ^{to address TIMSS-identified deficiencies and} to make best use of the proposed national test of mathematics at the end of eighth grade. Through its consultation with outside organizations and its review of Federal programs, the working group has identified three areas that must be addressed:
priority

strategy geared to higher standards in math/science

- Equipping teachers in grades 5-8 with the skills and knowledge to teach challenging mathematics content in effective ways, with high expectations for their students;
- Implementing high-quality, standards-based curricula and instructional materials ^{effective use of} ~~curricula that use~~ educational technologies in grade 5-8 mathematics classrooms; and
- Building public understanding of what challenging mathematics looks like in grades 5-8, and gaining public support for improving student achievement toward high standards.

^{improving it} ^{to support state/local efforts} Use of Federal resources in addressing these areas is the core of the action strategy. However, the strategy also takes into account the Federal Government's limited role in education — which properly is a State and local responsibility. The Federal role is to provide good information, effective tools, and financial support that will assist States and local communities in ensuring that all of their students have the mathematical skills they need to succeed in our society. This includes promoting effective partnerships that mobilize support from the community -- students, parents, educators, business, volunteers, and concerned citizens from all walks of life — to that end.

Focusing Federal Resources

Clearly, strategies for use of Federal resources in addressing these critical areas are interrelated and overlapping. The bulk of the Federal resources for improvement in K-12 mathematics and science education are in the programs of the Department of Education (ED) and the National Science Foundation (NSF). ~~The programs, both within and across the agencies, have very different foci and modes of operation.~~ (See Appendix 3 for a summary.) Developing a coherent, coordinated approach that focuses Federal resources on mathematics in grades 5-8 requires taking these differences into account.

NSF is investing \$377 million in K-12 science and mathematics education, including undergraduate preparation of teachers, in FY 1997. The funds go largely to colleges and universities, State and local educational agencies, and nonprofit organizations. They are awarded through competitive review of proposals for funding of specific projects. Over the past few years, NSF has placed a high priority on reform of mathematics and science education in educational systems, using local and State resources, including those obtained through ED programs, to supplement NSF funding to effect change. ~~NSF creates focus in its activities by developing new programs, creating new emphases within existing programs, or establishing clear priorities for funding within the criteria for selection of awards.~~ NSF-supported projects in mathematics education are grounded in the NCTM standards. Experience shows, however, that projects aimed at mathematics in grades 5-8 are scarce in comparison to those in science or to those in mathematics aimed at other grade levels.

^{allocates} ED will spend approximately \$8.0 billion in FY 1997 through three large programs (Goals 2000; Eisenhower Professional Development State Grants; and Title I: Education for the Disadvantaged) that include improved achievement in mathematics and science education among their objectives. Only the Eisenhower program has any explicit focus on science and mathematics (At least \$250 million out of the FY 1997 appropriation of \$310 million must be spent in these areas.). The 1994 reauthorization of the program requires that States and localities use Eisenhower funds for sustained professional development that makes a difference in classroom practice. Goals 2000 is aimed at aiding States and schools to develop and implement challenging academic standards and reform teaching and learning in order to reach the National Education Goals, including the goal of

becoming first in the world in mathematics and science. Title I funding is in transition to a new emphasis on helping disadvantaged students meet the same challenging academic content and performance standards expected of all children. ED funds are distributed to State and local educational agencies by formula. Thus, ED's options for creating focus (beyond the focus mandated in statute) are largely those of persuasion; providing information and examples; making technical assistance available; and working actively with States and school districts on identifying actions that can be taken to achieve significant change.

ED and NSF are committed to working together in order to realize a significant concentration of resources in improving mathematics achievement in grades 5-8 by creating synergy among these programs, including, particularly, Title I [which contains the largest share of the resources (\$7.2 billion in FY 1997)] The work of improving achievement must be done at the State and local level and, most fundamentally, within individual schools. State and local educational agencies can bring about the concentration of Federal resources by choosing to use the ED formula funds in a coordinated way. Thus, NSF and ED must stimulate the desire for change, support the coordinated use of all types of Federal, State and local funds toward improving mathematics achievement, provide examples of effective coordination in the use of such funds, and provide incentives to initiate change at the State and local levels.

- Through dissemination of models, research, guidance for TA, ED will demonstrate the priority it accords this effort through its active support of coherent State and local efforts to meet the high content and performance standards for mathematics in grades 5-8 that they have established under Goals 2000 and Title I.

NSF will give high priority to supporting coordinated, coherent strategies for improving mathematics education in grades 5-8 and, through its competitive awards, will provide incentives for effective, targeted use of Title I and Eisenhower funds in projects it supports. In particular, NSF will provide competitive planning grants to jump-start the creation of coherent efforts to upgrade mathematics instruction that use ED, State, and local funds to sustain long-term improvements.

- NSF and ED will bring together school superintendents and principals whose schools include some or all of grades 5-8 in a series of regional meetings to address the importance for their students of high-quality mathematics instruction aimed challenging national standards; to help them understand concretely what such a program of instruction means for students and teachers; and to address mechanisms to implement such instruction in their schools.
- ED and NSF will convene a national conference of State and local leaders of Eisenhower, Title I, Goals 2000, and State systemic initiatives, and other key actors to set the stage for focused, coordinated efforts to improve mathematics education in grades 5-8.
- NSF and ED will undertake a coordinated set of research and informational activities around mathematics in grades 5-8. These activities will include release of a TIMSS Toolkit that contains specific tools for professional development, curriculum analysis, and achievement benchmarking; follow-up with future TIMSS-like activities; an interactive program of research and test redesign surrounding the proposed eighth grade national test; and a sustained agenda of basic research in teaching and learning of mathematics.

Each of the specific items above will be aimed at mathematics in grades 5-8, reflecting the priority that ED and NSF accord to addressing improvement in achievement in this area. However, the activities described above can also serve as models for ~~coordinated, coherent~~ ^{effective} approaches to educational change in the broader arena of mathematics and science education. The working group strongly endorses the idea of future efforts that would encompass all of K-12 mathematics and science education.

Equipping teachers in grades 5-8 with the skills and knowledge to teach challenging mathematics content in effective ways, with high expectations for their students

In grades 5-8, students should begin to move from mastering arithmetic to using arithmetic in complex problems and learning the foundations of geometry, algebra, probability, and statistics. Teachers must know substantial mathematics and have strong pedagogical skills if they are to be effective in helping their students make this transition and meet high standards. Past practices in teacher education, licensure and certification, and in-service teacher enhancement did not often reflect these needs, nor do many current practices, handicapping many of the teachers on whom we depend for excellent education.

Over the next ten years, approximately 2 million teachers will enter the workforce. [It is essential that these new teachers receive adequate preparation in mathematics and pedagogy before they enter the classroom.] And many of the approximately 350,000 teachers who are already teaching mathematics in grades 5-8 could use extra support in upgrading their math content knowledge and teaching skills in order to better help the Nation's students achieve to high levels of excellence in mathematics.

Because of these critical needs, this action strategy addresses both the professional development of teachers who are already in the classroom and the preparation of new teachers. In order to assist current teachers, the strategy promotes sustained and intensive professional development activities that are based on mastery of mathematical content and tied to high-quality instructional materials and technology. Teacher preparation activities will aim at preparing future K-8 teachers to teach effectively challenging mathematics content geared to national standards of excellence, such as the NCTM standards. Our agencies will place a high priority on helping teachers gain the skills and develop the networks to continue learning and to be able to take advantage of new technologies.

The coordinated efforts of ED and NSF described above should stimulate the use of Title I and Eisenhower resources for high-quality professional development for grade 5-8 teachers of mathematics. [However, the increased demand for high-quality professional development will, without action now, exceed the capacity of those individuals and organizations currently supplying it.] Thus, an essential component of equipping teachers as we envision will be ensuring the presence of a sufficient cadre of individuals and institutions skilled in providing exemplary professional development. NSF and ED will work with the mathematics communities, institutions of higher education, and other Federal agencies to help ensure the capacity to respond effectively, particularly by supporting the development of exemplary materials and by providing training opportunities for those who will become leaders in teacher professional development and teacher preparation.

To address professional development needs of current teachers, NSF and ED will:

- Make sustained, intensive, high-quality professional development of teachers of mathematics in grades 5-8 the cornerstone of their cooperative efforts to focus Federal resources. [If we

wished to do so, this might be the place to set some goals for how many teachers per year we need to reach.]

- Support intensive programs aimed at increasing the supply of talented individuals able to provide exemplary professional development for classroom teachers in the near term.
- Support the creation of professional development tools aimed at mathematics in grades 5-8 that are tied to the newly emerging curricula and instructional materials and technologies grounded in the NCTM standards.
- Support opportunities for teachers to help one another with content knowledge and teaching skills through activities such as the development of master teachers, mathematics specialists, and teacher networks.

To promote improved preparation of future mathematics teachers for grades 5-8, ED and NSF will:

- Prepare and disseminate widely a study on State licensure requirements, focusing particularly on requirements for middle school teachers of mathematics, comparisons to other nations, and the impact of licensure requirements on the knowledge of mathematical concepts that teachers bring to their work in the classroom.
- Encourage and support the development of teacher preparation approaches that
 - ^{and} tightly link departments of mathematics and schools of education; ~~that~~
 - include mathematics courses focusing on the mathematical content future teachers of mathematics in grades 5-8 need to know;
 - model effective classroom practices; and
 - involve participation of local K-12 schools in the design of teacher preparation requirements;

→ highlighting exemplary programs and approaches.

- Support the creation of tools for preparation of K-8 mathematics teachers that are tied to newly emerging curricula and instructional materials and technologies grounded in the NCTM standards.

Implementing high-quality, standards-based curricula and instructional materials (including curricula that use educational technologies) in grade 5-8 mathematics classrooms

The TIMSS results showed that the ^{content of} curricula and instructional materials used in US classrooms in the middle school years in 1995 differed from those in high performing countries in significant ways. The content taught in most U.S. eighth-grade mathematics classrooms would be found in the seventh grade in high-performing nations. Our low expectations for student performance are also shown by the fact that only about 25 percent of U.S. eighth grade students are enrolled in algebra courses, while in high-performing nations virtually all students have the opportunity to master the foundations of algebra and geometry by the end of eighth grade.

In addition, TIMSS noted that middle school mathematics curricula covered more topics and were less focused in the U.S. than in leading countries. For example, typical American eighth grade mathematics textbooks in 1995 covered as many as 35 major topics compared to as few as 10 such topics in Japanese textbooks, leaving little time for teaching for student mastery and depth of understanding.

needed
needed

In a nation as diverse as ours, it is not surprising that there are a very large number of different text books and other curriculum materials available to schools or that textbooks tend to be inclusive in order to appeal to the greatest number of teachers and schools. However, ~~alternatives to the traditional materials that are widely used are now available.~~ New, comprehensive mathematics curricular and instructional materials, linked with high standards for content and pedagogy in alignment with the NCTM standards are now emerging from development and reaching the market. These new materials generally focus on 15 or fewer topics per year.

All those in States, school districts, and schools who are responsible for selecting and using curriculum and materials need good information to help them decide what materials are right for their community and students. And, once they decide what materials they wish to use, they may need assistance in ~~effective~~ ways to make the transition to using new and more challenging materials.

Vague

Textbooks
and
like (?)

In addition to comprehensive materials, most schools use some form of supplementary materials -- frequently incorporating the use of instructional technologies -- that permit teachers to tailor instruction to particular classrooms. Supplementary materials that take advantage of new and emerging learning technologies and facilitate a transition to the newly emerging comprehensive materials are essential for mathematics in grades 5-8, where the foundations for the study of more advanced mathematics are laid.

To assist schools, districts, and States choose and implement effective curriculum, NSF and ED will:

- Support Make upgrading mathematics instruction through easy
 - purchase of appropriate new curriculum materials;
 - necessary professional development aimed at their implementation; and
 - employment of highly skilled mathematics specialists who are prepared to teach the new materials and guide others in their implementation

a key element of the focusing of Federal resources, particularly for middle schools with Title I school-wide programs.

- Develop and disseminate guides to help schools and school districts select curriculum materials and software most appropriate for their local needs and undertake the necessary steps to effective implementation. This effort will include reviews of curriculum materials and software designated by experts as promising or exemplary.
- Provide dedicated technical assistance for schools and school districts in implementing new mathematics instructional materials in grades 5-8. We will link sites dedicated to such materials with broader technical assistance providers, including the Eisenhower National Consortia.

- Continue to develop supplementary materials, with new priority for efforts aimed at mathematics in grades 5-8, to assist schools and districts in making the transition to standards-based comprehensive materials.
- Seed research and development of powerful models for integrating technology, including support for critical expansion and evaluation efforts preceding commercialization of these models. K-8 mathematics will be a high priority in the near term.

Other agencies also have activities that fit into this framework.

- Agencies will work in cooperation with NASA and NCTM to develop materials along the lines of NASA's "Mission Mathematics." These materials illustrate the use of mathematics in real world examples related to the agency mission.

Two additional interagency efforts are linked to this area. ED will chair a Federal Government-wide working group that will promote and develop -- and make it easier for teachers and others to find -- high-quality educational materials, including instructional units and related materials, for use on the Internet. ED, NSF, and the Department of Defense are leading an interagency review of Federal activities related to learning technologies. Each of these efforts could make new capabilities possible in the future.

Building public understanding of what challenging mathematics looks like in grades 5-8, and gaining public support for improving student achievement toward high standards.

Our vision is that all American students leave eighth grade prepared to pursue the higher-level mathematics and science courses that are the gateway to college, citizenship, productive employment, and lifelong learning. To make this vision a reality will require the intensive Federal agency focus on teaching and curriculum that we have described in the prior sections. Also essential is that educators, parents, and students themselves understand what high standards in mathematics look like and why they are important. This outcome requires activities and information that reinforce the classroom experience and convey the importance of mathematics achievement. Such activities might draw on the support of parents, the professional community of mathematicians, scientists, and engineers, business, and the broader public.

This section of the action strategy includes two complementary pieces. The first consists of efforts to make standards concrete. If you don't know where you are trying to go, it is hard to get there. This is true if you are driving a car, building a house, or running a small business. To succeed, you need a vision of what success looks like so you know how to work to achieve it. The same is true in education. If parents and students and teachers don't know where they should be headed -- what they agree students should know and be able to do -- it is hard to all pull together to get there.

The second piece builds on the first by creating a platform for partnerships that bring together the many groups that can contribute to the effort of helping students achieve high standards in mathematics. The partnerships will elevate the importance of mathematics achievement and provide clear avenues for interested members of the mathematics, science, business and education communities, as well as parents and interested citizens, to contribute to efforts to raise mathematics achievement. The Federal government will support the partnerships by promoting a national dialogue on improving mathematics, acting as a clearinghouse for information and proven approaches to action, working with various elements of the partnerships to develop exemplary

materials that partners can use in their State and local efforts, and mobilizing its own employees and resources to join in local partnership efforts.

In order to support these strategies, ED and NSF will:

- Convene a national convocation on middle school mathematics to initiate a continuing national dialogue on:
 - what we should expect our students to be able to achieve in mathematics by eighth grade and beyond;
 - exemplary practices in professional development, curricula, instructional materials, and technologies; and
 - opportunities for parental involvement and community support to help students meet high expectations.
- Seed the continuing national dialogue by providing a wide variety of sample items illustrating the level of standards, examples of student work, and information on curricula, instructional methods and technologies that support high standards.
- Make widely available materials on how teachers and other educators can use assessment in planning instructional improvement strategies. These materials will include information on how best to use student, school building, and district results from the national voluntary mathematics test in efforts to improve mathematics instruction.
- Create mathematics Websites providing information on the national test, including sample problems, examples of student solutions, and all the other materials developed pursuant to this action strategy. We will target individual Websites to particular audiences.

The planned partnerships would be focused at State and local levels, with the Federal Government providing a platform for some types of activities and of drawing in national organizations that would then work through State and local affiliates. Examples of partnership options that currently exist, might be expanded, or might be incorporated in newly forming partnerships at local, State, or national levels include:

- Institutions of higher education or Federal agencies partnering with local K-12 schools to provide support for teachers and administrators implementing reform activities;
- Professional societies in mathematics, science, and engineering providing guidance for their members on interacting with schools and teachers productively;
- Summer mathematics efforts that keep students growing mathematically, modeled after ED's successful summer reading effort;
- Public service information campaigns;
- Mathematics fitness circles or networks with weekly problems, discussions of how these problems illustrate the standards, and discussions of the importance of mathematics for future education and work;
- Support for students via telementoring by adults actively using mathematics in their work;

- After school and evening use of facilities (such as space or computers) of local businesses, academic institutions, local government, and community organizations for mathematics-oriented activities (the "moonlight math" equivalent of "midnight basketball").

Partnership activities should be aimed at drawing together the broad resources of the local community, engendering a community understanding of the importance of challenging mathematics standards for the children of the community, and providing support to the schools outside the direct confines of the school system. In addition, partnership activities can help address considerations of equity, particularly in the use of technology.

Take
out
this
phrase

DRAFT FROM WURTZEL-- June 11, 1997

**AN ACTION STRATEGY
FOR IMPROVING ACHIEVEMENT IN
MATHEMATICS AND SCIENCE**

Boxer - 5-20-97
Vagueness
better staff focus w.
Compare w/ comm. -
NSF/ed & comm. -
Teching study?
Maximizing E-rate.

On March 6, the President issued a memorandum (Appendix 1) directing the Secretary of Education and the Director of the National Science Foundation to form an interagency working group and develop, within 90 days, an action strategy for using Federal resources to assist States and local school systems to meet challenging mathematics standards in the eighth grade, and for involving the mathematics, scientific, and technical communities in support of those efforts.

The Presidential directive specified that the action strategy include recommendations for the use of Federal resources to help States, local school districts, and schools improve teaching, upgrade curriculum, integrate technology and high-quality instructional materials into the classroom, and motivate students to help them understand how mathematics concepts are applied in today's global workplace. It called for the interagency group to review the current status of improvements in mathematics education and identify and address critical issues of need, drawing on research and input from educators and professional organizations. In addition, it called for the working group to review how Federal resources and partnerships with other organizations can help improve student achievement in science.

One of the immediate inspirations for this exploration of means for achieving high standards in mathematics and science education in eighth grade is the Third International Mathematics and Science Study (TIMSS) taken by 41 nations, including 30,000 in the United States. Results released in the Fall of 1996 show lackluster performance by U.S. 8th graders, with scores significantly below the international average in mathematics. On the other hand, TIMSS data also show that our 4th graders do substantially better than the international average. This evidence clearly indicates the middle school years as an important focus in our nation's efforts to improve mathematics education.

Eighth grade is a critical point in mathematics education, as levels of achievement at that stage pave the way for students to take advanced courses in mathematics and science in high school that are keys to college entrance and well-paid jobs. The importance of this sequence of course taking can be seen by its impact on students going to college. Seventy-six percent of low-income students who took Algebra II went on to college compared to only 32% who did not. Seventy-nine percent of low-income students who took chemistry in high school went on to college, compared to 31% who did not. The President's proposed nationwide, voluntary test in mathematics, to be taken near the end of eighth grade, is aimed toward ensuring that all students can meet challenging mathematics standards at that point in their education.

Beyond indicating a need to focus emphasis on grades 4 through 8, TIMSS also provides a wealth

} source?

of data about the content and rigor of how and what we teach our students -- and important clues about ways to improve both. TIMSS researchers collected not only achievement data in each participating country, but also much information about teachers and teaching, about curricula and instructional materials, about classroom lessons and interactions, and about attitudes and habits outside the classroom. Thus, TIMSS results have become a source of constructive motivation for mounting an action strategy, taking the issue well beyond the simple comparison of scores in international test taking.

Response of the Department of Education and the National Science Foundation to the Presidential Directive

Pursuant to the memorandum from the President, ED and NSF promptly formed an interagency working group comprised of ED and NSF staff experienced in the areas under review. Officials of the White House Offices of Science and Technology Policy and Domestic Policy, as well as the Office of Management and Budget, provided oversight. (A listing of the members of the interagency group is attached as Appendix 2).

The interagency group immediately began a review of current Federal efforts in mathematics and science education -- primarily, consistent with the directive, in mathematics education at the kindergarten through eighth-grade level. (See Appendix 3 for a summary of relevant programs in ED and NSF.) In addition, consistent with the memorandum's instructions for the interagency group to draw on research and input from educators and professional organizations, the group reached out to the broader mathematics and educational community for advice and guidance. (See Appendix 4 for a summary of these outreach efforts, including a list of organizations with which the working group consulted.) The interagency group also consulted with appropriate staff in other agencies that have activities, or are interested in establishing activities, in elementary and secondary-level mathematics or science education. (See Appendix 5 for a list of the agencies consulted and a summary of their input.)

The Context for a National Action Plan on Excellence in Eighth-Grade Mathematics and, More Broadly, in Mathematics and Science Education

This action plan builds on the work already accomplished by, or underway in, cutting edge schools, school districts and states around the nation, in the math, science, and education communities, and in the Federal agencies. This action plan is guided by the belief that all children can succeed in education if we have high expectations and standards for them, better prepare teachers, and develop rigorous but engaging textbooks and software, and involved parents and the community in improving education and our schools. These principles undergird the Goals 2000: Educate America Act, Title I and other Department of Education programs and the Education programs of the National Science Foundation.

More specifically, the goal of this action plan is that all American students leave eighth grade prepared to pursue higher-level mathematics and science courses that are the gateway to college, citizenship, productive employment, and lifelong learning. Whether rich or poor, all of our

students deserve an education that will help them prepare for a successful future.

Reaching this goal will require:

- " High expectations, held by educators, parents, and students themselves, for student performance in mathematics;
- " Challenging standards for content, materials, teaching, assessment, and proficiency;
- " Teachers with the skills and knowledge of mathematics to effectively teach challenging mathematics; and
- " Activities outside the classroom that reinforce the classroom experience by drawing on the support of parents, the professional community of mathematicians, scientists, and engineers, business and the broader public.

While achievement of our national objectives in mathematics and science education will rely on each of these elements, progress in one area will often depend on and demand improvement in others. For instance, the introduction of high-quality instructional materials will have little impact if teachers are not trained to use those materials effectively. Effective instruction during the school day will have limited results if parents and the entire community do not support student achievement and let students know how important success in mathematics is to their future opportunities for college and careers. In short, K-12 education improvement based on high expectations with everyone working together toward those high standards should remain the guiding principle behind any new initiatives in the area of mathematics and science. We should be working on all fronts -- high standards, effective curriculum, technology in the classroom, teacher training and licensure, assessments, and support from parents and the public -- to make progress towards this critical goal.

Building on Strength

This action plan builds on the considerable efforts underway, both within and outside of the Federal Government, to improve elementary and secondary mathematics and science education. Some of these activities began almost a decade ago in schools, colleges and states. Taken together, they provide a solid foundation for new initiatives. Some of the most important current or completed activities include:

The National Council of Teachers of Mathematics (NCTM) introduced standards for mathematics curriculum and evaluation in 1989, followed by standards for teaching, and assessment in mathematics. States and communities have made these voluntary standards the basis of many of their efforts to improve mathematics education. (As is appropriate in any effort to raise standards, NCTM is now reviewing the mathematics curriculum and evaluation standards and plans to update them over the next few years.)

of states - 1
math
standards?

All States have adopted frameworks for mathematics curricula, guided largely by the NCTM standards and often supported by ED curriculum framework grants or NSF Statewide Systemic Initiative awards.

A new generation of rigorous mathematics curricula geared to the NCTM standards, with development funded largely by NSF, is beginning to appear in classrooms. By the fall of 1997, we project that these materials will account for 25 percent of all new textbooks purchased, and that figure should grow in succeeding years.

TIMSS and other new assessment and research provide substantial information about how and what we are teaching and point to critical factors for improving achievement in mathematics and science.

Approximately 65% of all schools are now connected to the Internet, providing the opportunity for communication on improving mathematics and science education and for the use of distance learning and advanced technologies. Federal support has helped to make this possible -- and the newly enacted "E-rate", which will substantially reduce the cost of internet connections for schools, will allow more schools to take advantage of this learning tool.

Many States, with support through the NSF systemic initiatives, Goals 2000, the reauthorized Elementary and Secondary Act, and other ED and NSF programs, have [what particular want to say here; States that were in the forefront of reforms are now beginning to enjoy the benefits in improved student outcomes. EVIDENCE?]

Parameters around the Strategy

Consistent with the thrust of the President's memorandum, our proposed plan of action focuses fundamentally on actions Federal agencies, along with other partners, can take to help students reach challenging mathematics standards and ensure that their resources will support State and local reforms effectively. Through its consultation and active review of current Federal programs, the working group has established three areas of critical need:

- o Preparing teachers, particularly those teaching grades 5-8, to teach challenging mathematics content in effective ways with high expectations for their students;
- o Implementing high-quality, rigorous mathematics curricula and instructional materials and technology in the classroom, particularly in grades 5-8;
- o Building public understanding of what challenging mathematics looks like and promoting effective partnerships that ~~increase awareness~~ and mobilize community support for achievement of challenging standards in mathematics.

Focusing Federal resources on addressing these areas is the core of the action plan described

below. However, the plan also recognizes the federal government's limited role in education -- which ~~properly~~ is a state and local responsibility. The federal government's role is to provide good information, effective tools, and financial support that will assist States and local communities -- students, parents, educators, business, and volunteers and concerned citizens from all walks of life -- ensuring that all of their students have the mathematical skills they need to succeed in our society.

Program Action Plan: Focus Federal resources that could be used to improve teaching and learning in K-8 mathematics on the two areas of critical need.

Some actions address both preparing teachers and implementing instructional materials and technology.

Through its major programs supporting teaching and learning in the elementary and middle school years, particularly the Eisenhower Professional Development, Title I, and Goals 2000 programs, the Department will promote the importance of focusing on improving K-8, and particularly 5-8, mathematics education, will provide examples of how these programs can be used in states and communities to support coherent, rigorous efforts to improve mathematics teaching and learning, will work actively with states and school districts on identifying actions, including the granting of waivers, that can be taken to achieve significant movement in this direction.

In its education programs, the National Science Foundation will give high priority to supporting coordinated, coherent strategies for improving K-8, and particularly 5-8, mathematics education and, through its competitive awards, will provide incentives for effective, targeted use of Title I and Eisenhower for efforts to improve mathematics education.

To support effective state and local efforts to coordinate available resources and strategies in order to increase students mathematics achievement, ED and NSF will call a national conference of state and local leaders of Eisenhower, Title I, Goals 2000, state systemic initiatives and other key actors to set the stage for focused, coordinated efforts to improve [K-8] mathematics education.

Preparing K-8, and particularly grades 5-8, teachers to teach challenging mathematics content in effective ways with high expectations for their students.

The vast majority of teachers who teach mathematics to students in grades K-8 did not major in mathematics when they were in college. In the course of their undergraduate teacher preparation programs, the average teacher takes only 3 courses in mathematics. Yet, particularly in grades 4 to 8 as students should begin to move from mastering arithmetic to using arithmetic in complex problems and learning the foundations of geometry, algebra, probability and statistics, teachers are required to know substantial mathematics.

Over the next ten years, approximately 2 million teachers will enter the workforce, of which about xx are likely to teach mathematics to students in grades K-8. It is essential that these new

teachers receive adequate preparation in mathematics before they enter the classroom.

Activities in this area of critical need will address both in-service teacher professional development and pre-service teacher preparation. In the in-service area, the focus will be on intensive professional development activities infused with standards-based content that will make a difference in the classroom. Links to high-quality instructional materials and appropriate incorporation of technology will be encouraged. Pre-service teacher preparation activities will aim at preparing K-8 teachers to teach challenging mathematics content in line with NCTM standards. A high priority will be placed on preparing teachers who can learn and adapt to the new learning environments that the appropriate use of new technology will stimulate.

Federal action/role
vague
here

The coherent, coordinated use of funding from ED programs envisioned above should make significant new resources available for K-8 teacher professional development in mathematics. NSF incentives (e.g., planning grants to create coherent, coordinated programs of K-8 teacher professional development in mathematics making use of ED, state and local funds to jump-start the effort, and systemic efforts that explicitly leverage such sources of funds) should help diffuse mathematics education reform activities across the country.

The increased demand for high-quality, standards-based professional development of in-service teachers and preservice teacher preparation in mathematics stimulated by the new resources described above could, without action now, exceed the capacity of those organizations supplying it. NSF will work with the mathematics communities, institutions of higher education, and other agencies to ensure the capacity to respond effectively, providing training opportunities for those who will be leaders in teacher professional development and preparation.

ED and NSF will support the creation of sets of professional development and teacher preparation tools for K-8 mathematics, tied to new curricula and instructional materials and technologies, where appropriate.

NSF will seed additional activities aimed at preparation of K-8 teachers that reflect the mathematics they will need to teach in the standards-oriented schools of the future.

ED will work with State education agencies on issues of state licensure and mathematics requirements for K-8 teachers.

vague

NSF and ED will make the improvement of K-8 mathematics education a focus of greater interaction and cooperation among institutions of higher education and K-12 schools through partnerships for teacher education and professional development. Smoothing the transition from student to active teacher with a planned program of professional development and creating networks of teachers and faculty could be key components of interaction and cooperation.

Implementing high-quality, standards-based, K-8 mathematics curricula and instructional materials and technology in the classroom.

New, comprehensive mathematics curricular and instructional materials linked with high standards

for content and pedagogy are now emerging from development and reaching the market. These materials need to get to the classroom. New and existing supplementary materials that permit teachers to tailor instruction to particular classrooms, take advantage of new and emerging learning technologies, and facilitate a transition to these high quality, comprehensive materials are essential throughout K-12, but especially in K-8 where the foundations for further study of mathematics are laid.

ED and NSF will develop and disseminate reviews of new curricula and materials designated as promising or exemplary by an expert panel and ^{tools for use in selection of materials for classroom use} Similar reviews and guidance for software tools for K-8 mathematics will follow.

NSF will add one or two ^{local} sites for assistance in implementation of K-8 mathematics instructional materials. These sites will connect with ED technical assistance mechanisms to assure the broadest possible access to implementation assistance.

ED will encourage schools with Title I school-wide programs to ^{use federal funds to} purchase ^{high quality} new materials, ^{where possible} where needed, to obtain concomitant professional development aimed at their implementation using their Title I funds, and to ^{grow or} employ highly-skilled mathematics specialists who are prepared to teach the new materials and guide others in their implementation of new materials.

NSF will continue to develop ^{high quality} exemplary supplementary materials, with new priority for K-8 mathematics, to assist schools and districts in making the transition to exemplary comprehensive materials.

Other agencies will work in cooperation with NASA and NCTM to develop materials such as NASA's "Mission Mathematics." These materials illustrate the use of mathematics in real world examples related to the agency mission.

NSF will continue to ^{standards-based} ^{into what?} seed research and development of ^{powerful} models for integrating technology, including support for critical ~~scale-up~~ testing and evaluation steps preceding commercialization of these models. K-8 mathematics will be a high priority in the near term.

ED and NSF will play lead roles in a review of Federal support for learning technology research and development. ED will lead activities related to a Presidential Directive that agencies make high-quality education materials and lesson plans available on the Internet. All agencies will participate. In both efforts, particular attention will be addressed to use of learning technologies in K-8 mathematics.

Information Action Plan: Serve as an information resource for those making decisions with respect to improving mathematics and science education, with particular attention to K-8 mathematics.

ED and NSF support state and local education entities and support education reform in ways other than providing direct or indirect financial support. Developing and disseminating information on standards, what works in their implementation, and how to obtain assistance in making decisions about the future is an important component of an action strategy to improve mathematics and science education. Some aspects of the agencies' information function are described in the Program Action Plan above. Other aspects include:

Information on 4th grade TIMSS results and comparison with 8th grade TIMSS results and their implications for action. The primary audience for such information is teachers, principals, superintendents, etc. -- those with influence in the decision process. ED and NSF will continue their collaboration in bringing TIMSS results to the forefront of attention.

Information on use of assessment in planning instructional improvement strategies. ED will focus on information related to the President's proposed nation-wide test, while NSF activities will focus on assessment more broadly. The primary audience is teachers and principals.) ?

Some about -
Regional labs,
Ike consultant
Jury house, Nat'l Lab
ask
4/10, web site
SSI's / OSI's

What is the
action?

94 pmd - (all my math)
ED will create mathematics website(s) providing information on the national test, including sample problems and worked solutions. This will include feedback on pretesting and testing once that begins. Websites may be tailored to serve particular audiences, including parents, students, teachers, principals and superintendents, mathematics educators, etc.

in the spring of 1999.
why do separate sites?

Partnership Action Plan: Provide a venue for the formation of effective partnerships that increase awareness and mobilize community support for achievement of challenging standards in mathematics.

In the United States, decisions about K-12 education are made at the state and local level, with the Federal government providing support for making and assistance in implementation of decisions. In order to increase awareness and mobilize community support for the achievement of challenging standards in mathematics in the eighth grade, ED, NSF and other Federal agencies will provide a vision for partnership that brings together the many groups that could contribute to the effort and an arena in which such partnerships can develop fruitfully. In addition, ED, NSF and other Federal agencies will help to develop the core materials that provide substance around which state and local partnerships can coalesce.

NSF and ED will convene a national convocation on middle school mathematics to initiate a 3-year national dialogue involving all stakeholders on standards, professional development, curricula, instructional materials and technologies, and expectations for students at the completion of eighth grade. Regional meetings and meetings of groups with more focused interests will keep the dialogue moving, and a final convocation will address progress in improving achievement in eighth grade mathematics.

how compare to other
conferences?
✓

The NCTM standards provide core information on what students need to know by the end of eighth grade. ED and NSF will provide a stream of information in support of a national dialogue on what to expect in terms of

student work at various grade levels and how changes in curricula and instructional methods and technologies support the standards. ED will also provide information on how the proposed national test in mathematics addresses these issues.

NSF will work with academic mathematicians, scientists and engineers and with institutions of higher education (and with their professional societies and other non-governmental organizations) to articulate their roles in state and local partnerships.

NSF will give high priority to partnership efforts that work toward improving K-8 mathematics achievement in its informal education activities.

ED, NSF and other agencies will use program budgets and/or existing staff to develop substantive materials for use in partnership efforts aimed at activities outside the classroom. See the set of possible partnership activities below for examples.

Examples of partnership options that currently exist, might be expanded, or might be incorporated in newly forming partnerships at local, state, or national levels include:

- Institutions of higher education or Federal agencies partnering with local K-12 schools to provide support for teachers and administrators implementing reform activities;
- Professional societies in mathematics, science, and engineering providing guidance for their members on interacting with schools and teachers productively;
- Summer mathematics efforts that keep students growing mathematically, building on ED's successful summer reading effort;
- Public service information campaigns;

- Mathematics fitness circles or networks with weekly problems, discussions of how they illustrate the standards, and discussions of the importance of mathematics for future education and work options;
- Support for students via telementoring by adults actively using mathematics in their work;
- After school and evening use of facilities (including computers, etc.) of local businesses, academic institutions, local government, and community organizations for mathematics-oriented activities (~~the "moonlight math" equivalent of "midnight basketball"~~).

DOE labs
teachers/
principals.

Partnership activities should be aimed at drawing together the broad resources of the local community, engendering a community understanding of the importance of challenging mathematics standards for the children of the community, and providing support to the schools outside the direct confines of the school system. In addition, partnership activities can help address considerations of equity, particularly in the use of technology.

Accountability and Continuing Research

The Program Action Plan recommends focusing a portion of ED's existing Eisenhower, Title I, and Goals 2000 monies on the systemic elements of K-8 mathematics education. By coupling waivers, which ED can grant, to Systemic Initiatives (SIs) and Local Systemic Change (LSC) through Teacher Enhancement projects, which NSF oversees, an accountability mechanism for a national sample of sites (NN districts and NN schools) is created. The interagency partnership would enable monitoring of the changes prescribed above through NSF's regimen of annual reporting and data submission, as specified in the

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? ? ?

cooperative agreements with the SIs and in the ongoing cross-project evaluations of the LSCs. (The SIs and LSCs already report on how (and how much) they are using Title I and Eisenhower funds to support teaching and learning reforms. The Program Action Plan would unite NSF and ED in the expectation that funds flowing into districts, schools, and classrooms would be used strategically to support high standards.)

This interagency partnership also provides a research opportunity for studying systemic reform of K-8 mathematics. Those districts and schools, by dint of their participation as SI or LSC sites, define a sample of teachers and students whose experiences and performance can be measured and compared to other districts and schools that receive ED categorical monies, but not NSF grants. Systematic national evidence that waivers plus oversight (flexibility with accountability) make a difference in changing classroom practice and improving student achievement will only come from careful research and evaluation of these sites.

Appendix 4: Federal Agency Activities That Support K-8

Mathematics Education

The Department of Education (ED) and the National Science Foundation (NSF) have principal responsibility, among the Federal agencies, for K-12 education and for science and mathematics, respectively. However, a dozen other agencies sponsor activities that relate to, and could support, standards-based teaching that improves students', mathematics and science learning and overall academic performance.

The Working Group met with a dozen designated agency representatives (including the Departments of Agriculture, Commerce, Energy, Interior, and Veterans Affairs, EPA, NASA, NIH, and the Smithsonian ☺) to discuss relevant programs and activities sponsored by their agencies. In general, the agencies focus far more on science than mathematics, and commit modest resources to K-12 education. Most offer staff and facilities, often on a volunteer basis, to support local schools and teachers. And ^{all} have developed and are sharing supplementary instructional materials on their Web sites.

Some examples of works-in-progress can be cited. The Department of Energy, NIH, and USDA are conducting an inventory of their activities and trying to identify impacts and opportunities to expand. Among ideas that warrant further consideration are virtual teacher training based at DOE's Lawrence Berkeley Lab in partnership with the University of California system; USDA's 4-H Clubs as an after-school, weekend, and summer vehicle for promoting math skills; EPA's use of the trainer-of-trainer model for teacher development in environmental education; and NIH's middle-school curriculum supplements to be developed in conjunction with three Institutes. In virtually all cases,

materials based on agency missions could be designed with mathematics in mind.

vigorous
engaging

standards - same

(or lead to
NCTM
standards)

Two agencies not listed above represent contrasting approaches to introducing rigorous national standards in their education activities. Unique among the agencies are the Department of Defense Dependents' Schools, which run as essentially autonomous school systems overseas and on military bases in the U.S. They certify teachers and develop leader-teachers, tutors, and mentors who, like the DODDS math curriculum used world-wide (K-8 and 9-12), embrace the NCTM standards. ~~The rest of DOD supports technology applications with an emphasis on training, except for the National Security Agency, which established a Mathematics Education Partnership Program in 1991 (that includes NSF and the University Corporation for Atmospheric Research) and is described~~

at www.nsa.gov:8080/programs/mepp.

The Department of Transportation is a relative newcomer, among the Federal agencies, to education. Many students are not prepared for the transportation field because they see no connection between subjects such as math and science and attainable career possibilities. Through the new Garrett A. Morgan Technology and Transportation Futures Program, DOT will undertake a series of public-private partnerships dedicated to mathematics, science, and technology literacy (K-12). Activities will include helping educators integrate

transportation components into the curriculum for each grade level; encouraging the transportation community (in collaboration with ED) to participate in the America Goes Back To School program with a focus on for math, science, and technology achievement; building upon DOT's 300+ adopted

schools to provide mentors, tutors, career information, and other forms of support for math literacy; bringing together curriculum development specialists and private sector sponsors to develop "math kits" analogous to the reading kits currently distributed to schools throughout the U.S.; expanding the availability of curriculum enrichment programs that engage students in solving real world problems with a transportation focus, such as magnetic levitation trains; and contributing expertise and/or equipment to help America's schools get on-line, by participating in "Net Days."

may be too
detail.
could be good as
a box - how to
generate

In all, little investment by the agencies in formal evaluation of the quality and adaptability of methods or products appears to have been made. Until better documentation exists, recommending replication or adaptation of agency programs is probably premature. We must learn quicker, yet more systematically, about approaches and innovations that support students and teachers of mathematics both in and outside of schools.

Agency investment in
such area over last 10 years

Discussion DRAFT

5/21/97

12

have a strong interest
in developing a national
competitiveness program of
children. However
the agency should invest
in a variety of methods
to insure effectiveness.



William R. Kincaid
05/15/97 11:32:45 PM

Peckin -
Edwin S. Ball
William R. Kincaid
Math-sci/ action study

Record Type: Record

To: jsunley @ nsg.gov @ inet, Thomas_Corwin @ ed.gov @ inet, Judy_Wurtzel @ ed.gov @ inet, Daryl E. Chubin/OSTP/EOP

cc:

Subject: comments on draft

We all owe thanks to Judy, Tom, Judy, Daryl and others who put all of this down on paper. This was obviously a ton of work, but it was critical to do in order to get the feedback that's needed and move towards a final product..

I think everyone is agreed that the writing is going to need a lot of revising. For example, we need to take a much different approach on the introduction, one that focuses much more on the need for this kind of strategy, featuring a large focus on the 8th grade TIMSS results and building the case from there. And clearly, once some options are selected, they will need to be presented in a much different format, with some boxed examples of successful approaches. But this format is helpful in listing out what some of the possibilities are, and I will limit my comments to the options that have been supplied, tentative recommendations made, and some omissions that I think should be reconsidered.

Here are my (fairly extensive) thoughts. Depending on feedback from others, I would try to do one more revision before really trying to get the Mikes, Luther, et al to focus on this:

Objective 1:

I would pull the discussion of current activities out, maybe earlier in the document, and move straight into the options.

1.1.1. This could be more specific. Who should take the lead on development? Not clear why the additional \$10 million is needed for this. I would pull the dissemination piece into the recommendation. This could be fairly solid.

1.1.2.a I think this needs to be beefed up, perhaps with reference to ED's principles of effectiveness. This is one that should be done anyway. Overall, need to focus more on strengthening some of the no-cost options. This is not mutually exclusive with other recs here.

1.1.2.b I'm a little confused about how this differs from 1.1.c. My sense is that this could be a proposal for separate competitive ~~bonus pools in~~ Ike and NSF programs that would be used to reward p.d. efforts with an especially strong focus on standards-based K-8 math instruction, and

used to leverage higher quality within the base-funded activities. The key difference from 1.1.2.c would be that the bonus pools would be operated separately, rather than as a joint ED-NSF enterprise. If that is what is meant, it is probably more apropos to provide this type of incentive solely on the Eisenhower program, because of its formula funding nature.

1.12.c I don't think this description gives a very good sense of how a joint pool of funds could help get maximum impact from the existing programs. Part of the idea was to entice schools/districts to use their Eisenhower and state-provided p.d. funds to invest in higher-caliber p.d. activities. Not sure that comes through here.

Action 1.1.3 Not sure what is meant here. What does it mean to develop a leadership cadre? Who are these folks? Teachers?

1.1.3.a -- I would leave off the ■no-action■ option. Nobody has to pick any of the options offered here.

1.1.3.c -- Not clear what it means to expand opportunities for science and eng professionals.

1.1.3.d -- Should start by encouraging rapid completion of all math certifications within National Board Certification, especially middle school grades; if these have not been completed, they (along with reading-related ones) should be made top priority for producing master teachers. Also should recommend fully funding President's proposal for 100,000 master teachers, noting that many of those will be math teachers. As written, not clear what this means or why an additional \$10 M is needed.

Don't really understand the rationale on this recommendation, although b and d seem like the more likely options of those listed.

Action 1.2.1

1.2.1.e.-- This needs to be better explained.

Overall, these are in fairly good shape.

Action 1.2.2

This seems like a sound idea.

As with NTSB, INTASC should be urged to rapidly complete work with respect to teachers of math and math teaching.

Action 1.3.1

1.3.1.a. -- This is pretty vague. How would this be done? If there isn't more to it, leave it out.

What's not here?:

Idea of a national conference of Title I coordinators, math supervisors, SSI's and Eisenhower State coordinators to review TIMSS findings and best practices on math education.

Idea of using framework of the national tests to develop a nationwide network of teachers committed to improving math instruction--say, a serious of sponsored listservs. This could be an extension of the math circles idea in Objective 4.

No reference to Dept of Energy initiatives.

Objective 2

Action 2.1.1.

We will need to break out and make much more of these products that are already being planned:

- TIMSS toolkit
- Promising and exemplary materials review
- Guide to selecting exemplary materials

And be more specific about dissemination strategy.

Action 2.1.3

2.1.3.c. I would frame as ■ President should challenge publishers to... ■

Action 2.2.1

These all seem a little vague to me, and so it isn't clear why 2.2.1.c is recommended. Not clear why ED needs more resources to do this--it sort of seems like what the Eisenhower consortia are supposed to be doing already.

Action 2.2.3 How?

Action 2.3.1.b -- Need to better explain what the mission mathematics materials do -- explicitly relating mission and research of NASA to specific NCTM standards and related instructional strategies. Overall, the draft needs to more strongly emphasize the inter-agency aspect of this strategy, and building this piece up would be a good place to start; should focus on materials for K-8 math.

Note: We need to ask NASA not to roll out its new middle school product in advance of

roll-out of action strategy. Who should be responsible for this?

Objective 3

Action 3.1.1. In addition to encouraging agencies to focus on K-8 math related materials first, ED should work with other agencies to become familiar with NCTM standards and relate their products to those standards and preparing kids for the national tests.

Action 3.2.1 needs more explanation.

Action 3.2.2 This needs to be sharpened or dropped.

Action 3.4.1 This seems to be getting pretty far from the heart of improving math achievement.

What's not here?

What about the National Library of Education web-site for high-quality instructional units?

Objective 4

2. PSA Campaign

Need to grapple with NCTM's apparent plans to do something in this area and figure out how can make complementary.

3. This needs more thinking and focusing, but there is something to the idea of using a regular series of intriguing math problems to draw the public into regular conversations about math and math education. Not sure whether I like the ■fitness■ angle or not, though I see the connection with the Olympiad. Math circles focus on preparing for the national test may make sense as well. May want to separately develop some of the ideas here and not try to shoehorn them all together under the ■fitness■ banner. Maybe this is because I have never been impressed with the President's Physical Fitness or the Presidential Academic Fitness efforts.

4. This is important, but too vague. Should break out and build up a telementoring initiative.

5. This, too, is important but too vague. For example, there could be a concerted effort involving the Department of Commerce/NIST, SBA and the national School to Work office (or others). Does this mean internships, weekend or after-school experiences, or something else?

What's not here?

Inter-agency network, say within the partnership, to provide ongoing training and help insure that agency educational activities are as focused on standards as possible.

No reference to Dept. Of Transportation initiatives. 7

AN ACTION STRATEGY FOR IMPROVING ACHIEVEMENT IN MATHEMATICS AND SCIENCE

On March 6, the President issued a memorandum (Appendix 1) directing the Secretary of Education and the Director of the National Science Foundation to form an interagency working group and develop, within 90 days, an action strategy for using Federal resources to assist States and local school systems to meet challenging mathematics standards in the eighth grade, and for involving the mathematics, scientific, and technical communities in support of those efforts.

The Presidential directive specified that the action strategy include recommendations for the use of Federal resources to help States, local school districts, and schools improve teaching, upgrade curriculum, integrate technology and high-quality instructional materials into the classroom, and motivate students to help them understand how mathematics concepts are applied in today's global workplace. It called for the interagency group to review the current status of improvements in mathematics education and identify and address critical issues of need, drawing on research and input from educators and professional organizations. In addition, it called for the working group to review how Federal resources and partnerships with other organizations can help improve student achievement in science.

One of the immediate inspirations for this exploration of means for achieving high standards in mathematics and science education in eighth grade is the Third International Mathematics and Science Study (TIMSS). Results released in the Fall of 1996 show lackluster performance by U.S. 8th graders, with scores significantly below the international average in mathematics. On the other hand, TIMSS data also show that our 4th graders do substantially better than the international average. This clearly indicates the middle school years as a target of opportunity for improving mathematics education.

Eighth grade is a critical point in mathematics education, as levels of achievement at that stage pave the way for the advanced courses in mathematics and science that are keys to college entrance and well-paid jobs. The President's proposed nationwide, voluntary examination in mathematics, to be taken near the end of eighth grade, is aimed toward ensuring that all students can meet challenging mathematics standards at that point in their education.

Beyond indicating a need to focus emphasis on the middle school grades (4-8), TIMSS also provides clues about how to go about the process of improving. This is because researchers not only collected achievement data in each participating country, but also much information about teachers and teaching, about curricula and instructional materials, about classroom lessons and interactions, and about attitudes and habits outside the classroom. Thus, TIMSS results have become a source of constructive motivation for mounting an action strategy, taking the issue well beyond the simple comparison of scores in international test taking.

Response of the Department of Education and the National Science Foundation to the Presidential Directive

Pursuant to the memorandum from the President, ED and NSF promptly formed an interagency working group comprised of ED and NSF staff experienced in the areas under review (mathematics, professional development, curriculum, educational technology, and student motivation and public outreach). Officials of the White House Offices of Science and Technology Policy and Domestic Policy, as well as the Office of Management and Budget, provided oversight. (A listing of the members of the interagency group is attached as Appendix 2).

The interagency group immediately began a review of current Federal efforts in mathematics and science education -- primarily, consistent with the directive, in mathematics education at the kindergarten through eighth-grade level. (See Appendix 3 for a summary of relevant programs in ED and NSF.) In addition, consistent with the memorandum's instructions for the interagency group to draw on research and input from educators and professional organizations, the group reached out to the broader mathematics and educational community for advice and guidance. (See Appendix 4 for a summary of these outreach efforts, including a list of organizations with which the working group consulted.) The interagency group also consulted with appropriate staff in other agencies that have activities, or are interested in establishing activities, in elementary and secondary-level mathematics or science education. (See Appendix 5 for a list of the agencies consulted and a summary of their input.)

The Context for a New Federal Action Plan on Excellence in Eighth-Grade Mathematics and, More Broadly, in Mathematics and Science Education

The interagency group believes that any new action plan must build on the work already accomplished by, or underway in, the Federal agencies and in the broader math, science, and education communities. It must also be guided by a vision that all children can succeed in education, the same vision that undergirds Goals 2000, Title I, and other ED programs and the education programs of NSF. More specifically, the group has adopted the following vision statement as the template for its efforts:

All American students will leave eighth grade prepared to pursue higher-level mathematics and science courses that are the gateway to college, citizenship, productive employment, and lifelong learning.

To realize this vision, we must ensure that all students have access to high-quality, standards-based learning environments that permit them to demonstrate what they know and are learning in mathematics. This type of learning involvement must include:

- " **High expectations**, held by educators, parents, and students themselves, for student performance;
- " **Challenging standards**, for content, materials, teaching, assessment, and proficiency;
- " **Classrooms** where teachers have content background appropriate to the level of instruction, can effectively employ standards-based curricula and instructional materials, and can integrate technology into instruction; and

- " **Activities outside the classroom** that reinforce the classroom experience by drawing on the support of parents, the professional community of mathematicians, scientists, and engineers, and the broader public.

While achievement of our national objectives in mathematics and science education will rely on each of these elements, progress in one area will often depend on and demand improvement in others. For instance, the introduction of high-quality instructional materials will have little impact if teachers are not trained to use those materials effectively. Effective instruction during the school day will have limited results if parents do not have high expectations for their children and are not committed participants in the process of education reform. In short, systemic K-12 education reform should remain the guiding principle behind any new initiatives in the area of mathematics and science. All elements of the educational process -- standards, curriculum and technologies, professional development and licensure, assessments, funding for the system, and support from parents and the public -- must be aligned around the critical reforms.

Building on Strength

A new Federal action plan should build on the considerable efforts underway, both within and outside of the Federal Government, to reform and improve elementary and secondary mathematics and science education. Some of these activities began almost a decade ago. Taken together, they provide a solid foundation for new initiatives. Some of the most important current or completed activities include the following:

- The National Council of Teachers of Mathematics (NCTM) introduced standards for mathematics curriculum and evaluation in 1989, followed by standards for teaching, and assessment in mathematics. These have provided strong guidance to States and localities in their efforts to improve mathematics education and have shown the way for the development of education standards in other content areas. (As is appropriate in any standards-based process, NCTM is now reviewing the mathematics curriculum and evaluation standards and plans to update them over the next few years.)
- All States have adopted frameworks for mathematics curricula, guided largely by the NCTM standards and often supported by ED curriculum framework grants or NSF Statewide Systemic Initiative awards.
- A new generation of standards-based mathematics curricula, with development funded largely by NSF, is beginning to appear in classrooms. By the fall of 1997, we project that these materials will account for 25 percent of all curriculum adoptions, and that figure should grow in succeeding years.
- TIMSS and other new assessment and research tools provide means of identifying and acting upon critical factors for improving achievement in mathematics and science.
- With funding from ED, NSF, and other public and private resources, approximately 65% of all schools are now connected to the Internet, providing the opportunity for communication on improving mathematics and science education and for the use of distance learning and advanced technologies in the delivery of instruction.

- The Federal Government, through the NSF systemic initiatives, Goals 2000, the reauthorized Elementary and Secondary Act, and other ED and NSF programs, has provided States with opportunities to undertake comprehensive systemic reforms. States that were in the forefront of reforms are now beginning to enjoy the benefits in improved student outcomes.

Parameters around the Strategy

Consistent with the thrust of the President's memorandum, our proposed plan of action focuses fundamentally on actions Federal agencies, along with other partners, can take to help students reach challenging mathematics standards and assure that their resources will support State and local reforms effectively. Through its consultation and active review of current Federal programs, the working group has established two areas of critical need:

- Preparing K-8 teachers to teach challenging mathematics content in effective ways with high expectations for their students.
- Implementing high-quality, standards-based, K-8 mathematics curricula and instructional materials and technology in the classroom

Focusing Federal resources on addressing these areas is the core of the program action plan described below. In addition to this program action plan, the working group also recognizes the importance of providing information and providing a venue for the formation of partnerships. Action plans for these areas are also described below.

An Action Strategy for Effective Use of Federal Resources in Improving Achievement in Mathematics and Science Education

The Action Strategy consists of three pieces: a program action plan, an information action plan, and a partnership action plan. The program action plan is focused on the use of Federal programmatic resources for mathematics and science education. It is aimed at change in the classroom that incorporates high expectations for students and high standards for achievement. The information action plan is designed to ensure that those making decisions with respect to improving mathematics and science education at the state and local level have a strong information base from which to make them. The partnerships action plan recognizes the role that national organizations and the Federal government can play in stimulating effective partnerships at the state and local level.

Program Action Plan: Focus Federal resources that could be used to improve teaching and learning in K-8 mathematics on the two areas of critical need.

Some actions address both preparing teachers and implementing instructional materials and technology.

- ED will make clear to recipients of ED Eisenhower, Title I, and Goals 2000 funds that coherent, coordinated approaches to the critical areas of need for improvement of K-8 mathematics education are a very high priority, that requests for waivers to accommodate such approaches will be considered positively, and that the Department will actively seek to work with states on other actions that can be taken to achieve significant movement in this direction.
- NSF will make coordinated, coherent approaches to the critical areas of need for improvement of K-8 mathematics education a high priority of its programming and provide incentives for effective use of ED formula funds in conjunction with NSF competitive awards.
- Other agencies will enhance teacher professional development and instructional materials development activities, tying them to NCTM standards and emphasizing K-8 mathematics, where appropriate.
- ED and NSF will arrange a meeting for agency personnel and state and local leaders of ED's Eisenhower, Title I, and Goals 2000 activities and NSF's systemic initiatives to set the stage for implementation of the elements above.

Preparing K-8 teachers to teach challenging mathematics content in effective ways with high expectations for their students.

Activities in this area of critical need will address both in-service teacher professional development and pre-service teacher preparation. In the in-service area, the focus will be on intensive professional development activities infused with standards-based content that will make a difference in the classroom. Links to high-quality instructional materials and appropriate incorporation of technology will be encouraged. Pre-service teacher preparation activities will aim at preparing K-8 teachers to teach challenging mathematics

content in line with NCTM standards. A high priority will be placed on preparing teachers who can learn and adapt to the new learning environments that the appropriate use of new technology will stimulate.

- The coherent, coordinated use of funding from ED programs envisioned above should make significant new resources available for K-8 teacher professional development in mathematics. NSF incentives (e.g., planning grants to create coherent, coordinated programs of K-8 teacher professional development in mathematics making use of ED, state and local funds to jump-start the effort, and systemic efforts that explicitly leverage such sources of funds) should help diffuse mathematics education reform activities across the country.
- The increased demand for high-quality, standards-based professional development of in-service teachers and preservice teacher preparation in mathematics stimulated by the new resources described above could, without action now, exceed the capacity of those organizations supplying it. NSF will work with the mathematics communities, institutions of higher education, and other agencies to ensure the capacity to respond effectively, providing training opportunities for those who will be leaders in teacher professional development and preparation.
- ED and NSF will support the creation of sets of professional development and teacher preparation tools for K-8 mathematics, tied to new curricula and instructional materials and technologies, where appropriate.
- NSF will seed additional activities aimed at preparation of K-8 teachers that reflect the mathematics they will need to teach in the standards-oriented schools of the future.
- ED will work with State education agencies on issues of state licensure and mathematics requirements for K-8 teachers.
- NSF and ED will make the improvement of K-8 mathematics education a focus of greater interaction and cooperation among institutions of higher education and K-12 schools through partnerships for teacher education and professional development. Smoothing the transition from student to active teacher with a planned program of professional development and creating networks of teachers and faculty could be key components of interaction and cooperation.

Implementing high-quality, standards-based, K-8 mathematics curricula and instructional materials and technology in the classroom.

New, comprehensive mathematics curricular and instructional materials linked with high standards for content and pedagogy are now emerging from development and reaching the market. These materials need to get to the classroom. New and existing supplementary materials that permit teachers to tailor instruction to particular classrooms, take advantage of new and emerging learning technologies, and facilitate a transition to these high quality, comprehensive materials are essential throughout K-12, but especially in K-8 where the foundations for further study of mathematics are laid.

- ED and NSF will develop and disseminate reviews of new curricula and materials designated as promising or exemplary by an expert panel and tools for use in selection of materials for classroom use. Similar reviews and guidance for software tools for K-8 mathematics will follow.
- NSF will add one or two sites for assistance in implementation of K-8 mathematics instructional materials. These sites will connect with ED technical assistance mechanisms to assure the broadest possible access to implementation assistance.
- ED will encourage schools with Title I school-wide programs to purchase new materials, where needed, to obtain concomitant professional development aimed at their implementation using their Title I funds, and to employ highly-skilled mathematics specialists who are prepared to teach the new materials and guide others in their implementation of new materials.
- NSF will continue to develop exemplary supplementary materials, with new priority for K-8 mathematics, to assist schools and districts in making the transition to exemplary comprehensive materials..
- Other agencies will work in cooperation with NASA and NCTM to develop materials such as NASA's "Mission Mathematics." These materials illustrate the use of mathematics in real world examples related to the agency mission.
- NSF will continue to seed research and development of powerful models for integrating technology, including support for critical scale-up testing and evaluation steps preceding commercialization of these models. K-8 mathematics will be a high priority in the near term.
- ED and NSF will play lead roles in a review of Federal support for learning technology research and development. ED will lead activities related to a Presidential Directive that agencies make high-quality education materials and lesson plans available on the Internet. All agencies will participate. In both efforts, particular attention will be addressed to use of learning technologies in K-8 mathematics.

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Information Action Plan: Serve as an information resource for those making decisions with respect to improving mathematics and science education, with particular attention to K-8 mathematics.

ED and NSF support state and local education entities and support education reform in ways other than providing direct or indirect financial support. Developing and disseminating information on standards, what works in their implementation, and how to obtain assistance in making decisions about the future is an important component of an action strategy to improve mathematics and science education. Some aspects of the agencies' information function are described in the Program Action Plan above. Other aspects include:

- Information on 4th grade TIMSS results and comparison with 8th grade TIMSS results and their implications for action. The primary audience for such information is teachers, principals, superintendents, etc. -- those with influence in the decision process. ED and NSF will continue their collaboration in bringing TIMSS results to the forefront of attention.
- Information on use of assessment in planning instructional improvement strategies. ED will focus on information related to the President's proposed nation-wide test, while NSF activities will focus on assessment more broadly. The primary audience is teachers and principals.
- ED will create mathematics website(s) providing information on the national test, including sample problems and worked solutions. This will include feedback on pretesting and testing once that begins. Websites may be tailored to serve particular audiences, including parents, students, teachers, principals and superintendents, mathematics educators, etc.

Partnership Action Plan: Provide a venue for the formation of effective partnerships that increase awareness and mobilize community support for achievement of challenging standards in mathematics.

In the United States, decisions about K-12 education are made at the state and local level, with the Federal government providing support for making and assistance in implementation of decisions. In order to increase awareness and mobilize community support for the achievement of challenging standards in mathematics in the eighth grade, ED, NSF and other Federal agencies will provide a vision for partnership that brings together the many groups that could contribute to the effort and an arena in which such partnerships can develop fruitfully. In addition, ED, NSF and other Federal agencies will help to develop the core materials that provide substance around which state and local partnerships can coalesce.

- NSF and ED will convene a national convocation on middle school mathematics to initiate a 3-year national dialogue involving all stakeholders on standards, professional development, curricula, instructional materials and technologies, and expectations for students at the completion of eighth grade. Regional meetings and meetings of groups with more focused interests will keep the dialogue moving, and a final convocation will address progress in improving achievement in eighth grade mathematics.
- The NCTM standards provide core information on what students need to know by the end of eighth grade. ED and NSF will provide a stream of information in support of a national dialogue on what to expect in terms of student work at various grade levels and how changes in curricula and instructional methods and technologies support the standards. ED will also provide information on how the proposed national test in mathematics addresses these issues.
- NSF will work with academic mathematicians, scientists and engineers and with institutions of higher education (and with their professional societies and other non-governmental organizations) to articulate their roles in state and local partnerships.

- NSF will give high priority to partnership efforts that work toward improving K-8 mathematics achievement in its informal education activities.
- ED, NSF and other agencies will use program budgets and/or existing staff to develop substantive materials for use in partnership efforts aimed at activities outside the classroom. See the set of possible partnership activities below for examples.
- Examples of partnership options that currently exist, might be expanded, or might be incorporated in newly forming partnerships at local, state, or national levels include:
 - Institutions of higher education or Federal agencies partnering with local K-12 schools to provide support for teachers and administrators implementing reform activities;
 - Professional societies in mathematics, science, and engineering providing guidance for their members on interacting with schools and teachers productively;
 - Summer mathematics efforts that keep students growing mathematically, building on ED's successful summer reading effort;
 - Public service information campaigns;
 - Mathematics fitness circles or networks with weekly problems, discussions of how they illustrate the standards, and discussions of the importance of mathematics for future education and work options;
 - Support for students via telementoring by adults actively using mathematics in their work;
 - After school and evening use of facilities (including computers, etc.) of local businesses, academic institutions, local government, and community organizations for mathematics-oriented activities (the "moonlight math" equivalent of "midnight basketball").

Partnership activities should be aimed at drawing together the broad resources of the local community, engendering a community understanding of the importance of challenging mathematics standards for the children of the community, and providing support to the schools outside the direct confines of the school system. In addition, partnership activities can help address considerations of equity, particularly in the use of technology.

Accountability and Continuing Research

The Program Action Plan recommends focusing a portion of ED's existing Eisenhower, Title I, and Goals 2000 monies on the systemic elements of K-8 mathematics education. By coupling waivers, which ED can grant, to Systemic Initiatives (SIs) and Local Systemic Change (LSC) through Teacher Enhancement projects, which NSF oversees, an accountability mechanism for a national sample of sites (NN districts and NN schools) is created. The interagency partnership would enable monitoring of the changes prescribed above through NSF's regimen of annual reporting and data submission, as specified in the cooperative agreements with the SIs and in the ongoing cross-project evaluations of the LSCs. (The SIs and LSCs already report on how (and how much) they are using Title I and Eisenhower funds to support teaching and learning reforms. The Program Action Plan would unite NSF and ED in the expectation that funds flowing into districts, schools, and classrooms would be used strategically to support high standards.)

This interagency partnership also provides a research opportunity for studying systemic reform of K-8 mathematics. Those districts and schools, by dint of their participation as SI or LSC sites, define a sample of teachers and students whose experiences and performance can be measured and compared to other districts and schools that receive ED categorical monies, but not NSF grants. Systematic national evidence that waivers plus oversight (flexibility with accountability) make a difference in changing classroom practice and improving student achievement will only come from careful research and evaluation of these sites.

Appendix 4: Federal Agency Activities That Support K-8 Mathematics Education

The Department of Education (ED) and the National Science Foundation (NSF) have principal responsibility, among the Federal agencies, for K-12 education and for science and mathematics, respectively. However, a dozen other agencies sponsor activities that relate to, and could support, standards-based teaching that improves students' mathematics and science learning and overall academic performance.

The Working Group met with a dozen designated agency representatives (including the Departments of Agriculture, Commerce, Energy, Interior, and Veterans Affairs, EPA, NASA, NIH, and the Smithsonian) to discuss relevant programs and activities sponsored by their agencies. In general, the agencies focus far more on science than mathematics, and commit modest resources to K-12 education. Most offer staff and facilities, often on a volunteer basis, to support local schools and teachers. And all have developed and are sharing supplementary instructional materials on their Web sites.

Some examples of works-in-progress can be cited. The Department of Energy, NIH, and USDA are conducting an inventory of their activities and trying to identify impacts and opportunities to expand. Among ideas that warrant further consideration are *virtual teacher training* based at DOE's Lawrence Berkeley Lab in partnership with the University of California system; USDA's 4-H Clubs as an after-school, weekend, and summer vehicle for promoting math skills; EPA's use of the trainer-of-trainer model for teacher development in environmental education; and NIH's middle-school curriculum supplements to be developed in conjunction with three Institutes. In virtually all cases, materials based on agency missions could be designed with mathematics in mind.

Two agencies not listed above represent contrasting approaches to introducing rigorous national standards in their education activities. Unique among the agencies are the Department of Defense Dependents' Schools, which run as essentially autonomous school systems overseas and on military bases in the U.S. They certify teachers and develop leader-teachers, tutors, and mentors who, like the DODDS math curriculum used world-wide (K-8 and 9-12), embrace the NCTM standards. The rest of DOD supports technology applications with an emphasis on training, except for the National Security Agency, which established a Mathematics Education Partnership Program in 1991 (that includes NSF and the University Corporation for Atmospheric Research) and is described at www.nsa.gov:8080/programs/mepp.

The Department of Transportation is a relative newcomer, among the Federal agencies, to education. Many students are not prepared for the transportation field because they see no connection between subjects such as math and science and attainable career possibilities. Through the new Garrett A. Morgan Technology and Transportation Futures Program, DOT will undertake a series of public-private partnerships dedicated to mathematics, science, and technology literacy (K-12). Activities will include helping educators integrate transportation components into the curriculum for each grade level; encouraging the transportation community (in collaboration with ED) to participate in the *America Goes Back To School* program with a focus on for math, science, and technology achievement; building upon DOT's 300+ adopted schools to provide mentors, tutors, career information, and other forms of support for math literacy; bringing together curriculum development specialists and private sector sponsors to develop "math kits" analogous to the reading kits currently distributed to schools throughout the U.S.; expanding the availability of curriculum enrichment programs that engage students in solving real world problems with a

transportation focus, such as magnetic levitation trains; and contributing expertise and/or equipment to help America's schools get on-line, by participating in "Net Days."

In all, little investment by the agencies in formal evaluation of the quality and adaptability of methods or products appears to have been made. Until better documentation exists, recommending replication or adaptation of agency programs is probably premature. We must learn quicker, yet more systematically, about approaches and innovations that support students and teachers of mathematics both in and outside of schools.

**DoEd-NSF Working Group on
IMPROVING MATH AND SCIENCE EDUCATION**

Sources Reviewed
(Last Update: 3/25/97)

Compendia

Eisenhower National Clearinghouse, *The Guidebook of Federal Resources for K-12 Mathematics and Science*, OERI, 1996.

Districts

Annie E. Casey Foundation, *City Kids Count: Data on the Well-Being of Children in Large Cities*, Baltimore, MD: 1997.

DeRoche, Tim, "What's a Superintendent To Do?" *Education Week*, Feb. 26, 1997, p. 52.

First in the World Consortium, *Achieving Excellence: A Report of Initial Findings of Eighth Grade Performance from the Third International Mathematics and Science Study*, Northbrook, IL: January 1997.

National Research Council, *Science for All Children: A Guide to Improving Elementary Science Education in Your School District*, Washington, DC: National Academy Press, 1996.

Educational Technology

"Education -- Getting Wired, U.S. Schools Face Steep Learning Curve," *Wall Street Journal*, Mar. 19, 1997, p. B1.

Fischer, Gerhard, "Making Learning a Part of Life: Beyond the "Gift Wrapping" Approach of Technology," Center for LifeLong Learning and Design, U. Of Colorado at Boulder, June 1996.

Guzdial, Mark, and Fred W. Weingarten, *Setting a Computer Science Research Agenda for Educational Technology*, Computing Research Association, Sept. 30-Oct. 2, 1995.

Lesley College, and Bolt Beranek and Newman, Inc., "Setting a Research and Planning Agenda for Computer Modeling in the PreCollege Curriculum," Conference Report, February 1996.

Educational Technology (cont.)

Morse, M. Patricia, and Nora H. Sabelli, "Role of Technology in Student and Scientist Partnerships: Perspective from the National Science Foundation," unpublished paper, Dec. 5, 1996.

Soloway, Elliot, and Joseph Krajcik, "Computational Support for the Full Range of Authentic Science Inquiry Activities: Assessing Impact on Learning Content and Process," Quarterly Progress Report on REC95-55710, Sept. 16, 1996.

Trotter, Andrew, "IBM Shares Results from Field-Tests of Technology," *Education Week*, Feb. 26, 1997, p. 5.

Higher Ed Role in K-12

National Research Council, *The Catalyst*, quarterly newsletter of Resources for Involving Scientists in Education, Issue #7, Fall/Winter 1996.

Materials

Annenberg/CPB Math and Science Collection, *Building Better Math & Science*, a resource catalog for forward-thinking schools and communities, no date.

Cozzens, Margaret B., and Eric Robinson, "Implementation of Standards-based Curricula," *ESIE Access*, Winter 1995.

Parents

NSF Pointers for Parents Produced by National Science & Technology Week '97, "Seven Things You Need to Know Before Visiting Your Local Science Center," Mar. 10, 1997, SP/96-7.

"NSF Science Fair 'Starters' on the Web," Mar. 13, 1997.

Roberts, Mark E.P., "A Parent's Place Is in the Schools," *Washington Post*, Mar. 9, 1997, p. C8.

Russell, Robert L., "What Research Says About the Role of Parents in Science Education," *Informal Science*, No. 21, Nov./Dec. 1996, pp. 1, 13-18.

Professional Societies

Joint Policy Board for Mathematics, "'The Internet' Is the Theme for Mathematics Awareness Week, April 20-26, 1997," press release, Mar. 1, 1997.

Standards – Content and Achievement

Everyday Learning Corp., *Everyday Mathematics -- Student Achievement Studies*, Chicago, 1996.

Gagnon, Paul, "What Should Children Learn?" *Atlantic Monthly*, December 1995, pp. 65-78.

Neill, Monty, "Accountability, Standards Do Not Require Tests [letter]" *Education Week*, Feb. 26, 1997, p. 41.

Reese, Clyde M., et al., *NAEP 1996 Mathematics Report Card for the Nation and the States*, NCES, February 1997.

Remarks by the President at the National Governors Association Education Summit, Palisades, NY, Mar. 27, 1997.

Robitaille, David F., et al., *Curriculum Frameworks for Mathematics and Science*, TIMSS Monograph No. 1, 1993.

Stevens, Floraline I., "Fairness in Performance Assessment: The Impact of Opportunity to Learn on Students' Assessment Outcomes," paper presented at AAAS Annual Meeting, Seattle, WA, Feb. 13-18, 1997.

Webb, Norman L., "Determining Alignment of Expectations and Assessments in Mathematics and Science Education," *NISE Brief*, January 1997.

States

Council of Chief State School Officers, *State Standards and Curriculum Frameworks in Mathematics and Science*, various reports at www.ccsso.org – what's new, 1997.

_____, *Key State Education Policies on K-12 Education: Content Standards, Graduation, Teacher Licensure, Time and Attendance*, A 50-State Report, October 1996.

States (cont.)

- _____, *State Education Accountability Reports and Indicator Reports: Status of Reports Across the States*, Results of a 50-State Survey by the CCSSO State Education Assessment Center, 1996.
- Education Commission of the States, *Standards & Education: A Roadmap for State Policymakers* (www.ecs.org.ecs/2206.htm).
- George, Yolanda S., and Virginia V. Van Horne, *Science Education Reform for All (SERA) – A Look at How State Departments of Education Are Infusing Equity and Excellence Into PreK-12 Systemic Reform*, AAAS, 1997.
- ## **Teacher Preparation, Certification, and Professional Development**
- NRC Center for Science, Mathematics, and Engineering Education, *Improving Teacher Preparation and Credentialing Consistent with the National Science Education Standards*, Report of a Symposium, National Academy Press, 1997.
- NSTC Committee on Education and Training, *An Assessment of the Capacity of Federal Laboratories to Provide Inservice Teacher Enhancement Programs*, Abt Associates, March 1996.
- NSTC Dissemination and Evaluation Working Group, *Best Practice in Action – A Descriptive Analysis of Exemplary Teacher Enhancement Institutes in Science and Technology*, SRI International, November 1995.
- _____, *Case Stories: A Presentation and Analysis of Findings Drawn from Site Visits and Interviews with Participants in Science and Technology Teacher Enhancement Institutes Sponsored by the Federal Government*, Westat, Inc., August 1996.

ACTION STRATEGY

Proposed New Beginning

In a Directive issued 6 March 1997, the President instructed the Secretary of Education and the Director of the National Science Foundation to create an interagency working group to develop an action strategy in support of a voluntary national test for individual eight-grade students. The strategy would ensure that Federal programs, research, and human resources are effectively used – in partnership with professional, business, and community organizations – to help improve teaching and learning based on widely accepted, challenging national standards in mathematics.

One of the immediate inspirations for this re-examination and rededication to high standards in mathematics and science education is the Third International Mathematics and Science Study (TIMSS). Results released in the Fall of 1996 show lackluster performance by U.S. 8th graders, with scores significantly below the international average in mathematics. There is evidence that our 4th graders do substantially better than the international average. Clearly we must focus attention on what we are and are not doing in middle school mathematics.

Even more important than indicating an emphasis on middle school grades (4-8), TIMSS also provides clues about how to go about the process of improving. This is because researchers not only collected achievement data in each participating country, but also much information about teachers and teaching, about curricula and instructional materials, about classroom lessons and interactions, and about attitudes and habits outside the classroom.

For example, we have learned from the TIMSS 8th grade study that American students spend at least as much time each year on mathematics and science as their counterparts in other countries, but that the U.S. approach is scattershot rather than focused on a few topics. We assign as much if not more homework, but require less high-level thought. U.S. mathematics teachers report familiarity with recommendations for reform and teaching to high standards, but only a few apply the key points in the classrooms. In all, U.S. teachers have less time to plan lessons, but spend more time in the classroom than teachers most everywhere else in the world. In short, the typical educational environment in the U.S. shortchanges both teachers and students.

Perhaps even more important than specific findings are lessons we can draw from the reception and impact of the 8th grade TIMSS results. They have become a source of constructive motivation creating a context for action far beyond "horse race" data about achievement. TIMSS provides opportunities to explain and learn about how educational systems work and thus how they can be improved.

The Nation's challenge, on a sustained and decentralized basis, is to make good on the potential TIMSS has demonstrated for learning about and improving U.S. education. This requires three major ingredients:

- First, we need consensus on a national measure of achievement that accurately embodies high standards. The Department of Education (ED) is currently developing one such instrument, the voluntary 8th grade National Mathematics Test, with the involvement of experts in mathematics and mathematics instruction.
- Second, we need surveys and studies like those included in TIMSS for investigating the practices, programs, and policies that might correlate with the achievement of high standards as measured by a National Test or other indicators. This is especially a matter for social scientists and psychometricians.
- Third, we need to use what we can learn about those correlations to allocate agency resources strategically for improving education. This means setting aside funds that, instead of being awarded either according to formula or according to what a program officer thinks should work, are tied directly and accountably to results. This does not mean offering rewards for good scores. Rather, teachers, schools, and states whose practices correlate well with high achievement should be able to apply for support to continue and disseminate what they are doing, while those scoring below average apply to try new techniques that can raise performance to meet high standards.

The techniques for improving science and mathematics education proposed as options in what follows are all supported by some evidence and experience. To set priorities convincingly among them, we must publicly put them to the test. Given that TIMSS, NAEP, and the new National Mathematics Test can be seen as symbols of high standards, the question is, by what means can such testing help improve education? Low scores may, at least temporarily, attract attention and even resources from policymakers, parents, and educators. This would be enough if everyone knew what to do next. That there is no shortage of ideas that sound good makes it all the more essential to build quite visibly on all that standards and research like TIMSS can teach us about formulating and validating action strategies.

DRAFT