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Mathematics Assessment Summit 4/24/91 [OA 6897]

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**MATHEMATICS ASSESSMENT SUMMIT \ NAT'L ACAD. OF SCIENCES  
WEDNESDAY, APRIL 24, 1991 \ 1:45 P.M.**

**[[ SECRETARY ALEXANDER, DR. ALLAN BROMLEY, DR. FRANK  
PRESS... YOU KNOW, WHEN I FIRST HEARD I WAS INVITED  
TO A MATH SUMMIT, I HAD IMAGES OF GORBACHEV AND ME,  
GOING HEAD-TO-HEAD IN LONG DIVISION. \\\ AT LEAST  
BOTH OF US MANAGED TO AVOID THE POP QUIZ YOU ALL HAD TO  
TAKE. ]]**

**BUT YOUR PURPOSE HERE TRANSCENDS PUBLIC FIGURES.  
IT CONCERNS OUR NATION'S FUTURE.**

---

**- 2 -**

**OF THE SIX NATIONAL EDUCATION GOALS WE ESTABLISHED  
WITH THE NATION'S GOVERNORS LAST YEAR, YOU'RE HELPING  
TO REALIZE ONE OF THE MOST AMBITIOUS: THAT AMERICAN  
STUDENTS BE FIRST IN THE WORLD IN MATH AND SCIENCE  
ACHIEVEMENT BY THE YEAR 2000.**

**THIS CHALLENGING GOAL -- WORTHY OF A GREAT NATION  
AND ITS FUTURE AMBITIONS -- PLAYS AN IMPORTANT ROLE IN  
OUR AMERICA 2000 STRATEGY TO RE-INVENT THE AMERICAN  
SCHOOL.**

**WE CAN'T EXPECT KIDS TO MEET THE TEST OF WORLDWIDE COMPETITION -- UNLESS WE FIRST ESTABLISH WORLD-CLASS STANDARDS -- STANDARDS THAT DEFINE THE KNOWLEDGE AND SKILLS WE EXPECT STUDENTS TO LEARN AND MASTER. ONCE WE HAVE SET STANDARDS, WE MUST ASSESS OUR PROGRESS IN MEETING THEM.**

**I SALUTE THE MATHEMATICAL SCIENCES EDUCATION BOARD FOR HOSTING THIS CONFERENCE, THE NATIONAL EDUCATION GOALS PANEL, FOR THIS AFTERNOON'S FORUM -- AND ABOVE ALL, I THANK THE EDUCATORS AND POLICY-MAKERS HERE.**

**YOU HAVE LABORED FOR YEARS TO REACH CONSENSUS ON STANDARDS FOR MATHEMATICAL SKILLS AND PERFORMANCE. I COMMEND YOU FOR YOUR COMMITMENT -- AND YOUR ACHIEVEMENT.**

**WE CANNOT BLAZE A TRAIL TO THE FUTURE UNTIL WE KNOW WHERE WE STAND. THE VOLUNTARY AMERICAN ACHIEVEMENT TESTS, A CORNERSTONE OF OUR AMERICA 2000 STRATEGY, WILL MEASURE ACHIEVEMENT IN FIVE CORE SUBJECTS, INCLUDING MATHEMATICS.**

I HAVE CHALLENGED THE NATION TO HAVE A TEST READY FOR THE 4TH GRADERS OF 1993, AND TO PRODUCE TESTS FOR 8TH AND 12TH GRADERS SOON AFTER.

I ASK EACH OF YOU TO HELP THE PUBLIC UNDERSTAND THE PURPOSE OF STANDARDS AND ASSESSMENTS -- AND TO MAKE SURE OUR ACHIEVEMENT TESTS MOTIVATE AND INSPIRE OUR STUDENTS.

LET'S ALSO SEE THAT THESE TESTS MOTIVATE AND INSPIRE OUR SCHOOLS.

THAT THEY MAKE SCHOOLS MORE ACCOUNTABLE TO THE PEOPLE THEY SERVE. THAT THEY RESTORE THE KIND OF COMPETITION AND PRIDE ESSENTIAL FOR EDUCATIONAL EXCELLENCE. THAT THEY TELL US WHERE WE STAND -- SO WE MAY START THE JOURNEY TO WHERE WE WANT TO GO.

WE IN THE FEDERAL GOVERNMENT ARE PARTNERS WITH YOU IN ADVANCING THE CAUSE OF EDUCATIONAL EXCELLENCE.

ALL OF YOU HAVE HELPED SET OFF AN AMERICAN EDUCATIONAL  
RENAISSANCE. I THANK YOU FOR WHAT YOU'VE DONE -- AND  
FOR WHAT YOU WILL ACHIEVE. MAY GOD BLESS YOU AND THE  
UNITED STATES OF AMERICA.

# # #



(Lange/Simon)  
April 24, 1991  
11:30 A.M.  
[MATHSUM.TS]

PRESIDENTIAL REMARKS: MATHEMATICS ASSESSMENT SUMMIT  
THE NATIONAL ACADEMY OF SCIENCES  
WEDNESDAY, APRIL 24, 1991  
1:45 p.m.

[[ Secretary Alexander, Dr. Allan Bromley, Dr. Frank Press...

You know, when I first heard I was invited to a Math Summit, I had images of Gorbachev and me, going head-to-head in long division. \\ At least both of us managed to avoid the pop quiz you all had to take. ]]

But your purpose here transcends public figures. It concerns our nation's future.

Of the six National Education Goals we established with the nation's governors last year, you're helping to realize one of the most ambitious: that American students be first in the world in math and science achievement by the year 2000.

This challenging goal -- worthy of a great nation and its future ambitions -- plays an important role in our America 2000 strategy to re-invent the American school.

We can't expect kids to meet the test of worldwide competition -- unless we first establish world-class standards -- standards that define the knowledge and skills we expect students to learn and master. Once we have set standards, we must assess our progress in meeting them.

I salute the Mathematical Sciences Education Board for hosting this conference, the National Education Goals Panel, for

this afternoon's forum -- and above all, I thank the educators and policy-makers here. You have labored for years to reach consensus on standards for mathematical skills and performance. I commend you for your commitment -- and your achievement.

We cannot blaze a trail to the future until we know where we stand. The voluntary American Achievement Tests, a cornerstone of our America 2000 strategy, will measure achievement in five core subjects, including mathematics. I have challenged the nation to have a test ready for the 4th graders of 1993, and to produce tests for 8th and 12th graders soon after.

I ask each of you to help the public understand the purpose of standards and assessments -- and to make sure our achievement tests motivate and inspire our students.

Let's also see that these tests motivate and inspire our schools. That they make schools more accountable to the people they serve. That they restore the kind of competition and pride essential for educational excellence. That they tell us where we stand -- so we may start the journey to where we want to go.

We in the federal government are partners with you in advancing the cause of educational excellence. Secretary of Energy James Watkins has chaired a committee that has produced the first inventory of federal activities that directly influence science, math, engineering and technical education.

As you know, we must improve training for pre-college math and science teachers. We need to attract more women and minorities into science and technology.

The budget we sent to Congress this year calls for a 13 percent increase for math and science education; for a total of nearly \$2 billion.

But you understand that the federal government can play only a limited role in making America's students first in math and science. Dollars alone won't do the job. Real excellence demands a commitment from us all. Everyone must declare: we will re-invent the American school. We will achieve our ambitious National Education Goals.

So, as you consider your "principles, goals, and actions" for math assessment, I'd ask you to keep a few questions in mind:

- \* Consider what it means to be "best in the world" -- and the kind of balance our students will need, between theoretical math, and practical, applied skills for life.

- \* How can we create tests to ensure not just that our best students are as good as any in the world, but that our average students achieve world-class status?

- \* How can we emphasize testing that encourages better teaching -- that doesn't weed kids out, but develops better math skills for all?

Every student needs goals and challenges. Every school needs goals and challenges. I hope your work will help every American student, and every American teacher, reach our National Education goals.

Many of you already have shown the way. Consider one member of today's audience. Larry Williams, a math teacher at Eutaw

High School in rural Alabama and a member of the Mathematical Sciences Education Board -- has lit a fire under his students, many of whom come from poor or disadvantaged homes. His math teams can compete with any other teams in Alabama and throughout the Southeast.

When people ask how America can become first in the world in math and science by the year 2000, I point to teachers like Larry Williams -- dedicated professionals who help all our children reach their potential. All of you have helped set off an American educational renaissance. I thank you for what you've done -- and for what you will achieve. May God bless you and the United States of America.

# # #

*Staffed*

(Lange/Simon)  
April 23, 1991  
2:45 P.M.  
[MATHSUM.TS]

PRESIDENTIAL REMARKS: MATHEMATICS ASSESSMENT SUMMIT  
THE NATIONAL ACADEMY OF SCIENCES  
WEDNESDAY, APRIL 24, 1991  
1:45 p.m.

[[ Secretary Alexander, Dr. Allan Bromley, Dr. Frank Press...

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But your purpose here transcends public figures. It  
concerns our nation's future.

Of the six National Education Goals we established with the  
nation's governors last year, you're helping to realize the most  
ambitious: that American students be first in the world in math  
and science achievement by the year 2000.

It's a challenging goal -- worthy of the future we want for  
our children. And it begins with the kind of work you've  
undertaken here.

In a competitive world, we can't expect kids to pass the  
test of international competition until we know how to test our  
kids. In our schools and among our teachers, we can't make  
progress, until we know how to measure progress.

I commend the National Education Goals Panel for convening  
this conference -- the Mathematical Sciences Education Board, for

*Mary  
Krentler  
Director of  
Summit*

*America 2000  
p. 8-9*

holding its regional hearings -- and above all, I thank the educators and policy-makers here today.

Over the past year, an inter-agency Committee on Education and Human Resources, headed by Secretary of Energy James Watkins, has put together an integrated program designed to advance science and math education.

That committee wants to improve training for pre-college math and science teachers. It hopes to attract more women and minorities into science and technology. It has produced the very first inventory of federal activities that directly influence science, math, engineering, and technical education.

The budget we sent to Congress this year calls for a 13 percent increase for this program, for a total of nearly \$2 billion. But while we've increased spending on education by 33 percent since 1981, I don't imagine anyone in this room would claim education is 33 percent better.

[[ In my mind, the numbers just don't add up. But I'm still puzzling over that legendary Gary Larson cartoon -- where, after doing elaborate, complex calculations, Einstein discovers that Time is actually Money. ]]

You understand that the federal government alone cannot make America's students first in math and science by the end of this century. Everyone must declare: we will reinvent the American school. It will take all of us, working together, to achieve our ambitious National Education Goals.

Steve  
Olson  
OSTP

FY 92  
Budget  
Part II  
P. 14  
Table A-3  
America  
2000  
p. 5

Carolyn  
Cawley

Efforts like yours help show the way to that future, and they help highlight the importance of first-rate assessment. We cannot blaze a trail to the future until we know where we stand.

*speech*  
4-18-91 I've called for voluntary American Achievement Tests, beginning with a test for 4th graders in September 1993, and tests for 8th and 12th graders soon after.

So, as you consider your "principles, goals, and actions" for math assessment, I'd ask you to keep a few questions in mind:

- \* Consider what it means to be "best in the world" -- and the kind of balance our students will need, between theoretical math, and practical, applied skills for life.

- \* It's generally agreed that our best are as good as the world's best -- but how will we create tests that ensure that our average students achieve world-class status?

- \* How can we emphasize testing that leads to better teaching -- using tests not to weed kids out, but to develop better math skills for all?

Finally, I ask each of you to help the public understand the purposes of tests and assessments -- and to make sure those tests are used the way they're designed and intended.

Every student needs goals and challenges. I hope your work on these tests will help every American student, and every American teacher, reach their fullest potential.

Your efforts today put you on the leading wave of an education renaissance. They assure that we will not simply reform our schools. We will reinvent the American school.

This is a great and exciting challenge, and I thank you for taking such an active role joining in our effort to revitalize all our schools. Thank you for everything you're doing to shape our future -- and may God bless the United States of America.

# # #



**Mathematical Sciences Education Board  
NATIONAL SUMMIT ON MATHEMATICS ASSESSMENT**

April 23 - 24, 1991

National Academy of Sciences  
2101 Constitution Avenue, N.W.  
Washington, D.C.

Sheraton Washington Hotel  
2660 Woodley Road, N.W.  
Washington, D.C.

**Tentative Agenda**

**Tuesday, April 23, 1991**

**1:00 pm - 2:00 pm**

**PLENARY SESSION**

**NAS Auditorium**

- Presider Lamar Alexander, Secretary of Education;  
Chairman, National Summit on Mathematics Assessment
- Welcome Alvin W. Trivelpiece, Director, Oak Ridge National Laboratory;  
Chairman, Mathematical Sciences Education Board
- Greetings Philip M. Smith, Executive Officer, National Research Council
- Opening Address Shirley A. Hill, Curator's Professor of Mathematics & Education,  
University of Missouri - Kansas City;  
Past Chairman, Mathematical Sciences Education Board  
*"The Vision: World Class Mathematics Education for  
Achieving the Nation's Goals"*
- Charge Lamar Alexander, Secretary of Education  
*"The Challenge: Building Consensus on Directions for  
Mathematics Assessment"*

**2:00 pm - 5:00 pm**

**SMALL GROUP SESSIONS**

**National Academy of Sciences**

In small groups, Summit participants will discuss the draft document, *Principles, Goals, and Actions for Mathematics Assessment*, developed by the Steering Committee, and will recommend revisions and additions to it. Each group discussion will be led by a member of the Steering Committee.

**6:00 pm - 9:00 pm**

**RECEPTION & BANQUET**

**Sheraton Washington Ballroom**

- Welcome Lamar Alexander, Secretary of Education
- Greetings Mark O. Hatfield, United States Senator, Oregon  
Walter Massey, Director, National Science Foundation

**Tuesday, April 23, 1991 (cont.)**

- Panel Discussion *"Changes in the Classroom: Implications for State and National Policy on Mathematics Assessment"*
- Moderator Mary Harley Kruter, Project Director, National Summit on Mathematics Assessment
- Panelists Arnold Cutler, Mounds View High School, St. Paul, Minnesota  
Paula Duckett, River Terrace Community Elementary School, Washington, D.C.  
Mardi Gale, El Rodeo Middle School, Los Angeles, California

**Wednesday, April 24, 1991**

**9:00 am - 10:00 am**

**PLENARY SESSION**

**NAS Auditorium**

- Presider Alvin W. Trivelpiece, Chairman, Mathematical Sciences Education Board
- Welcome Frank Press, President, National Academy of Sciences
- Remarks David Hamburg, President, Carnegie Corporation of New York  
Ian Ross, President, AT&T Bell Laboratories
- Keynote Address Lamar Alexander, Secretary of Education  
*[Title Forthcoming]*

**10:00 am - 11:00 am**

**PLENARY SESSION**

**NAS Auditorium**

- Presider Iris M. Carl, President, National Council of Teachers of Mathematics; Vice-Chair, Mathematical Sciences Education Board
- Panel Discussion *"How will we know when American mathematics education has become world class and American students are first in the world?"*
- Moderator Roy Romer, Governor of Colorado; Chairman, National Education Goals Panel
- Panelists Gordon Ambach, Executive Director, Council of Chief State School Officers  
Nancy S. Cole, Executive Vice-President, Educational Testing Service  
John Dossey, Professor of Mathematics, Illinois State University; Past President, National Council of Teachers of Mathematics

**Wednesday, April 24, 1991 (cont.)**

Emerson Elliott, Acting Commissioner, National Center for Education Statistics, U.S. Department of Education

Robert Linn, Professor of Education, University of Colorado;  
Co-Director, Center for Research on Evaluation Standards and Student Testing

Thomas Romberg, Professor of Mathematics Education, University of Wisconsin - Madison;  
Director, National Center for Research in Mathematical Sciences Education

**11:30 am - 1:00 pm**

**GROUP SESSIONS**

**NAS Locations**

**A National Forum of the National Education Goals Panel**

Governor Roy Romer, Secretary Lamar Alexander, Assistant to the President Roger Porter, and other members of the National Education Goals Panel will meet with groups of Summit participants to hear their reactions to the issues involved in monitoring progress toward national education goals.

**1:00 pm - 2:00 pm**

**MEDIA BRIEFING/LUNCH  
WITH MAJOR SPEAKERS**

**NAS Lecture Room**

**2:00 pm - 3:00 pm**

**PLENARY SESSION**

**NAS Auditorium**

Presider

Frank Newman, President, Education Commission of the States

Panel Discussion

*"What is the role of assessment in making U.S. mathematics education world class? How are the states initiating and achieving assessment reform?"*

Moderators

Lauren Resnick, Director, Learning Research Development Center, University of Pittsburgh

Marshall Smith, Dean, School of Education, Stanford University

Panelists

Joan Barron, Education Consultant, Connecticut Department of Education

Donald Chambers, Supervisor of Mathematics, Wisconsin Department of Education

Bill Honig, Superintendent of Public Instruction, California

Joanne Lenke, Vice President, The Psychological Corporation

Richard Mills, Commissioner of Education, Vermont

Edward Roeber, Supervisor, Michigan Educational Assessment Program, Michigan Department of Education

**Wednesday, April 24, 1991 (cont.)**

**3:00 pm - 4:00 pm**

**PLENARY SESSION**

**NAS Auditorium**

Presider

Lamar Alexander, Secretary of Education

Panel Discussion

*"Next Steps: The Summit Agreements and Beyond"*

Moderators

Manya Ungar, Immediate Past President, National Congress of Parents and Teachers

Nellie Weil, Past President, National School Boards Association

Panelists

Gregory Anrig, President, Educational Testing Service

Roseann Bentley, Immediate Past President, National Association of State Boards of Education

Shirley A. Hill, Curator's Professor of Mathematics & Education, University of Missouri - Kansas City

George Madaus, Director, Center for the Study of Testing, Evaluation, and Educational Policy, Boston College

Michael Nettles, Vice President for Assessment, University of Tennessee

Donald Stewart, President, The College Board

**4:00 pm - 5:00 pm**

**AUDIENCE RESPONSE**

**NAS Auditorium**

**5:00 pm**

**ADJOURNMENT**

SMART test - pop quiz tonight  
8th grade level

multiple choice

they get calculators

to show why the test we're  
using

audience : ETS staff

policy makers from states

heads of ed groups

PTAs administrators

test publishers

Dr. Frank Press  
Bronley  
Alexander

Test taken by Summit participants  
on 4/23

Standardized  
Multiple-Choice  
Arithmetic  
Review  
Test

# SMART

Instructions: Use a #2 pencil to mark the correct answer to each question on the separate optically scanned scoring sheet.

1. Sporting Gear

Item	Price
Shoes	\$49.50
Socks	\$7.99
Shorts	\$17.49
Shirt	\$12.99
Sweatbands	\$4.00

If a sports enthusiast bought one of each of the five items, what would be the total cost?

- A. \$43.46  
 B. \$163.88  
 C. \$97.97  
 D. \$91.97  
 E. \$88.01
- 71.97

2. In which way are the numbers 6.02, 6, 6.19, 6.2, and 6.029 written in order from least to greatest?

- A. 6, 6.2, 6.02, 6.19, 6.029  
 B. 6.029, 6.02, 6.19, 6.2, 6  
 C. 6, 6.02, 6.029, 6.2, 6.19  
 D. 6, 6.02, 6.029, 6.19, 6.2  
 E. 6, 6.2, 6.02, 6.19, 6.029

3. A wire is 0.24 cm in diameter. A cable is 2.064 cm in diameter. How many times thicker than the wire is the cable?

- A.  8.6  
 B. 1.824  
 C. 0.49536  
 D. 2.304  
 E. 0.254
- $.24 \overline{) 2.064}$

4. What are the next three terms in the sequence 1, 4, 10, 19?

- A. 24, 30, 39  
 B. 20, 24, 30  
 C. 31, 46, 64  
 D. 31, 62, 93  
 E. 23, 33, 52
- 12 ?  
31  
15

5. What is the quotient when  $8 \frac{1}{4}$  is divided by  $4 \frac{1}{2}$ ?

- A. 2  
 B.  $\frac{1}{2}$   
 C.  $1 \frac{5}{6}$   
 D.  $37 \frac{1}{8}$   
 E.  $4 \frac{2}{11}$

$$\begin{array}{r} 1 \\ 4.5 \overline{) 8.25} \\ \underline{4.50} \\ 3.75 \end{array}$$

8 1/4

6. Five cars are priced at \$23,400, \$16,800, \$21,500, \$28,700, and \$32,600. What is the average price of these cars?

- A. \$24,600  
 B. \$24,700  
 C. \$24,000  
 D. \$23,400  
 E. \$23,800

7. A service worker earns \$15.75 per hour. How much does the worker earn for working 37.25 hours?

- A. \$53.00  
 B. \$586.69  
 C. \$157.50  
 D. \$372.50  
 E. \$582.75

$$\begin{array}{r} 272 \\ 15.75 \overline{) 37.25} \\ \underline{37.25} \\ 0 \end{array}$$

31  
15  
37  
105  
450  
555

8. If one angle of a right triangle measures 42 degrees, what are the measures of the other two angles?

- A.  48 and 90  
 B. 48 and 24  
 C. 42 and 42  
 D. 48 and 48  
 E. 90 and 42



9. What is 7.5% of 840?

- A. 0.063  
 B. 0.63  
 C. 6.3  
 D. 63  
 E. 630

$$\begin{array}{r} 804 \\ 7.5\% \overline{) 840} \\ \underline{840} \\ 0 \end{array}$$

10. Which is closest to the quotient when 1.4 trillion is divided by 249 million?

- A. 12 thousand  
 B. 2 billion  
 C. 34 million  
 D. 2 hundred  
 E. 56 hundred

EVEN

# SMARTER

TEST

## OPEN-ENDED MATHEMATICAL PROBLEM

**Instructions:** Use this sheet to solve this problem. Write a complete justification of each solution.

For an upcoming sports vacation, the Smith family has budgeted \$250 for some new sports clothing for their children, Mike and Karen. Mike would happily spend the entire \$250 on a new pair of sports shoes. Karen wants two new designer sports outfits that cost \$85 each. However, Mike must have at least one pair of sports shoes and two athletic shirts. Karen must have at least one new sports outfit, a pair of sandals, and two sweatbands. The sports clothing must be purchased from mail order catalogs.

Use at least three different mail order catalogs to develop two different purchasing plans that you think would satisfy both Mike and Karen. Write a justification for each plan and include shipping charges and tax.

FROM STEVE OLSON  
OSTP X2734

Mark:

Here's some material, drawn largely from things I've written up here, that might help with tomorrow's speech. Good luck.



o American education is now suffering from some extremely serious breakdowns. Particularly at the precollege level, the education that many of our young people are receiving is scandalously poor. For the first time in American history, our children and grandchildren are now receiving a worse education than their parents and grandparents received.

o As is the case throughout society, science and technology are becoming an ever more important part of the educational enterprise. Jobs requiring high levels of scientific and technical training are the most rapidly growing segment of the labor market. But our schools are not producing nearly enough scientifically literate and technically training individuals to meet the demand. International comparisons show the United States at or near the bottom in scientific and mathematical achievement. If we cannot educate our young people properly, scientific and technological supremacy will inevitably pass from the United States to other countries.

o The importance of science and technology is apparent in the National Education Goals established by the President and the nation's Governors last year. Of the six goals, three directly involve science and technology, including the most ambitious of the six, that American students be first in the world in science and technology by the year 2000. *math &*

o Revitalizing and reforming American education will require a partnership among all sectors of society. But the federal government, even though it provides only about 6 percent of total spending for elementary and secondary education, can play a leadership role by highlighting national problems, mobilizing national support, and funding programs that offer unique national solutions.

o Over the past year, the interagency Committee on Education and Human Resources, under the leadership of Secretary of Energy James Watkins, has put together an integrated, government-wide program designed to significantly advance

science and mathematics education. As part of that effort, the committee produced, for the first time, an inventory of all of the activities in the federal government that directly influence science, mathematics, engineering, and technical education. And in the budget sent to Congress last month, the President proposed a 13 percent increase for this interagency program, to a total of nearly \$2 billion.

o Two points deserve special attention. The first is that the single highest priority, in the eyes of the committee, is the education and training of precollege mathematics and science teachers. Very few precollege teachers are fully qualified to teach science and mathematics, yet these are the individuals that we must rely on for our future flow of scientists and engineers, because, in contrast to most other professions, those students who go on to become scientists and engineers usually make career decisions in junior high school or even earlier.

o The other pressing need identified by the committee is to attract far more people to science and technology from groups that have been underrepresented in these areas. The number of college-age students is going to continue to fall well into the 1990s, and of the new entrants into the workforce between now and the year 2000, almost 70 percent are going to be women and minorities. Unless our high schools and colleges become much more effective in terms of attracting women and minorities into science and technology -- and retaining them once they are attracted -- the personnel shortages that are predicted for the future are going to be worse than now expected.

o We are now looking seriously at the next iteration in developing a federal program in mathematics and science education. Precollege education was the top priority to emerge from the past year's work. A strong candidate for high priority in the FY 1993 round is technician training, in the broad sense of the term. This is an area where the United States has fallen behind other countries, especially Germany and Japan, to the detriment of our high-technology industries.

o These are important first steps, but of course the federal government alone cannot guarantee the achievement of the National Education Goals. It is going to take all of us working together to make the kind of progress they envision.



## OFFICE OF PRESIDENTIAL ADVANCE IN-TOWN EVENT CONTACT SHEET

Name	Office	Phone Number
Presidential Advance Office		456-7565
Presidential Advance Fax Number		456-2820
<b>CRAIG RAY</b>	Lead Presidential Advance	456-7565
<b>PEG HAZELRIGG</b>	Presidential Advance	" "
<b>Kelley GANNON</b>	PRESS LEAD	" "
JERRY WILLIAMS	USSS - LEAD ADV.	395-4011
Lea Soucy	USSS - WFO.	634-5100
Charlie DeVera	USSS - PTD	395-4011
Sarah Keegan	WH Sci. Ofc.	395-6142
Donna Miller	USSS TSD	395-4005
John HORTON	USSS TSD	395-4005
Dhiver Hensley	USSS/UD MAGS	395-2020
ROBE N. SMITH	NAS	334-3200
REGGIE ANDERSON	NAS	334 3204
Bob Simon	WH speechwriting	456-7790
Caroline Berezny	WH Cabinet Affairs	456-2800
Daniel Casse	WH Cabinet Affairs	456-2800
Ginger Pinkolster	NAS - News	334-2138
Mary Hala Keith	Director Nat Summit	334-1452
LARRY DRYSON	WHCA	395-4070
Daryl Bright	WHCA	395-4077
JIM MANNING	USDEPT. OF EDUCATION	401-0113
Cindy BIENVENUE	NAS	334-2345
Michael Anderson	NAS	334-2343



MATHEMATICAL SCIENCES EDUCATION BOARD  
NATIONAL RESEARCH COUNCIL

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(202) 334-3294 • Facsimile: (202) 334-1453

**WHAT'S BEING DONE ABOUT THE PROBLEM?**

- The mathematics education community is attempting to break the cycle of narrowly-focused tests driving narrowly-focused instructional programs by making assessment a positive force for strengthening mathematics education.**

Mathematics educators are seeking valid means for reporting results to the public; they have joined with public policy makers and the assessment industry to reform mathematics assessment. At the National Summit on Mathematics Assessment, leaders of the public policy sector, the assessment community, and the mathematics education community will reach consensus on directions for change in mathematics tests and assessments. With these agreements, the mathematics community expects to launch a consensus-building process to develop standards for mathematics assessment to parallel the curriculum standards and the teaching standards mathematics teachers have adopted.

Consensus-based national standards for mathematics assessment can guide teachers, schools, and states as they develop and implement a greater variety of assessments methods. The problem may not be in developing the standards themselves, but in developing them soon enough for the change process that is already underway.

Several states and localities are developing alternative assessment methods for mathematics.

California is changing mathematics assessment to measure complex skills, such as problem solving, with performance-based assessments.

Connecticut's testing program uses sampling procedures to measure program effectiveness with tests of multiple-choice items and performance tasks in which students integrate content and process to generate solutions to complex problems.

In Vermont, a two-part assessment program for mathematics includes a standardized test with open-ended items and a state-wide sample of student portfolios. The portfolio assessment is to show the depth and breadth of the mathematics curriculum in Vermont as well as to provide indications of student progress and achievement in a wide range of mathematical concepts.

Massachusetts, Maryland, and Arizona are other states moving rapidly and very deliberately into assessment systems that include alternative forms of assessment.

The testing industry is becoming responsive to the demands for better mathematics tests. Several of the large commercial testing companies are working with state education agencies now on new mathematics assessments that will not be solely multiple-choice items measuring only arithmetic skills. Arizona is working with Riverside Publishing Company, and Maryland with CTBS/McGraw Hill. Other testing organizations, such as Educational Testing Service and the Psychological Corporation, are developing alternative assessments for mathematics.

The educational measurement community is beginning to develop testing theories based on current theories of cognition so that tests of all types can be significantly improved. As one ETS psychometrician, Dr. Robert Mislevy, put it, "It is only a slight exaggeration to describe the test theory that dominates educational measurement today as the application of twentieth century statistics to nineteenth century psychology."

A major, highly visible change in assessment was announced by The College Board recently. The College Board has decided to use open-ended items and permit the use of calculators on the mathematics portion of the SAT beginning in 1994.

At the highest levels of education policy making, assessments with alternatives to multiple-choice testing of minimum skills are being planned. The National Education Goals Panel has committed itself to looking for authentic assessments of the performance of students and the performance of educational systems in meeting the nation's education goals.



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**PROPOSED PRINCIPLES, GOALS, AND ACTIONS  
FOR MATHEMATICS ASSESSMENT**

**A paper for discussion at the**

**NATIONAL SUMMIT ON MATHEMATICS ASSESSMENT**

*"I have faith that Americans, once well-informed of the problems and issues, will begin to figure out for themselves how to strengthen mathematics programs in their local schools. This National Summit on Mathematics Assessment will help us all to understand the issues and launch a national effort to inform the American public about what it means to be first in the world in mathematics achievement and how we can know if we have accomplished that goal."*

-Lamar Alexander, Chairman  
National Summit on Mathematics Assessment  
February, 1991

The Steering Committee for the National Summit on Mathematics Assessment has spent eight months learning and talking about assessment issues in mathematics education. Based on that experience and the results of the regional hearings held by the Mathematical Sciences Education Board, the Steering Committee and the MSEB developed these draft principles, goals, and actions for your consideration. As a participant in the National Summit on Mathematics Assessment, you will be discussing these principles, goals, and actions with other leaders on April 23-24, 1991. Because you are leaders and practitioners who must take responsible action on assessment, your special attention to the proposed actions will be of great value. It is expected that in these discussions, Summit participants will reach consensus and that these principles, goals, and actions will become, with appropriate modifications, the Summit agreements.

This document is accompanied by two other documents, both of which provide important background information for Summit participants. One is *A Summary of the Regional Pre-Summit Forums*; the other is the background paper entitled *Toward National Standards for Mathematics Assessment*.

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## **PRINCIPLES**

The following principles are based on beliefs members of the Steering Committee share about tests, assessments, and accountability systems.

--- **The purposes of testing and assessment are to:**

- **improve learning and teaching,**
- **judge the effectiveness of instructional programs,**
- **aid in selecting individuals for placement in educational programs or for certification, and**
- **report to many audiences the accomplishments and the needs of the educational system.**

Assessment is an integral part of the teaching-learning process. Results of tests and assessments reveal what mathematics students know and can do, as well as what mathematics they have yet to learn. With this information, teachers can make appropriate instructional decisions for students, and students can learn how well they are progressing in developing their mathematical abilities and in extending their knowledge of the mathematics specified by the curriculum standards developed by the National Council of Teachers of Mathematics (NCTM).

Quality tests and assessments are essential for program evaluation at local, state, and national levels. Test results of student achievement in mathematics can be used in conjunction with other indicators of program quality to provide parents, school officials, public policy makers, and the public at large with information about how well instructional programs in mathematics are working. Any tests and assessments used for program evaluation must be founded on the consensus-based national standards for mathematics curriculum and instruction.

Tests and assessments are essential for making good decisions about an individual's placement in education programs and certification for a job. Because placement and certification decisions affect educational opportunities and careers for individuals, no single test or assessment should be used in isolation for making these decisions. Multiple-sources of information must be used by educators for such decisions. Tests and assessments used for placement or certification must not wrongly or unfairly classify individuals. The content of assessments for placement and certification must be carefully aligned with the real-life skills and performances required for the educational opportunity or job.

Tests and assessments are also essential for evaluating the accomplishments and the needs of educational systems. Because of the complexity of an education system, tests must be only one of multiple sources of information used for needs assessment and for evaluating accomplishment.

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- **The content of a particular test or assessment is derived from the purpose to be served, and different purposes require different tests and assessments.**

Tests in mathematics education are not always used in a manner appropriate to their design. Tests designed for diagnostic purposes are often used for evaluating programs; scores from self-selected populations (for example, takers of the Scholastic Aptitude Test) are used to compare districts and states; and results of commonly used achievement tests that stress simple skills are used as indicators of more encompassing mathematical achievement than warranted. In most cases, the misuse is not deliberate, but simply the uninformed or misinformed efforts of those with good intentions.

- **The content of tests and assessments is derived from the consensus of the discipline.**

One inevitable consequence of tests and assessments is the importance users of tests and test results place on them. The mathematical content of tests and assessments is a clear, powerful message to students, parents, and teachers about what mathematics it is important to know and to be able to do. It is essential, therefore, that the mathematical content of tests reflect the best judgment of the professional community of mathematics educators and mathematicians, and the broad-based consensus of the public on the mathematics that it is necessary for the nation's youth to learn. The quality of tests and assessments is defined by how well they measure the **valued** mathematical knowledge, skills, and processes.

- **The primary use of results of tests and assessments is to promote the development of the talents of all people.**

Perhaps more than any other school subject, mathematics is used to filter students out of educational opportunities. This must change. Mathematics tests and assessments should be used to promote the development of mathematical abilities of all students, as well as the effectiveness of schools and mathematics programs in developing those student abilities. Scores and results of tests and assessments are meaningful and valuable in developing human resources only if the tests and assessments are used for the purpose for which they were designed and if the results are interpreted appropriately.

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## **GOALS**

Based on the principles presented above, the Steering Committee believes that the nation needs:

- tests and assessments aligned with the mathematical knowledge, skills, and processes defined by the standards established by the National Council of Teachers of Mathematics in *Curriculum and Evaluation Standards for School Mathematics*, and aligned with instructional practice defined by the standards established by the NCTM in *Professional Standards for Teaching Mathematics*;
- systems of program evaluation that can be used effectively by school officials, public policy makers, and the public for holding schools accountable for mathematics programs and student achievement, as well as for monitoring progress toward the President's and the Governors' national goals for mathematics achievement;
- guidelines that can be used to judge the quality of all forms of mathematics tests and assessments;
- a variety of effective assessment methods with which to evaluate outcomes of mathematics education;
- public understanding of the various purposes of tests and assessments, the meaning of test results, and the questionable practice of using tests for purposes for which they were not designed; and
- teachers and school administrators knowledgeable about and proficient in the use of a wide variety of assessment methods, skillful in reporting the results, and skillful in using results to improve instruction.

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## **ACTIONS**

Action has begun. The dearth of adequate assessments to measure the mathematics described in the NCTM curriculum standards has spurred much activity. Several states have mathematics curriculum frameworks based on the NCTM curriculum standards and are moving rapidly to develop assessments that are aligned with the frameworks. Educational measurement specialists and psychometricians, in the academic and private sectors, are undertaking studies and serious discussion about alternative forms of assessment with which to better measure mathematical processes. Measurement organizations are modifying existing tests and beginning to develop new forms of assessment. Some mathematics teachers are beginning to use performance tasks, investigations, portfolios, essays, and other open-ended questions to assess students' development of mathematical knowledge, skills, and processes.

Simultaneously, public policy makers are becoming better informed about how limited current tests, assessments, and accountability systems are for measuring and monitoring progress toward today's more demanding goals for education. The National Education Goals Panel, established to monitor and report progress toward the national education goals, has undertaken an intensive effort to develop recommendations for new assessment and accountability systems that will be necessary for its task. The U.S. Department of Education is working to strengthen the National Assessment of Educational Progress (NAEP) so that it can provide even more information on the nation's progress in pursuit of one of the national goals—the goal for American students to demonstrate competency in challenging subject matter including English, mathematics, science, history, and geography.

Emerging from the intense national dialogue about assessment across all disciplines, is the realization that to have good assessments and accountability systems it is necessary to have clear:

- definition and public consensus on what it is that students must know and be able to do in each discipline;
- criteria by which to judge the worth or value of an assessment for its intended purposes;
- plans for the use of data to be generated by any given assessment; and
- understanding of the potential impact on groups and individuals of any proposed accountability system.

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For mathematics, there is consensus on what mathematics students should know and be able to do. The challenge now facing the mathematics education community is the development of assessment standards---criteria that enable us to judge how well assessments and assessment/accountability systems provide valid, clear information to the public on how well students are achieving and how good mathematics education programs are.

The process of developing standards for mathematics assessment must involve more than mathematics educators. It must involve test developers, measurement specialists, psychometricians, teachers, parents, mathematics supervisors, school administrators, college and university faculty, and a host of public policy makers.

For all, there is a role. The challenge is to accelerate the process of developing standards for mathematics assessment so that we can put in place the assessments and accountability systems we need to support curriculum and instruction that will yield success in meeting our national goals for mathematics.

The Steering Committee urges all of the following groups to become directly involved in pursuit of the goals for mathematics assessment, and recommends the following actions for each group:

#### **School and College Faculty and Administrators**

- Base tests and assessments on the mathematical knowledge, skills, and processes promulgated by NCTM in *Curriculum and Evaluation Standards for School Mathematics*.
- Interpret test and assessment results clearly and accurately to parents and to the community.
- Expand public knowledge and skill in understanding and interpreting results of mathematics tests and assessments.
- Accelerate research and development of alternative forms of assessment for mathematics.
- Ensure that teachers and school administrators become increasingly proficient in the use of alternative assessments to improve learning and teaching.

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### **Parents, Media, and Business and Industry**

- Judge the effectiveness of mathematics education programs on appropriate, multiple sources of information.
- Expect teachers, school administrators, school board members, and public officials to report assessment results in clear and understandable terms.
- Expect schools and education agencies to use assessment methods that are aligned with the national standards for curriculum and instruction in mathematics.
- Promote development of and commitment to funding a long-term plan for reforming mathematics tests and assessments.
- Expect the media to report on the achievement of students and the quality of instructional programs in mathematics in a complete and accurate manner that contributes to greater public understanding of test results.

### **Makers and Administrators of Public Policy**

- Lead the nation in developing valid assessments for monitoring progress toward the national goals for mathematics education.
- Base large-scale assessment efforts on curriculum frameworks that meet the national standards for mathematics curriculum.
- Facilitate the revision of policies, regulations, and law that impede mathematics assessment reform.
- Expect that all government-funded mathematics programs be evaluated with appropriate assessments of high quality.
- Support school districts with the resources to train teachers and administrators in assessment and in its use in improving learning and teaching.
- Provide resources for long-term research on development, use, and impact of alternative assessments for mathematics.

**DRAFT**



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UNITED STATES DEPARTMENT OF EDUCATION  
OFFICE OF THE DEPUTY UNDER SECRETARY FOR PLANNING, BUDGET AND EVALUATION

# FAX COVER SHEET

TO : Mark Lange

White House (Speechwriting)

FROM: Randolph Beales

U.S. Department of Education

Name and telephone number of sender Randolph Beales  
telephone number 401-0085 or 401-0094

No. of pages 3 including cover sheet.

Our fax number is (202) 401-2837

Your fax number is 456-6218

91 APR 24 10:19

April 23, 1991

MEMO FOR: WADE T. DYKE  
FROM : RANDOLPH A. BEALES **RAB**  
SUBJECT : PRESIDENTIAL SPEECH AT THE MATH SUMMIT

The speech is a good one. Someone has done a good deal of work. I just have the following comments.

The National Education Goals Panel is not convening this conference. The Mathematical Sciences Education Board is hosting it. The National Education Goals Panel is holding a forum in conjunction with the Math Summit. Therefore, I would change the last paragraph on the first page to read:

I commend the Mathematical Sciences Education Board for hosting this conference and the National Education Goals Panel for holding its forum today -- and above all, I thank the educators and policy-makers here.

On page 2, I suggest changing the first sentence in the third paragraph to read, "The budget we sent to Congress this year calls for a 13 percent increase for this purpose, for a total of nearly \$2 billion." According to our budget staff, the \$1.9 billion in question is a total amount for a number of programs across the federal government. Consequently, if we use the term, "program," people may wonder, "Which program?" Using "purpose" gets us around that. At the end of that paragraph, we could also add the sentence as transition (and to drive home the point), "Dollars alone just won't do the job."

You may want to consider deleting the next paragraph with the Gary Larson cartoon example. I am not sure that this makes your point as well as you want it to do so.

On page 3, before the beginning of the last paragraph, after you have talked about helping every American student reach their fullest potential, you may wish to cite Larry Williams, the black math teacher from rural Alabama who has done such wonders with the disadvantaged students in his school, leading his school's math teams to compete in (and frequently win) mathematics competitions and tournaments. He comes highly recommended from Mary Harly Kruter of the Mathematical Sciences Education Board and was the 1989 winner of the Presidential Award for Excellence in Science and Mathematics Teaching for mathematics teachers in the State of

Alabama. He will be present for the speech tomorrow. If you do want to include something on him, following is a suggested insert:

... will help every American student, and every American teacher, reach their fullest potential.

Larry Williams, a math teacher at Eutaw High School in rural Alabama and member of the Mathematical Sciences Education Board, is doing just that. He is having great success at helping the kids in his high school become excited about learning and excelling in mathematics. And even though his students there come overwhelmingly from poor and disadvantaged backgrounds, Eutaw High's math teams are competing with some of the best math schools in Alabama and the Southeast ... doing well in competitions and often winning. So, when people question how America can become first in the world in math and science by the year 2000, I point them to teachers like Larry Williams ... teachers who are helping ALL of our children reach their full potential.

Your efforts today put you on the leading wave ....

It is a well-written speech. However, the speech might also wish to emphasize the importance of setting high standards in testing and assessments since setting high standards is an important theme in the President's Education Reform Plan. The speech might also mention the words, "America 2000."



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**TOWARD NATIONAL STANDARDS FOR MATHEMATICS ASSESSMENT**

**A Background Paper for Participants**

**NATIONAL SUMMIT ON MATHEMATICS ASSESSMENT**

**April 23-24, 1991**

## **OUR CHALLENGE IN MATHEMATICS EDUCATION**

*"Our national goal must be to make U.S. mathematics education the best in the world. Nothing less will be adequate to fulfill American aspirations."*

-National Research Council,  
*Everybody Counts*,  
January 1989

*"By the year 2000, U.S. students must be first in the world in math and science achievement."*

-President George Bush,  
State of the Union Address,  
January 1990

American mathematics education must become world class if our students are to be first in the world in mathematics achievement. As schools are restructured to better serve the social and economic needs of the nation and its people, the infrastructure of mathematics education must be greatly strengthened. Otherwise, our children will have no chance to learn and to excel in the mathematics they need for living and working in the 21st century.

The mathematics education community is uniquely positioned to support the President, the Governors, the States, and local districts in pursuit of national goals for mathematics education. The mathematics community has developed and has begun to implement a consensus-based national plan for revitalization of mathematics education. The nation's plan is based on a strategy of national standards with local implementation---a strategy that provides a degree of coherence among education programs across the country, yet preserves the uniquely American legal and traditional practice of State responsibility and local control of education.

The nation's plan for renewal of mathematics education cannot succeed with only the mathematics education community involved. All Americans with responsibilities for and vested interests in the whole of the American educational endeavor must:

- participate in the democratic process of consensus-building on national goals and standards for mathematics,
- work arduously within their spheres of responsibility and cooperatively with all others, contributing their talents to the common cause, and
- commit to sustaining the American will to stay the course.

Nor can the nation's plan for renewal of mathematics education succeed if school reform continues at its 1980s pace. The nation must accelerate its pace and more sharply focus its human and fiscal resources on strengthening the infrastructure of mathematics education.

A vital infrastructure will have:

- **curricula** tailored to local needs but consistent with demanding national standards for what mathematics **ALL** American students must know and be able to do;
- **teachers** well-trained in mathematics and able to meet the national professional standards for teaching mathematics;
- **materials and equipment**, including high quality technological tools such as calculators, computers, and telecommunications, to support the teaching and learning of mathematics in ways that hold promise of achieving the nation's goals for mathematics achievement;
- **students and the public** who recognize the value of mathematics for all citizens and who expect that all students can and should succeed in school mathematics; and
- **tests, assessments, and accountability systems** that give students, teachers, parents, policy makers, and the public clear and valid information about the quality of instructional programs in mathematics and the level of mathematics achievement of the nation's youth.

## CHANGING MATHEMATICS

*"Any successful effort to improve mathematics curricula and instruction in the schools will require an extensive public information campaign that reaches all the varied constituencies of mathematics education. These diverse publics must be convinced in understandable language that a very different mathematics education is both better and necessary for their children and for the country."*

-National Research Council, *Everybody Counts*, 1989

*"We must ensure that tests measure what is of value, not just what is easy to test. What is tested is what gets taught. Tests must measure what is most important."*

-National Research Council, *Everybody Counts*, 1989

The nation's mathematics teachers are leading a coordinated national reform effort. The plan for restructuring school mathematics programs begins with fundamental redirections of curriculum, instruction, and assessment. These changes are most easily described in terms of what we want students and teachers to be able to do, and what assessments must do for students, teachers, and others who require information about mathematics education.

## Curriculum

*Goals for student performance are shifting from a narrow focus on routine skills to development of broad-based mathematical power.*

Broad-based mathematical power refers to students' ability to:

- solve non-routine problems, individually and in groups;
- reason logically;
- communicate about mathematics and describe quantitative situations;
- connect mathematical ideas to real situations; and
- use thinking skills to select and apply routine procedural skills.

The repertoire of skills that now undergird mathematical power includes not only some traditional paper-and-pencil skills, but also many more powerful capabilities. A few examples of the latter are ones for which *all* students must be able to:

- make decisions based upon the collection, representation, and interpretation of real data;
- use tables, graphs, spreadsheets, and statistical techniques to organize, interpret, and present numerical information;
- judge the validity of mathematical and technical information presented by the media and others;
- use computer software for mathematical tasks;
- estimate orders of magnitude to confirm mental or calculator results; and
- perform mental calculations and estimates with proficiency.

## Instruction

*Goals for teacher performance are shifting from authoritarian models based on "transmission of knowledge" and "drill and practice" to student-centered methods featuring "stimulation of learning" and "active involvement".*

The familiar classrooms of passive students who are expected to absorb rules that appear as arbitrary dicta are gradually giving way to learning environments that:

- encourage students to explore;
- help students to verbalize their mathematical ideas;
- show students that many mathematical questions have more than one right answer;
- teach students through experience the importance of careful reasoning and disciplined understanding;
- make mathematics alive and exciting; and
- build confidence in all children that they can learn mathematics.

The most useful metaphor for describing the modern teacher is that of an intellectual coach. At various times, this will require that the teacher be:

- a *role model* who demonstrates not just multiple paths to a solution but also the false starts, the higher-order thinking skills, and the effort that lead to the solutions of problems;
- a *questioner* who challenges students to make sure that what they are doing is reasonable and purposeful, and ensures that students can defend their conclusions;
- a *moderator* who poses questions to consider but leaves much of the decision making to the students, working individually or in groups; and
- an *interlocutor* who supports students by encouraging them to reflect on their activities and to explore mathematics on their own.

## **Assessment**

*Needs for assessment information are shifting from single numerical descriptors of minimum skills achievement to multiple descriptors of performance across a wide range of mathematical skills and processes.*

We need mathematics assessments that:

- promote the development of mathematical power for all students;
- communicate to students, parents, and teachers the mathematics students know as well as the mathematics they have yet to learn;
- measure the full range of mathematical knowledge, skills, and processes that are valued and needed by society; and
- communicate to school administrators, policy makers, and the public about the quality of mathematics education in the nation's schools.

The means of assessing student achievement in mathematics must be expanded to include judging of student products and performances such as:

- responses to open-ended questions,
- writings,
- computer demonstrations,
- debates,
- presentations,
- designs and inventions,
- investigations, and
- models and simulations.

## STRATEGY FOR CHANGE

*"If we expect to mount a successful effort to reform mathematics and science education in this country, we must have consensus agreement on three things:*

- what kids ought to know about math and science;*
- how it should be presented to them; and*
- how we're going to measure the results."*

-Richard Heckert, Former Chair and Chief Executive Officer,  
E.I. DuPont de Nemours and Company,  
December 1988

Effective reform of school mathematics requires professional, political, and public consensus on three issues:

- curriculum--what mathematics young people should know and be able to do;
- instruction--how it is to be presented to them; and
- assessment--how results are to be measured.

For two of these building blocks of reform---curriculum and instruction---consensus-based national goals and standards are established. The National Summit on Mathematics Assessment is the first major step in establishing the third of these building blocks.

### **Standards for Curriculum and Instruction**

The 1989 *Curriculum and Evaluation Standards for School Mathematics* of the National Council of Teachers of Mathematics are a milestone in the history of education in our country. They are forward-looking goals, describing with appropriate specificity the teaching profession's best judgement of what students should learn about mathematics at various ages. These guidelines provide school mathematics programs across the nation with a common philosophy and framework---a universal set of interrelated concepts and methods held together by a simple workable philosophy, yet flexible enough to allow for local and regional variations.

In 1991, school and college teachers of mathematics have taken another significant step by issuing *Professional Standards for Teaching Mathematics* (National Council of Teachers of Mathematics) and *A Call for Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics* (Mathematical Association of America). These reports set forth goals and standards for the teaching of school mathematics and address the corresponding changes needed in college-university preparation of teachers. Like the curriculum standards that preceded them, these are demanding standards that call for both increased knowledge about mathematics and greater expectations of what teachers must know and be able to do to teach mathematics. These guidelines provide teachers, school administrators, college faculty, and policy makers the basis for renewing teacher professionalism in the nation.

## **Standards for Assessment**

Development of goals and standards for assessment was begun by mathematics teachers: the NCTM's *Curriculum and Evaluation Standards for School Mathematics* includes standards for evaluating student performance and curricula programs that emphasize classroom assessment---assessment to provide teachers information for instructional decisions. Because more encompassing assessment standards are needed to guide broader constituencies on accountability assessment, mathematics educators recognized that the initial effort had to be expanded.

The process for developing comprehensive goals and standards for assessment is different from the process mathematics teachers used to develop national standards for curriculum and instruction. For curriculum and instruction, the mathematics teachers themselves developed draft goals and standards, and then offered the draft to the public at large for a full year of review and examination. Following the extensive public review and debate, mathematics teachers spent another year revising the standards so that the finished product would represent the consensus of all constituencies concerned about mathematics education.

It is not possible to develop goals and standards for mathematics assessment in the same way because the decision-making authority for external assessment and the expertise in test development lay outside the mathematics education community. From school house to State house, a host of people, agencies, and test developers make decisions about what mathematics is assessed, how it is assessed, and which particular tests are used. Thus, all of those constituencies had to be part of the process at its very beginning.

The Mathematical Sciences Education Board (MSEB), established in 1985 by the National Research Council to provide a continuing national overview and assessment capability for mathematics education, initiated collaborative action by forming in June, 1990, a Steering Committee for a National Summit on Mathematics Assessment. The Steering Committee members represent the assessment/testing industry, the private sector, the public policy sector of States and localities, the mathematics education community, assessment/measurement experts, and national policy organizations such as the National Governors' Association, the College Board, Education Commission of the States, Council of Chief State School Officers, National Conference of State Legislatures, National Education Association, American Federation of Teachers, National Alliance for Restructuring Education, National Congress of Parents and Teachers, National School Boards Association, National Association of State Boards of Education, the Council for Basic Education, and Association for Supervision and Curriculum Development.

The Steering Committee conducted regional forums for exchange of information, concerns, and priorities of various groups and individuals throughout the United States on mathematics tests and assessments. A summary of the regional forums is available as a separate document. From the consensus that emerged from these regional meetings and the Steering Committee's deliberations, a vision for mathematics assessment is emerging.

## **A VISION FOR ASSESSMENT**

*"Substantial work will be required to develop new tools for assessing and reporting on student performance."*

-National Governors' Association Report,  
July 1990

*"Accountability for progress toward achieving the goals, on part of states and the federal government, has been a key ingredient in the goals process from the beginning. The role of the Panel is to try to make this measurement process meaningful, credible and a constructive force for changing the system."*

-National Education Goals Panel,  
October 1990

*"Tests and other assessments need to be aligned with the forward-looking national curriculum standards set by the mathematics education community so that the public has a clear understanding of how well American students are achieving in the mathematics that is valued and needed by today's society."*

-Mathematical Sciences Education Board,  
October 1990

As Americans begin to recognize the importance of a stronger mathematics education for the entire population, they are beginning to call for improved means for measuring results. The public is not only calling for greater accountability, but for tests and assessments that present them clear and valid information about students' achievement in the mathematics that is valued and needed by society. Mathematics educators have joined with public policy makers and the testing industry to launch a consensus-process that will produce national goals and standards for mathematics assessment, standards to complement the existing national standards for curriculum and instruction in school mathematics.

The purpose of assessment is to provide useful information for decision makers. Thus, the overarching purpose of mathematics assessment is to provide information to:

- students who make decisions about themselves as learners of mathematics;
  - teachers who make decisions about how they are to instruct each student;
  - parents who make decisions about supporting their children in developing mathematical abilities;
  - school administrators who make decisions about the effectiveness of mathematics programs in their schools;
  - public policy makers who make decisions about the best use of resources in developing and maintaining mathematics programs of the highest quality;
- and
- the public who make decisions about the effectiveness of (i) mathematics education systems and (ii) the policy makers, school administrators, and teachers who are who are responsible for those systems.

### **Classroom Assessment**

Assessment used within a classroom, sometimes referred to as internal or clinical assessment, serves the information needs of students, teachers, and parents. The primary purpose of classroom assessment is to improve learning.

Rich and highly detailed information about a student's strengths and weaknesses help both a student and a teacher know which efforts are improving mathematical learning and which are not. With the same information and the teacher's analyses, parents are better informed about their child's progress and how they can contribute to the development of the child's mathematical abilities.

Teachers improve their instruction with assessment information that informs them about:

- knowledge, skills, and processes the student has acquired;
- specific knowledge and skills the student has yet to master;
- sources of error and faulty procedures;
- specific learning behaviors that are to be encouraged and developed or discouraged and replaced, and;
- the effectiveness of their teaching strategies.

Classroom assessments must produce information about a student such as the student's:

- use of mathematics to make sense of complex situations and to cope with poorly-defined problems similar to those in real life that have more than one right answer;
- ability to formulate and reformulate hypotheses, collect and organize data, and communicate results orally or in writing;
- use of mathematical processes, including computation, in applied contexts;
- understandings and misunderstandings about mathematical concepts and processes;
- ability to question solutions, to consider all possibilities, and to persist in extended investigations; and
- growth in mathematical power and productive work over time.

### **External Assessment**

External assessments, sometimes referred to as formal or accountability assessments, provide information for school administrators, policy makers, and the public on achievement levels of groups of students and on the effectiveness of mathematics education programs. It is essential that these assessments clearly inform the public about how well its schools are equipping its young people in the mathematics that counts for living and working in today's society.

Adults are valued and rewarded in their working lives for the tasks/projects they complete, for their ability to work productively with others to achieve a goal, and for the ways in which they respond to problem situations. If formal assessments are to give the public accurate information on how they may expect the next generation of workers to perform, then these assessments must produce, in addition to information about mathematical skills and knowledge, information about how well schools are fostering students' ability to:

- apply mathematics to produce solutions to real problems and to complete a project;
- communicate quantitative information and ideas effectively;
- persist in a demanding task; and
- work productively in a group, coordinating individual efforts to solve problems and complete projects.

External assessments of mathematics achievement and performance of groups of students, in conjunction with other indicators, provide information about the effectiveness of mathematics education programs. These other indicators should provide information about:

- how well curricula are aligned with the nation's vision for school mathematics;
- the quality of mathematics instruction;
- the qualifications and training of teachers of mathematics;
- the adequacy and availability of instructional materials (print, video, and software) to support the vision for school mathematics;
- the adequacy and availability of instructional technology---calculators, computers, telecommunications;
- the expectations that students, parents, and teachers have for the mathematical achievement of students; and
- equity of opportunity to learn.

## **OUR OPPORTUNITY**

Mathematics is a key to opportunity:

- for our children---the opportunity to participate fully and equally in the world of the future;
- for American citizens---the opportunity to make better informed decisions on issues arising in our rapidly changing society; and
- for the nation---an opportunity to compete successfully in a technology-based world economy.

Many observers believe that mathematics offers the best hope the country has for making significant progress in education reform in this decade. Summit participants have an opportunity to contribute significantly to meeting national education goals by accelerating the development of national standards for mathematics assessment.

The Mathematical Sciences Education Board is pleased that you have accepted the invitation to join in common cause.



## MATHEMATICAL SCIENCES EDUCATION BOARD

NATIONAL RESEARCH COUNCIL

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### ASSESSMENTS: BACKGROUND/FACTS & FIGURES\*

"In the **Education Index**, a yearly listing of all educational literature, entries under the categories of curriculum and testing show that increasingly more attention in the literature is given to testing than to what should be taught. While the average annual number of column inches devoted to curriculum issues barely doubled from the 1930s to the 1980s, the number devoted to testing citations increased 35-fold." (p.15)

"From 1972 through 1985 the number of state testing programs grew from one to 34. by 1989 every state had a mandated testing program of some sort."

"From 1955 to 1986 the **reported** dollar volume of sales of tests and testing services at the elementary and secondary level (referred to in the industry as the ELHI market) grew by almost 400 percent. Reported sales (in 1988 dollars) rose from less than \$30 million in 1955 to over \$100 million by 1986."

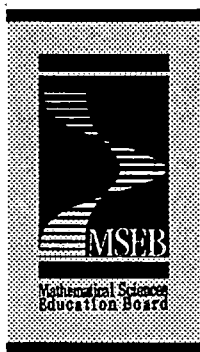
"Direct costs to taxpayers of purchasing and scoring state and local tests range from \$70 million to \$107 million annually."

"Indirect costs of this testing, in terms of teacher and administrator time simply spent administering the tests, is in the range of \$268 million to \$421 million, or three to four times the direct costs."

"Indirect costs associated with teacher time given over to test preparation conservatively adds \$387 million to the costs of education."

"Overall, the direct costs to taxpayers for state and local testing plus indirect teacher costs total between \$725 million and \$915 million annually."

**\*All of the above is from the Report of the National Commission on Testing and Public Policy, *From Gatekeeper to Gateway: Transforming Testing in America*, 1990.**



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## National Summit on Mathematics Assessment

### STEERING COMMITTEE

#### Mathematical Sciences Education Board

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**MATHEMATICAL SCIENCES EDUCATION BOARD STAFF FOR  
NATIONAL SUMMIT ON MATHEMATICS ASSESSMENT**

Dr. Kenneth M. Hoffman  
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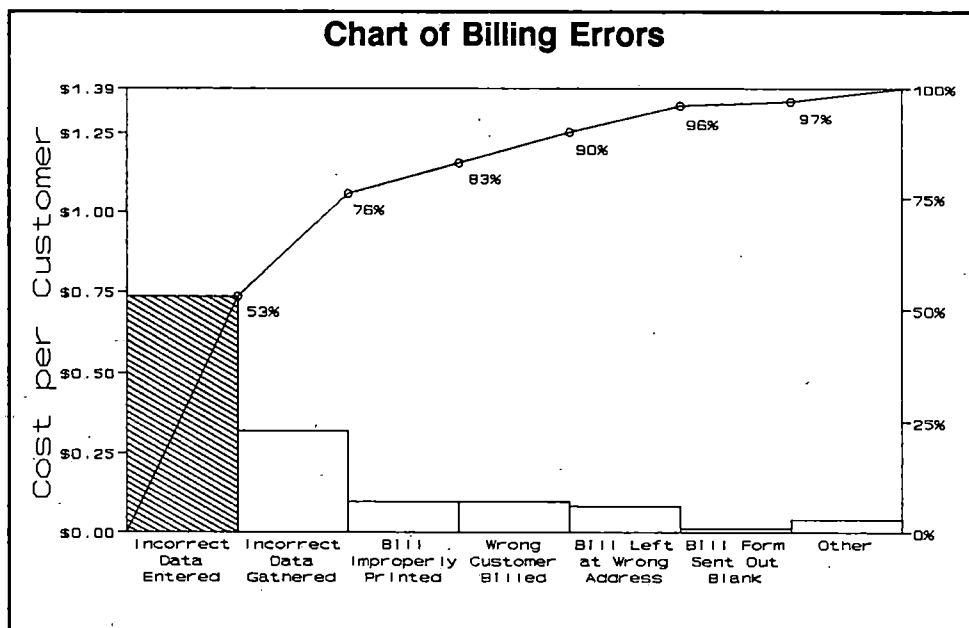
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## WHAT'S THE PROBLEM?

- Current tests do not measure the mathematics business leaders and educators believe students should know.**

This fact is important for two reasons: (i) test content determines what is taught in the nation's classrooms and (ii) the mathematics taught in today's schools must change in order to create the quantitatively literate workforce the nation needs to remain competitive in the global economy.

Students need to master mathematical content beyond arithmetic; they need skills and knowledge of algebra, geometry, measurement, probability, and statistics to function in a society increasingly shaped by mathematics, science, and technology. For example, businesses need employees who can use statistical techniques to organize and describe data and who can make inferences and convincing arguments based on that data analysis. Such skills were required of a team of employees of a utility company working together to minimize per-customer cost of billing errors. These employees collected and organized the data presented in the chart below so that they could develop an effective quality control plan.



Source: Florida Power and Light Company

An analysis of six of the most widely used commercially-produced tests of grade mathematics achievement shows that, on the average, 74% of the tests measure arithmetic skills, including paper and pencil computational skills which are little used in school because calculators are so readily available. The remaining 26% of the tests measure skills and concepts in algebra, probability, statistics, geometry, and measurement...many of which are the knowledge needed for everyday life applications. (See Romberg's paper elsewhere in this packet for more detail of this analysis.)

**Current tests are not matched with goals for education reform.**

Current multiple-choice and standardized tests tend to measure routine procedural skills rather than problem-solving skills. For example, an item such as the one given below measures a procedural skill involving percentages.

What percent of 500 is 30 ?	
A. 6%	C. 60%
B. $16.\bar{6}\%$	D. $166.\bar{6}\%$
E. none of the above	

Whereas, an item such as the one below measures the ability to apply procedural skills involving percentages to solve a problem, and further measures the skills of communicating quantitative information. This item was used on a national assessment project in the Netherlands, a country which ranks third or fourth on mathematics tests on which the U.S. ranks at or near the bottom. (Holland, as well as most other industrialized nations, does not rely solely on narrowly-focused, multiple-choice tests for accountability purposes.)

In Defense of Holland	
The Facts:	
In 1980, the defense budget of a certain country was \$30 million out of a total budget of \$500 million. In 1981, the defense budget of that same country was \$35 million out of a total budget of \$605 million. The country's inflation rate for that one-year period was 10%.	
The Tasks:	
1. Use the facts to argue that the defense budget increased from 1980 to 1981.	
2. Use the facts to argue that the defense budget declined from 1980 to 1981.	



**Current pressures for more accountability testing have increased the stakes and inhibited curricular reform.**

As policy makers' needs for measuring educational progress increase, there is greater reliance on currently-available tests for educational decision-making. Between 1972 and 1985, the number of mandated state testing programs grew from 1 to 34; by 1989, every state had a mandated testing program of some type. The high stakes now associated with test results have caused teachers to increase time spent on instruction of topics measured by the tests and on test preparation, and to decrease time spent on developing students' abilities to integrate, synthesize, and apply knowledge and data to solve complex problems. Thus, the use of current tests means that well-intentioned accountability demands may be inhibiting needed reform.

## MISSION...guiding local actions toward national goals

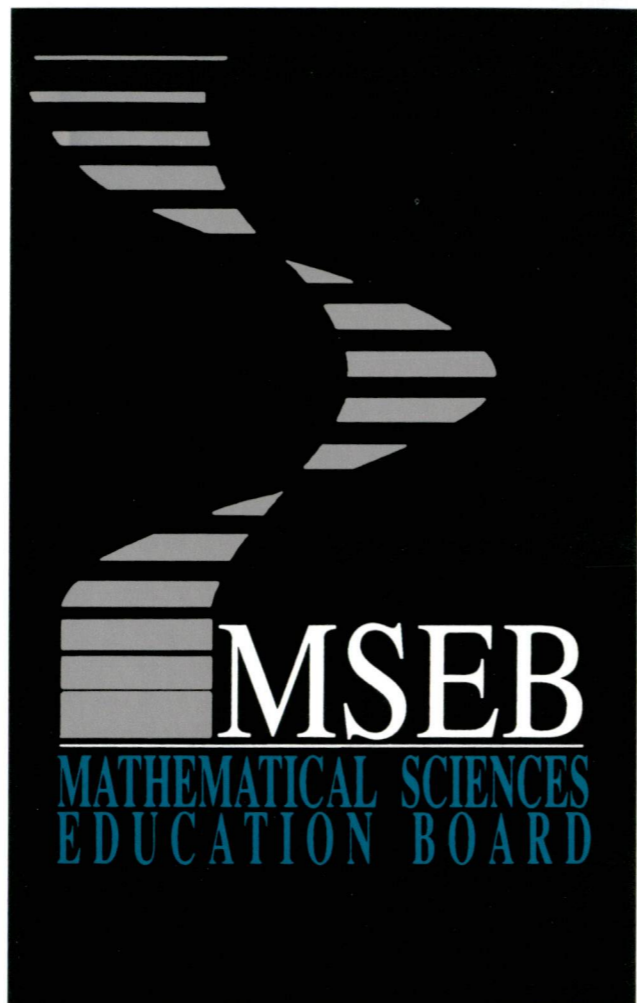
In 1985, the National Research Council created the Mathematical Sciences Education Board as part of a national reform of mathematics education.

In its first major publication, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education in the United States*, MSEB sets forth a compelling argument for fundamental mathematics education change. *Everybody Counts* presents four essential national goals for school mathematics programs:

- Teaching a significant common core of mathematics to *all* students
- Stimulating the interests and challenging the capabilities of *each* student
- Placing greater emphasis on topics that are relevant to students' needs
- Developing student confidence in using a wide range of problem-solving strategies

*The MSEB is a unique coalition of national leaders from the mathematical sciences, education, government, parent groups, and the corporate sector. To carry out its mission, the Board:*

- *Builds consensus on the goals of mathematics education*
- *Promotes national standards*
- *Establishes structures for facilitating change*
- *Develops prototypes of content and instruction*
- *Reports to the nation on the status of mathematics education*
- *Defines national strategies for implementing change*



*...from consensus to action*



National Academy of Sciences  
National Academy of Engineering

### Mathematical Sciences Education Board

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*More than ever before, Americans need to think for a living...  
to think mathematically. —Everybody Counts*

tionally

## ACTIVITIES...facilitating change

In the national strategy to  
The MSEB is working  
in a manner that  
on a national need. It does this  
programs in mathematics  
national goals as repre-  
*valuation Standards for*  
nal Council of Teachers

The MSEB is engaged in a wide variety of activities in its effort to improve mathematics education at *all* levels and for *all* students.

Several of these activities are well advanced.

- Coordination of the work of professional organizations that are developing professional teaching standards
- Development of a national strategy for reaching out to groups that are traditionally underrepresented in the mathematical sciences
- Dissemination of the results of recent international comparisons of mathematics achievement
- Creation of materials that, through family involvement, encourage young children to be successful in mathematics
- Establishment of a national network of state-level mathematics coalitions
- Promotion of mathematics education as a priority concern for a wide range of national organizations

Other MSEB activities are just beginning.

- Organization of a national Corporate Council to link business and industry with the reform effort in mathematics education
- Adaptation to U.S. schools of successful international practices in mathematics instruction
- Development of national standards for assessing mathematics education, focusing on accountability

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*In the next decade, the United States has an historic opportunity to revitalize mathematics education.* – *Everybody Counts*

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## BOOKS, KITS, AND OTHER EDUCATIONAL MATERIALS...inviting participation

You have a role to play in improving school mathematics, and MSEB publications can help you to clarify that role. MSEB books, kits, and other educational materials provide information about national issues in mathematics education.

*Everybody Counts: A Report to the Nation on the Future of Mathematics Education* (1989) documents the need for fundamental change in the content and delivery of the mathematics curriculum.

*Mathematics Education: Wellspring of U.S. Industrial Strength* (1989) presents the views of business, industry, and education regarding their roles in producing a work force in which all employees are mathematically literate problem solvers.

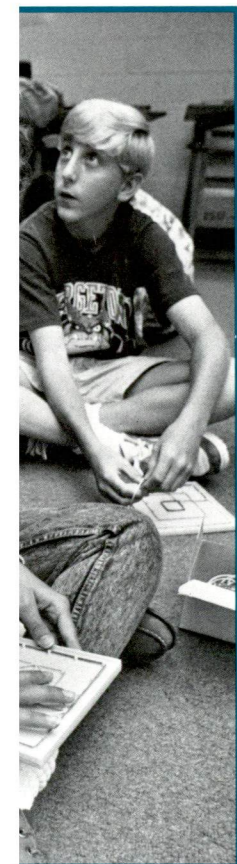
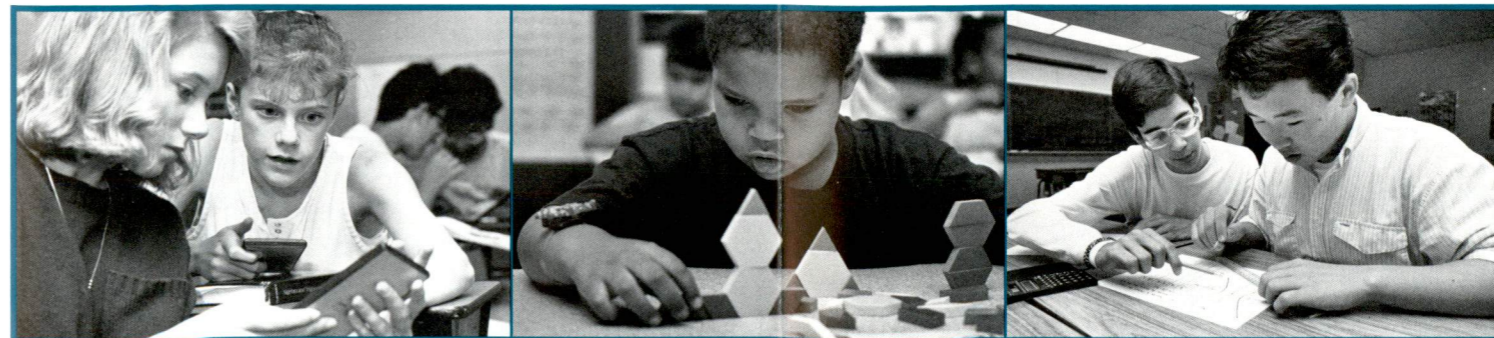
*Reshaping School Mathematics: A Philosophy and Framework for Curriculum* (1990) examines fundamental issues that govern curricular reform – the roles of mathematics, the state of research on teaching and learning, and the dynamics of change.

*On the Shoulders of Giants: New Approaches to Numeracy* (1990) is a collection of essays on sample strands for school mathematics of the next century – change, dimension, quantity, shape, and uncertainty.

*Math Matters: Kids Are Counting on You* (1989) is a kit of parent-tested mathematics materials that foster positive parental attitudes while building elementary school children's interest and confidence in doing mathematics.

*U.S. School Mathematics from an International Perspective: A Guide for Speakers* (1989) is a speaker's kit (35mm color slides, speaker notes, and background information) summarizing the results of recent international comparisons of mathematics achievement.

If you wish further information about any of these publications, contact the Mathematical Sciences Education Board at 202/334-3294.



# NATIONAL SUMMIT on MATHEMATICS ASSESSMENT

April 23-24, 1991



*“Substantial work will be required to develop new tools for assessing and reporting on student performance.”*  
– National Governors’ Association Report  
July, 1990



National Academy of Sciences  
National Academy of Engineering  
National Institute of Medicine

**Mathematical Sciences Education Board**  
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*“By the year 2000, U.S. students must be first in the world in math and science achievement.”*  
– President George Bush, State of the Union Address, January 1990



Mathematical Sciences  
Education Board

Our country’s economic well-being demands that we have a population with greater thinking, reasoning, and learning skills in mathematics. For this reason, two of the national education goals set by President Bush and the 50 Governors call for significantly increased mathematics achievement.

The mathematics education community is pursuing a coordinated and broad based reform plan in order to meet these national goals. Its key elements are new and more demanding national standards for what is taught in mathematics and how it is taught.

These standards call for all students to develop mathematical power, the ability to use mathematics to solve non-routine problems – to explore, conjecture, reason logically, and communicate about mathematics.

If our students are to meet such standards, mathematics programs in our schools must expand to include much more than the traditional basic skills. Teaching must change. Most of all, the tests that we use to measure student achievement must be significantly changed to emphasize thinking skills as well as computational skills.

*“There will be fewer jobs for those who cannot read, follow directions, and use mathematics.”*  
*“Undereducated, Uncompetitive USA”*  
– Report of a Corporation Task Force on Education  
Union Carbide Corporation, 1989

At the National Summit on Mathematics Assessment, consensus was forged among

- mathematicians
- the education community
- the assessment community
- business and industry
- parents and the public

As the public need for progress increases, the number of currently-available tests for mathematics has grown. Between 1972 and 1988, the number of testing programs grew from 10 to 100. Most states had a mandated test.

Unfortunately, most mathematics programs have a narrow focus on basic skills. The range of mathematical topics and business/industry applications is limited. The ability to live and work in a technologically advanced society requires mathematics, science, and engineering.

The high stakes now attached to these tests have resulted in *more* content being taught, *more* instruction of topics meant to be covered in preparation, and *less* time for students to integrate their knowledge and data to solve problems.

Tests and other assessments are being set by the mathematics education community. The public has a clear understanding of what American students are doing and that is valued and needed.

# SUMMIT ON MATHEMATICS ASSESSMENT PURPOSES

- Reach consensus among key constituencies on both the goals and the plan
- Gain commitments of Summit participants and their organizations to the implementation of the national plan
- Produce and widely disseminate a document describing Summit outcomes

As a way to learn about the concerns and priorities of various groups and individuals throughout the U.S., the MSEB is holding four regional meetings prior to the National Summit on Mathematics Assessment.

Sites and 1990 dates:

- Portland, OR                      October 19-20
- Nashville, TN                     October 26-27
- Minneapolis, MN                 November 2-3
- Hartford, CT                      November 16-17

Planning for the Summit is directed by a Steering Committee of 40 national education and public policy leaders who are advising the mathematics education community about new directions for mathematics assessment. Summit attendance is invitational. In addition to individuals in mathematics education, assessment, and educational policy fields, attendees will include state teams made up of Governors (or their representatives), state school board chairs, chief state school officers, state mathematics supervisors, state legislators, state directors of assessment programs, and members of state mathematics coalitions.

To request further information about the National Summit on Mathematics Assessment project, contact Dr. Mary Harley Kruter, Project Director.

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Education Board is  
on Mathematics  
pment of standards for  
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