



Still At Risk

*Mathematics
in the US*



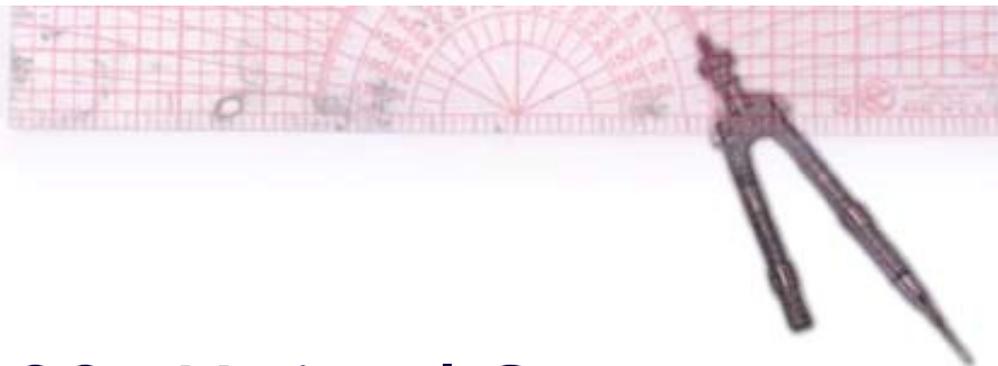


A Nation At Risk

“We are at risk of becoming a nation divided both economically and racially by knowledge of mathematics.”



Source: National Research Council, 1989



“By the year 2000, United States students will be first in the world in mathematics and science achievement.”

–National Education Goal #5





Achievement In K-12



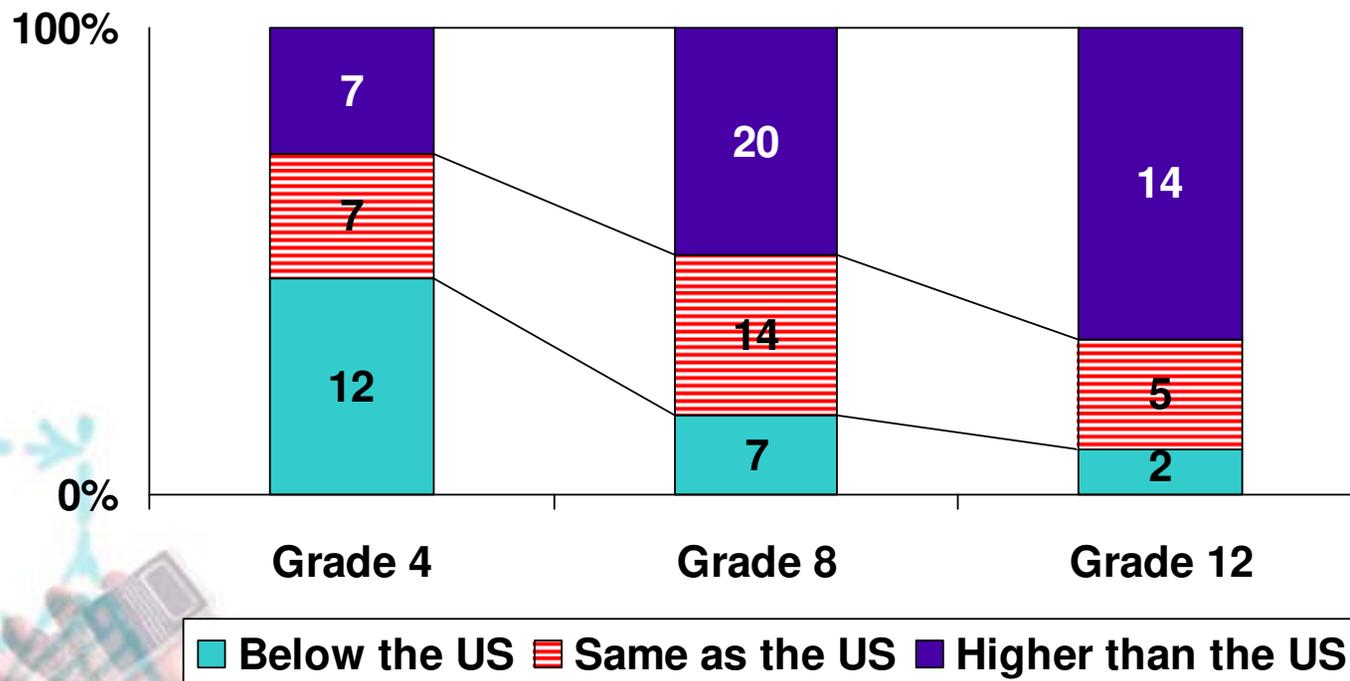


Results on International Assessments



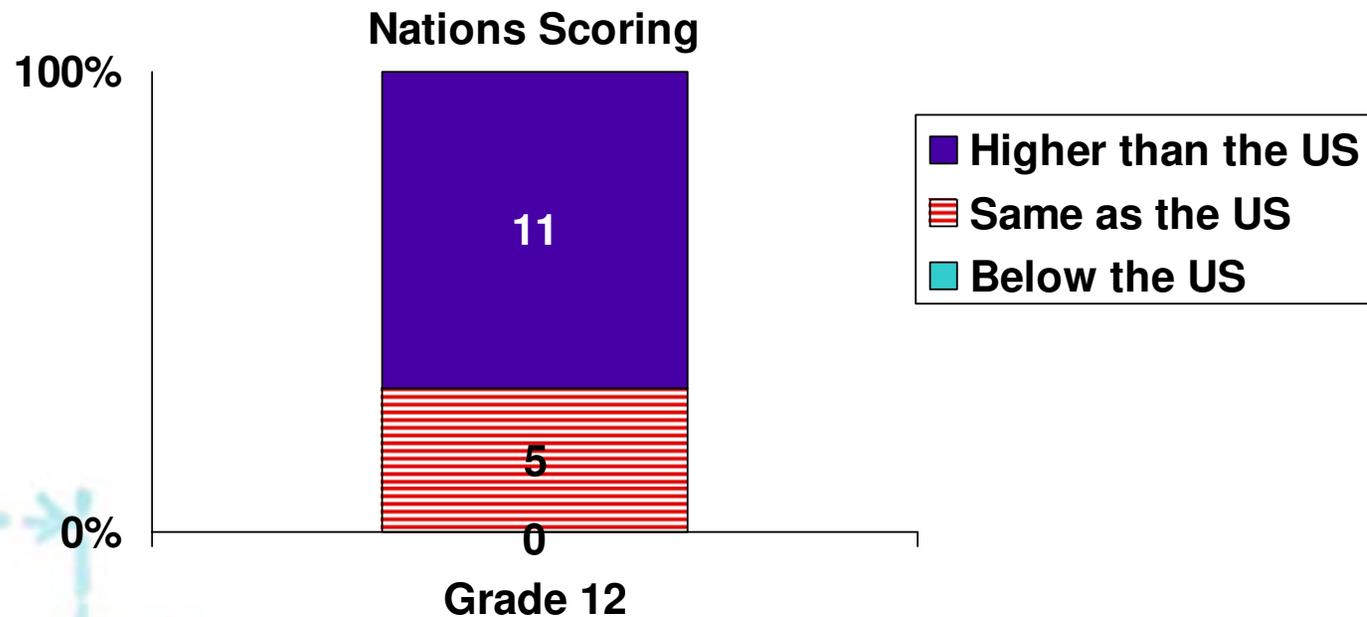
TIMSS Nations' Average Mathematics Performance Compared With the US

Nations Scoring



Source: NCES 1999-081R, *Highlights From TIMSS*

Average Mathematics Performance of Advanced Mathematics Students in All TIMSS Countries

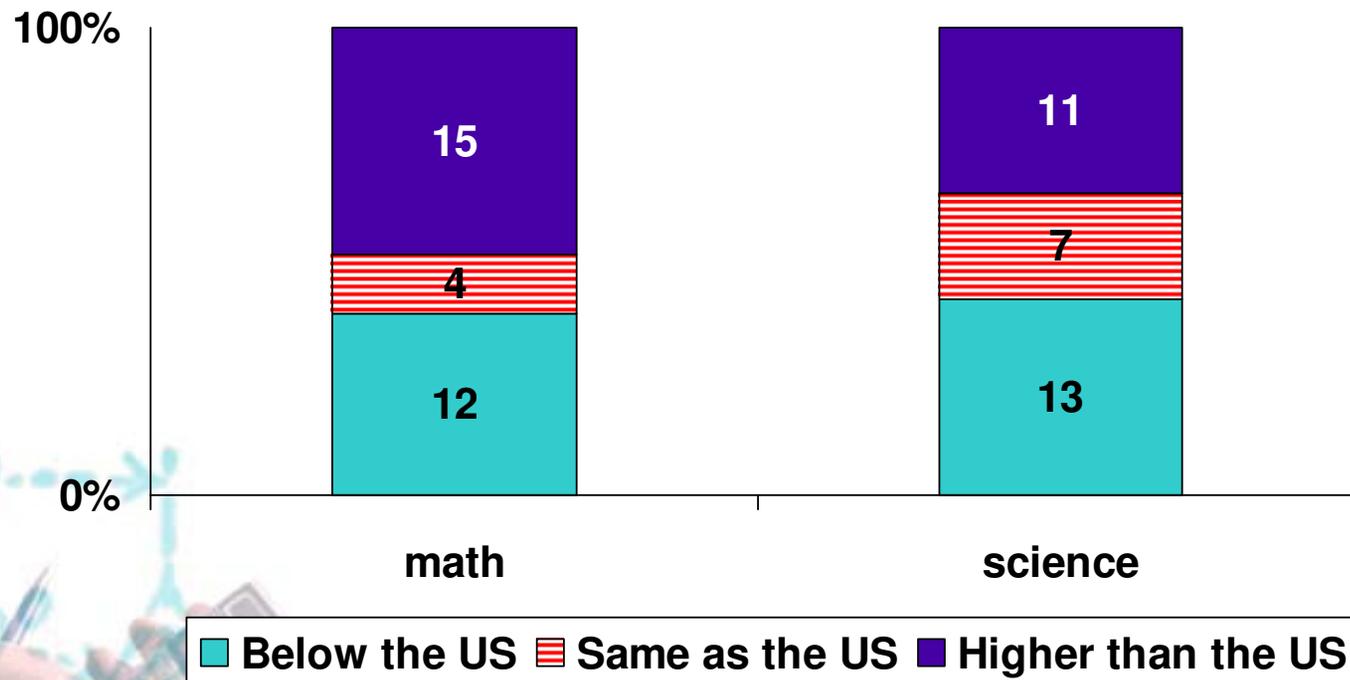


*US students with pre-calculus, calculus, analytic geometry or AP calculus instruction, representing about 14% of the US cohort. Of the higher-performing countries, all but four include more of their age cohort in this category.

Source: NCES, TIMSS, Pursuing Excellence: A Study of US Twelfth-Grade Mathematics and Science Achievement in International Context, 1999.

Nations' Average Mathematics & Science Performance Compared With the US on PISA

Nations Scoring



Source: Organization for Economic Cooperation & Development, Programme for International Student Assessment, 2000



One measure on which we're
near the top on PISA?

Inequality!





Performance Of US 15 Year-Olds Highly Variable

	PISA 5 th -95 th Gap Rank*
Reading (interpreting texts)	3
Mathematical Literacy	6 (tie)
Science Literacy	7

***Of 27 OECD countries**

Source: OECD, *Knowledge and Skills for Life: First Results From PISA 2000, 2001.*



Inside the US

... a look at NAEP results



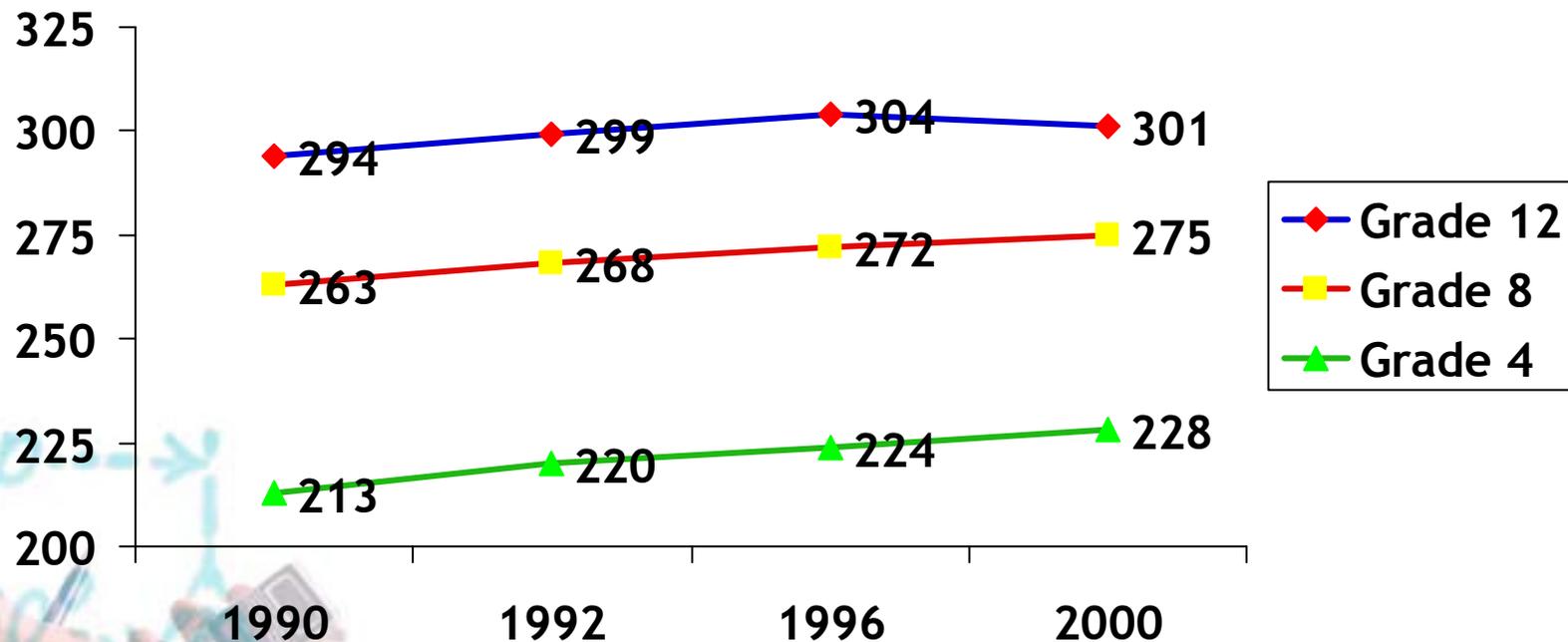


Results Up at All Grade Levels



National Mathematics Scale Score Results: 1990-2000 4th Graders Show Most Gains

Nation



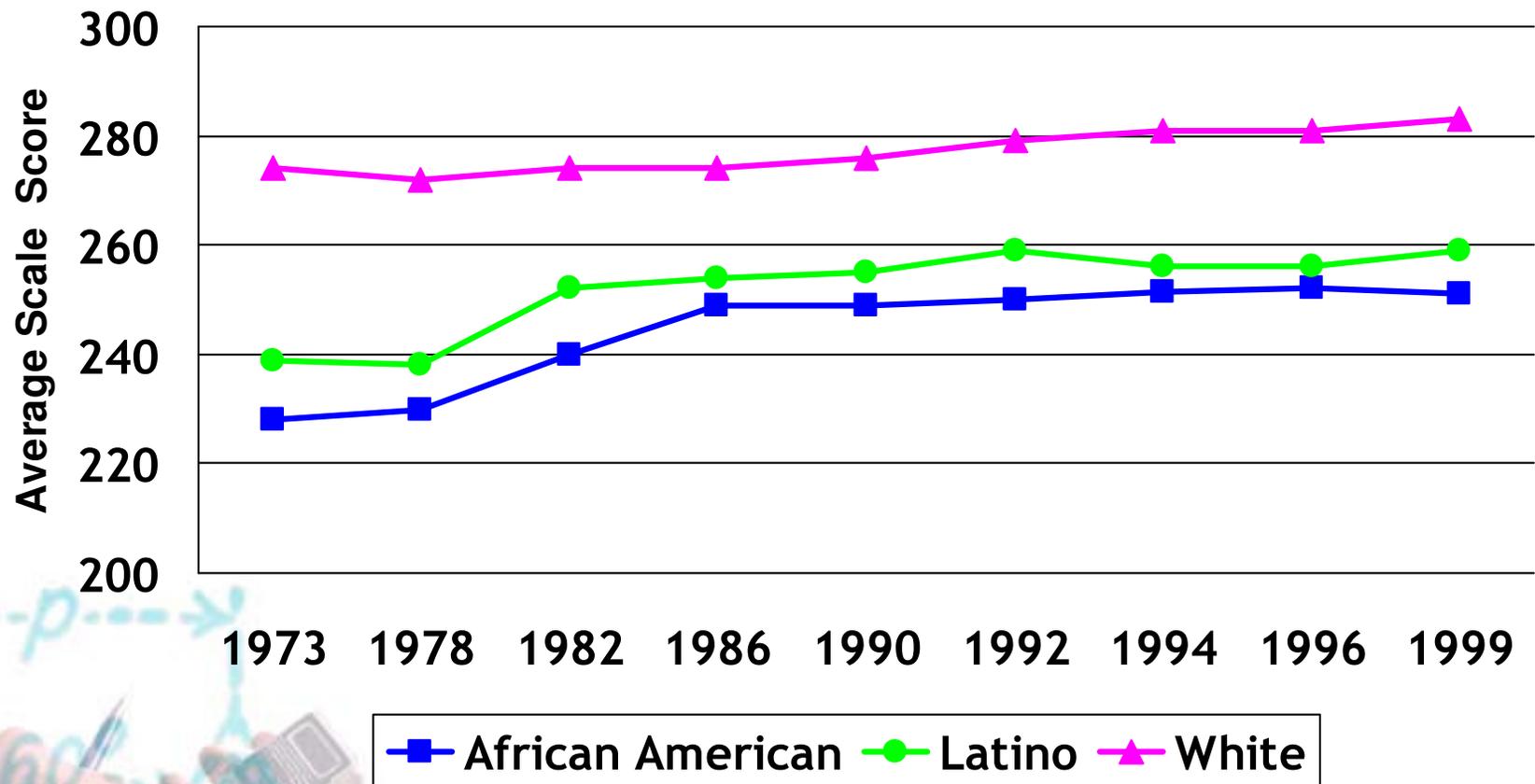
Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1992, 1996, and 2000 Mathematical Assessments.



Unlike in previous decades, when minorities made greater gains, gaps remained wide during nineties.

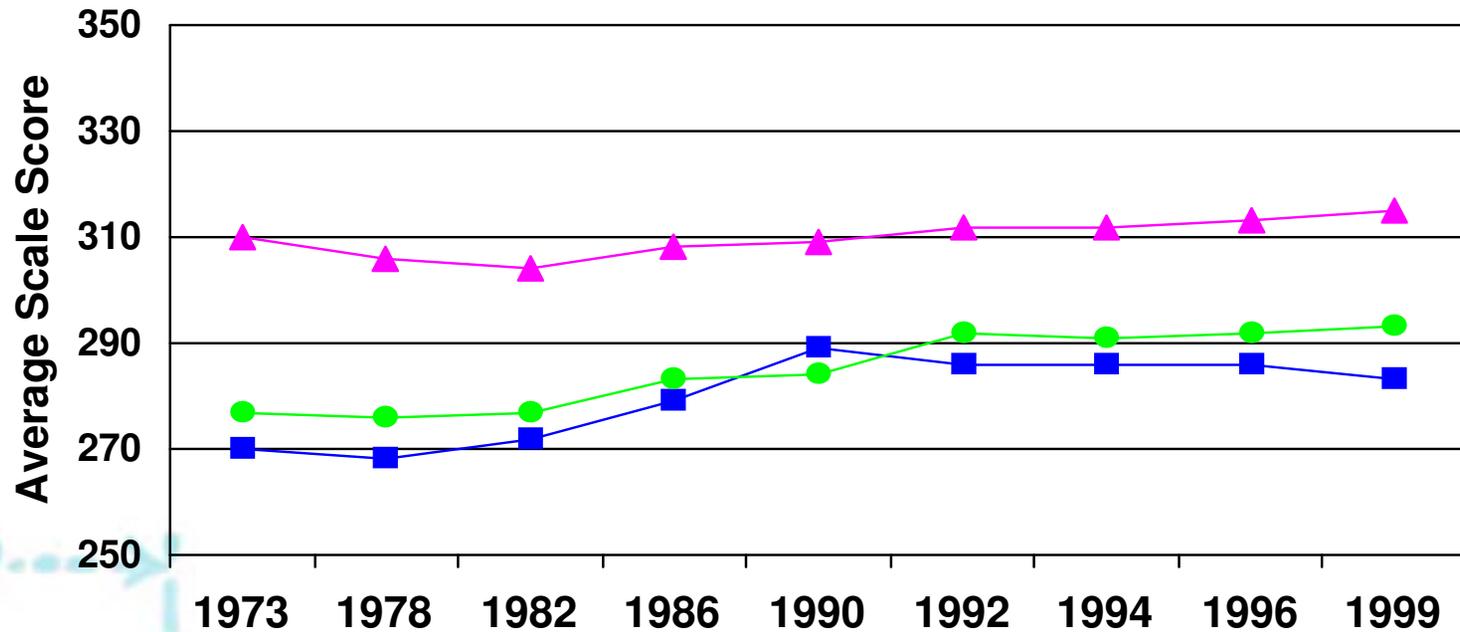


Gaps Narrow, Then Hold Steady or Widen: NAEP Math Scores, 13 Year-Olds



Source: US Department of Education, National Center for Education Statistics. *NAEP 1999 Trends in Academic Progress* (p. 108). Washington, DC: US Department of Education, August 2000

Gaps Narrow, Then Hold Steady or Widen: NAEP Math Scores, 17 Year-Olds



Source: US Department of Education, National Center for Education Statistics. *NAEP 1999 Trends in Academic Progress* (p. 108) Washington, DC: US Department of Education, August 2000

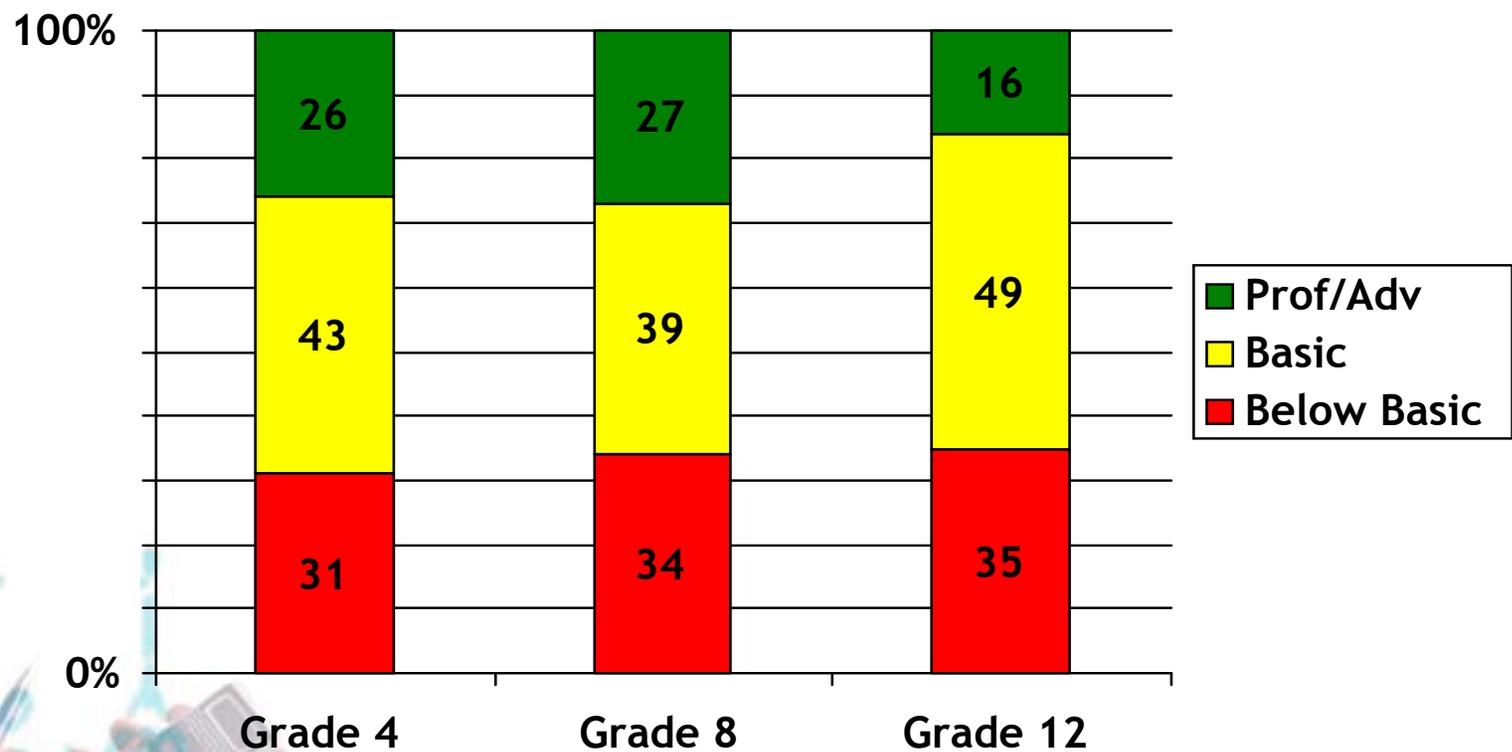


Despite progress, few students
proficient or advanced...
and too many performing below
even the basic level.





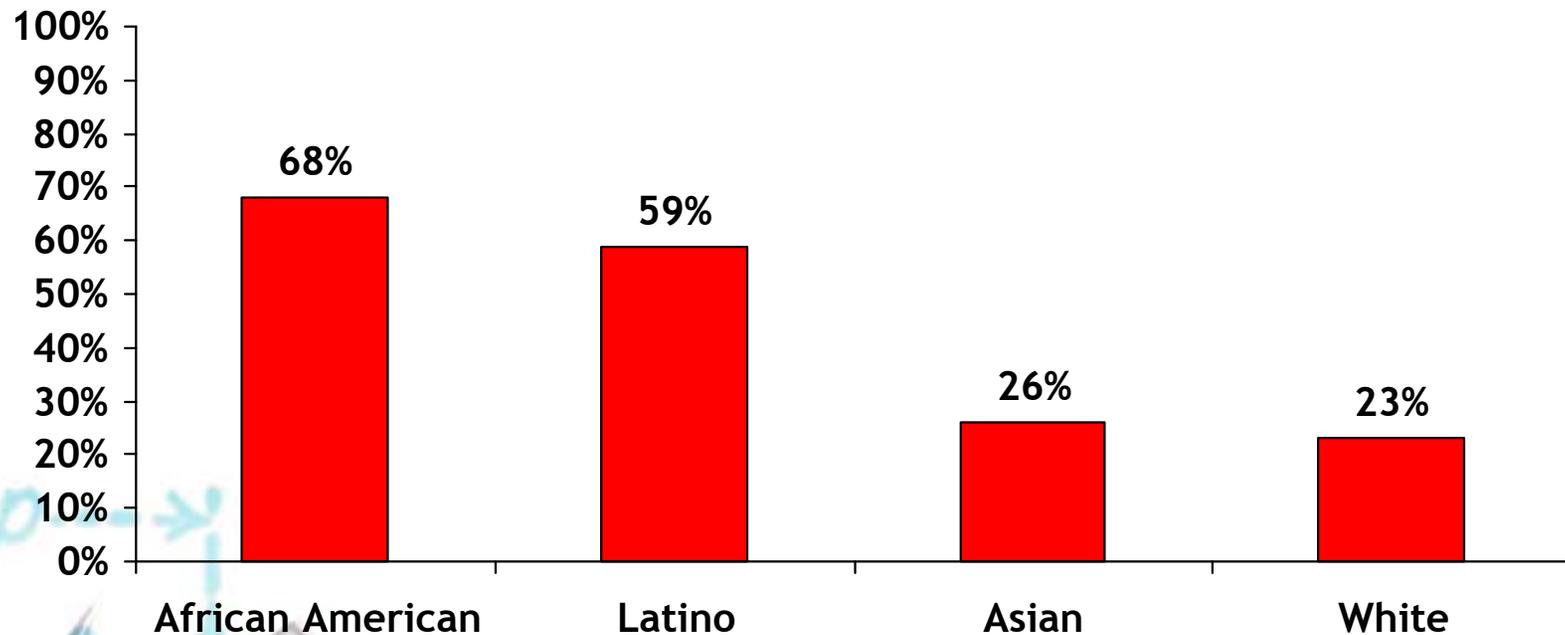
NAEP Mathematics Performance 2000



Source: US Department of Education, NEAP Mathematics 2000.



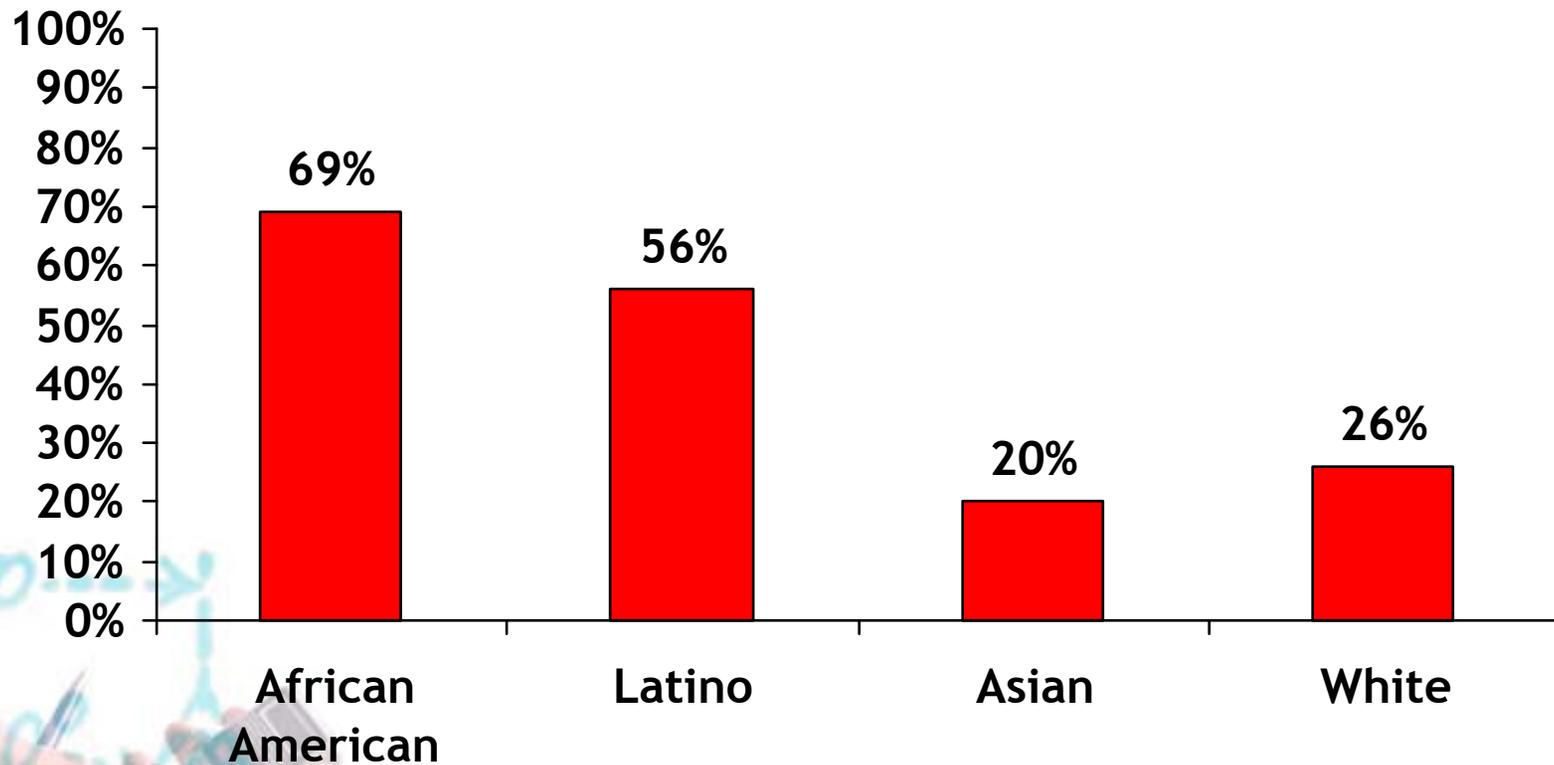
8th Graders Performing Below Basic in Mathematics 2000



Source: US Department of Education, NEAP Mathematics 2000.



12th Graders Performing Below Basic in Mathematics 2000



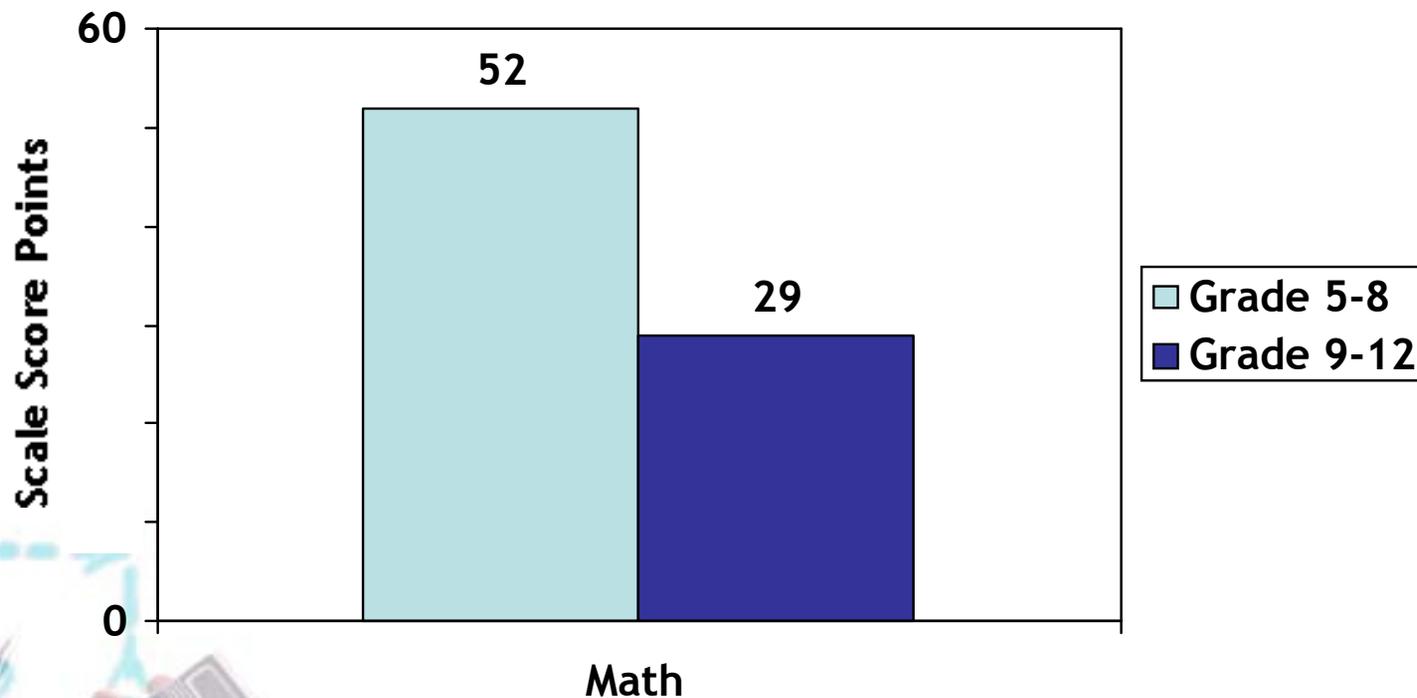
Source: US Department of Education, NEAP Mathematics 2000.



High schools a special problem



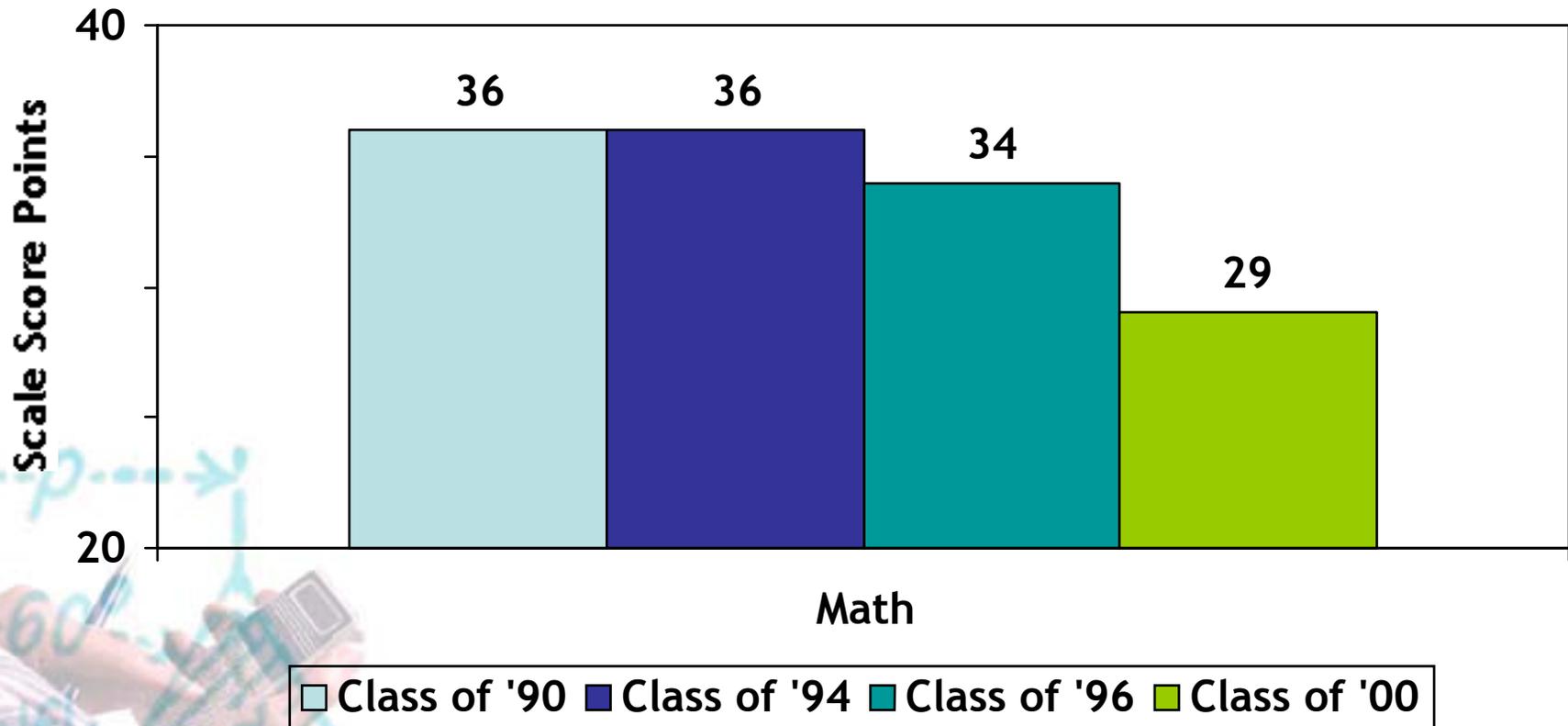
Students Make More Growth In Grades 5-8 Than 9-12, Class of '00



Source: US Department of Education, NEAP Mathematics 2000.

Value Added Declining in High School Math

Age 13-17 Growth



Source: US Department of Education, NEAP Mathematics 2000.



Skills at end of high school?



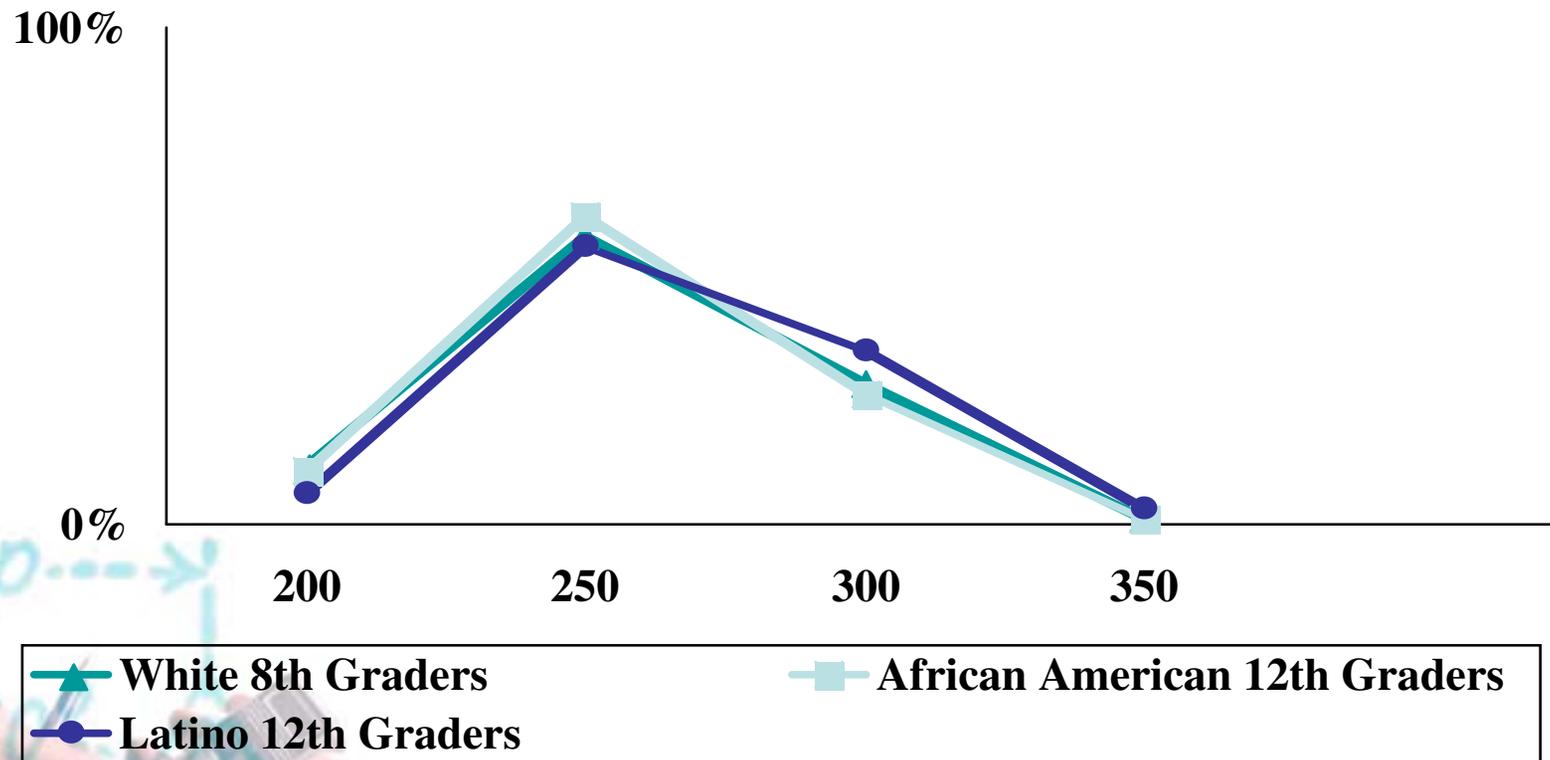


Too Few 17 Year-Olds Demonstrate Strong Math Skills

	African American	Latino	White
Multi-Step Problem Solving, Algebra	1%	3%	10%
Moderately Complex Procedures	27	38	70
Numerical Operations	89	94	99

Source: USDOE, NCES, 1999 NAEP Summary Data Tables

African American and Latino 17 Year Olds Do Math at Same Levels As White 13 Year Olds



Source: NAEP 1999 Long Term Trends Summary Tables (online)



Achievement in Higher Education



Many College Graduates Demonstrate Weak Quantitative Literacy Skills



	Grads: 2 Yr. Colleges	Grads: 4 Yr. Colleges
Level 5: High	5	13
Level 4	30	40
Level 3	44	40
Level 2	17	10
Level 1: Low	4	3

Source: USDOE, NCES, National Adult Literacy Survey, 1992, in Literacy in the Labor Force: Results from the NALS, September 1999, p. 61.



Description:

Quantitative Literacy Level 2

- **CAN** Calculate postage and fees for certified mail
- **CAN** Determine difference in price between tickets for two shows
- **CAN'T** Calculate difference between regular and sale price from an advertisement using a calculator
- **CAN'T** Plan travel arrangements for meeting using flight schedule



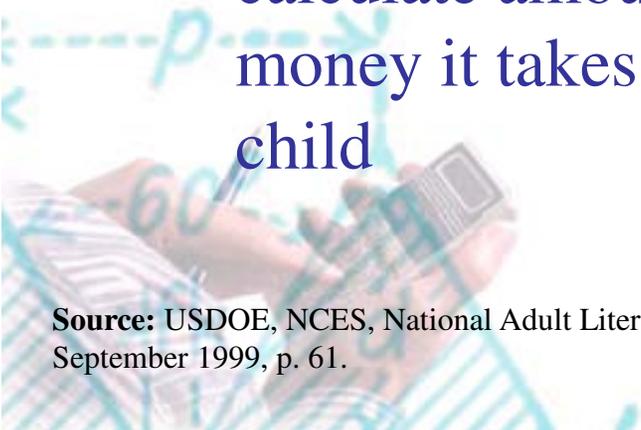
Source: USDOE, NCES, National Adult Literacy Survey, 1992, in Literacy in the Labor Force: Results from the NALS, September 1999, p. 15.



Description:

Quantitative Literacy Level 3

- **CAN** Determine correct change using information on a menu
- **CAN** Use information stated in news article to calculate amount of money it takes to raise a child
- **CAN'T** Determine shipping and total costs on an order form for items in a catalog
- **CAN'T** Use information in news article to calculate difference in time for completing a race



Source: USDOE, NCES, National Adult Literacy Survey, 1992, in Literacy in the Labor Force: Results from the NALS, September 1999, p. 61.



Gaps between groups?





Colleges Don't Close Gaps

	Highest Education	White Black Gap	White Hispanic Gap
Quantitative	HS Diploma	47	39
	2 Year Degree	46	27
	4 Year Degree	49	43



Source: USDOE, OERI, *Adult Literacy in America: A First Look at the Results of the Results of the National Adult Literacy Survey (NALS)*, 1992, September 1993, p. 36.





How do our skills compare internationally?



Almost Half of US Adults Perform at Lowest Literacy Levels in All Areas



Literacy Scale	Level 1 (0-225)	Level 2 (226-275)	Level 1 + 2 (0-275)
Prose	21%	26%	47%
Document	24%	26%	50%
Quantitative	21%	25%	46%
Composite	20%	25%	45%

(score range in parenthesis)

Source: Andrew Sum, Irwin Kirsch, and Robert Taggart. *The Twin Challenges of Mediocrity and Inequality: Learning to Read and Write in a Global World*. Policy Information Center, Educational Testing Service. (2002)



College Degrees Don't Fix the Problem: US Adults Rank Poorly Among 20 High-Income Countries

Educational Attainment	Quantitative Scale
High-School Grad/GED, no college	19th
1-3 yrs of college	17th
Bachelor's degree or higher	13th



Mathematics Education





“Mathematics and science education will be strengthened throughout the system, especially in the early grades.

–National Education Goal #5, Objective 1





CURRICULUM: K-12

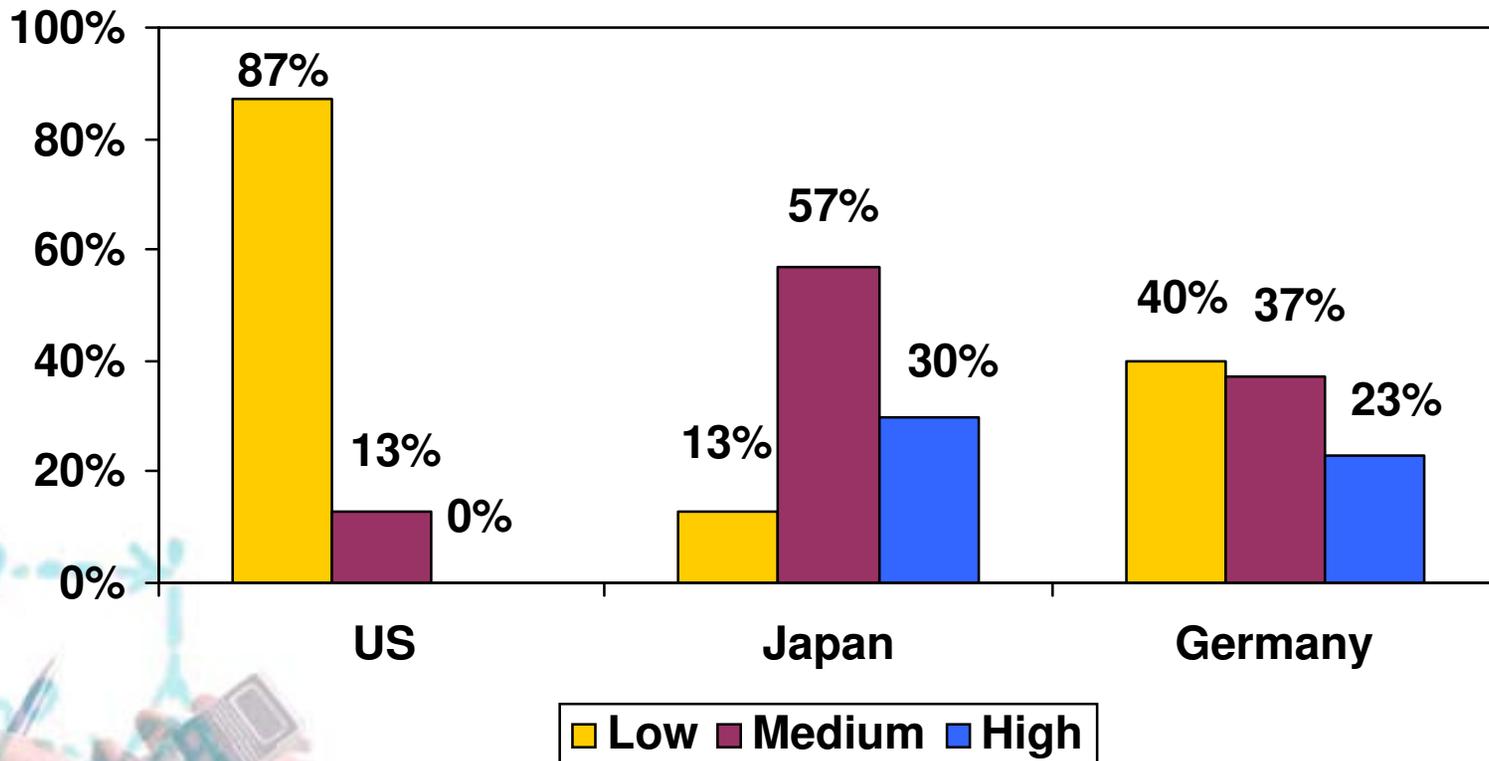




8th Grade: A lot of cross-national information because of TIMSS

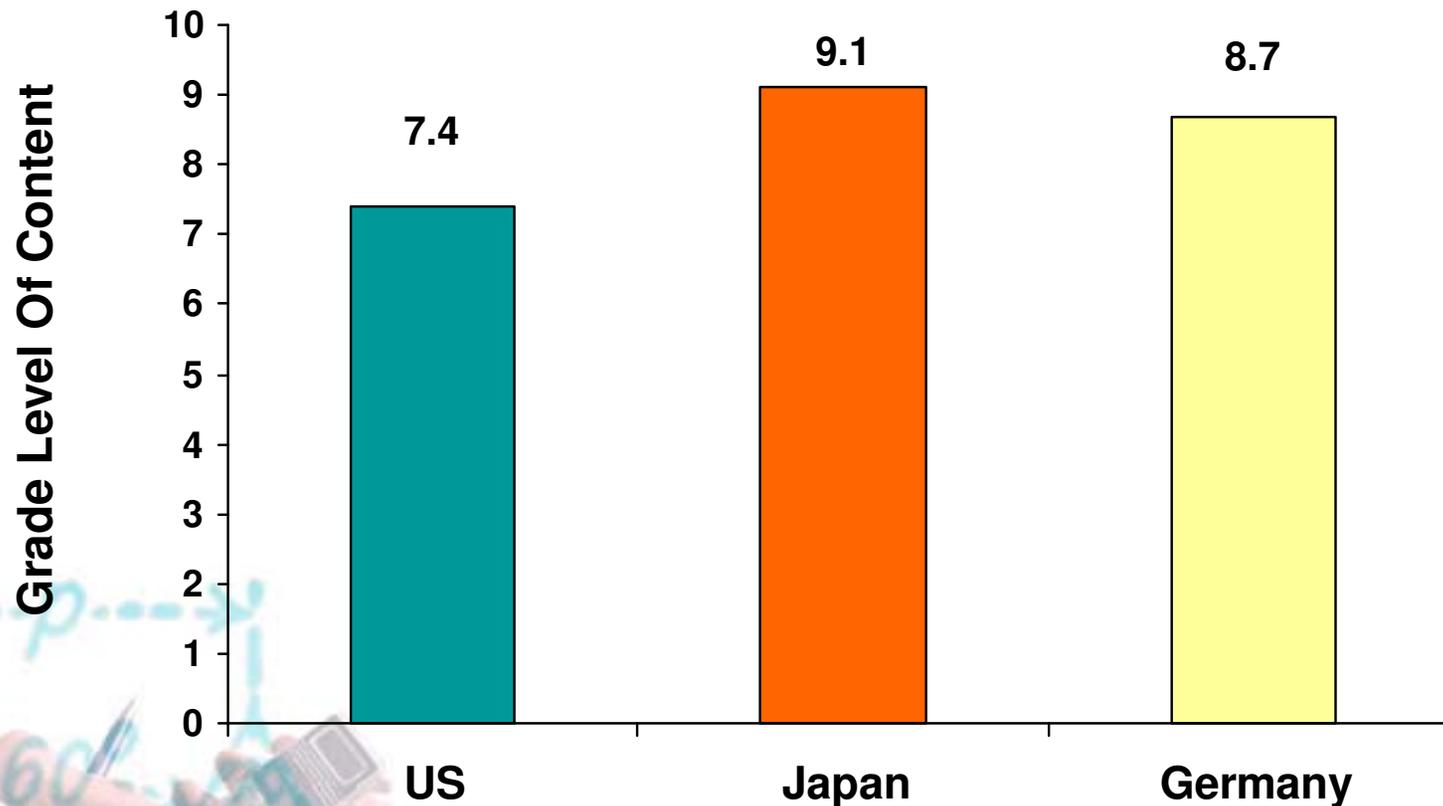


Quality of Mathematical Content of 8th Grade Lessons



Source: TIMSS : unpublished tabulations, Videotape Classroom Study, UCLA, 1996, in Pursuing Excellence: A Study of US Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum and Achievement in International Context, 1997.

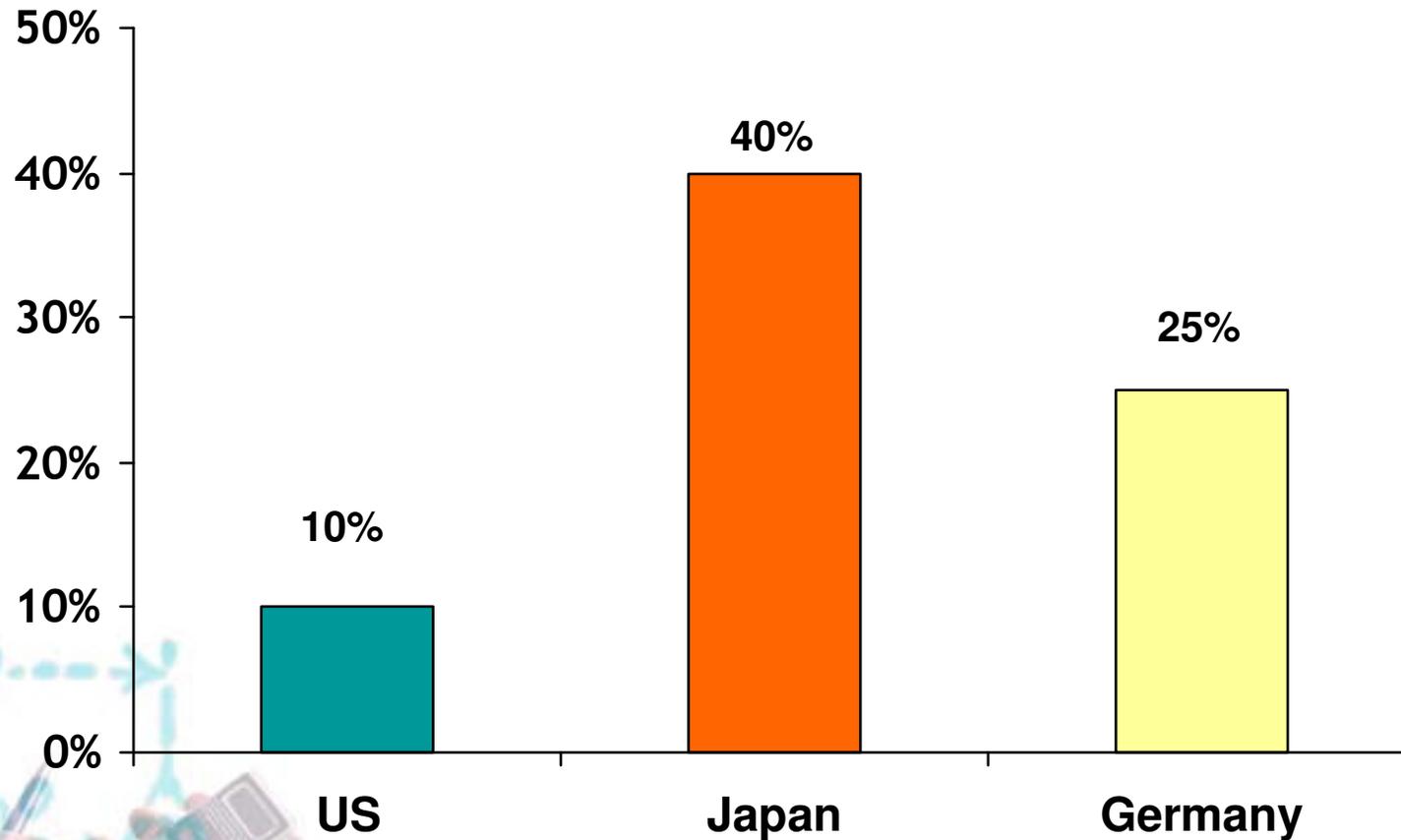
Average Grade Level of Content in 8th Grade Lessons, by International Standards



Source: NCES, "Pursuing Excellence: A Study of US Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum, and Achievement in International Context", 1997.

Algebra In 8th Grade Text Books

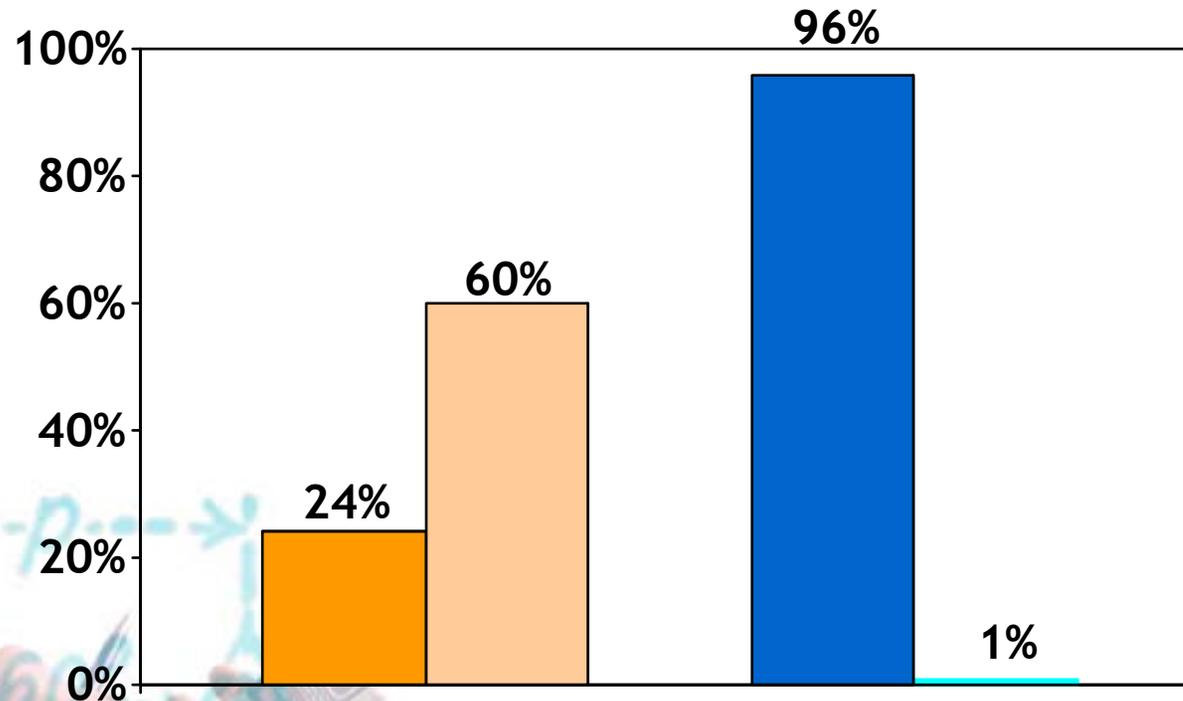
% Of Space Devoted To Algebra In 8th Grade Mathematics Textbooks



Source: NCES, "Pursuing Excellence: A Study of US Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum, and Achievement in International Context", 1997.

Math Emphasis Favors Routine Skills Over Understanding

United States 8th Grade Math Teachers



- Goal = Mathematical thinking
- Goal = Learn skill/formula
- Practice routine procedures
- Invent new solutions and proofs

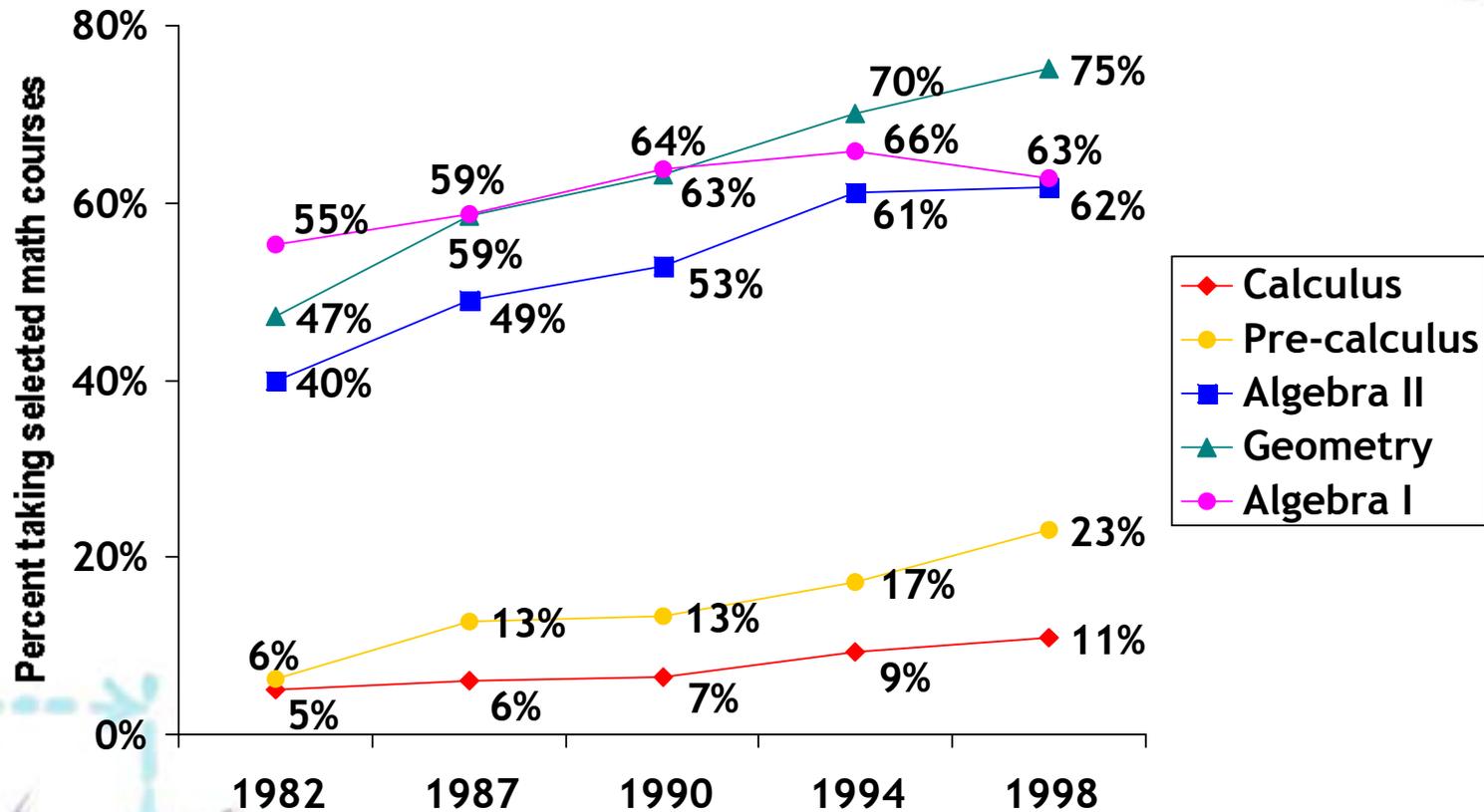
Source: Pursuing Excellence: A Study of US Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum and Achievement in International Context, 1997.



High School: Moving More Students into College-Prep Math Sequence



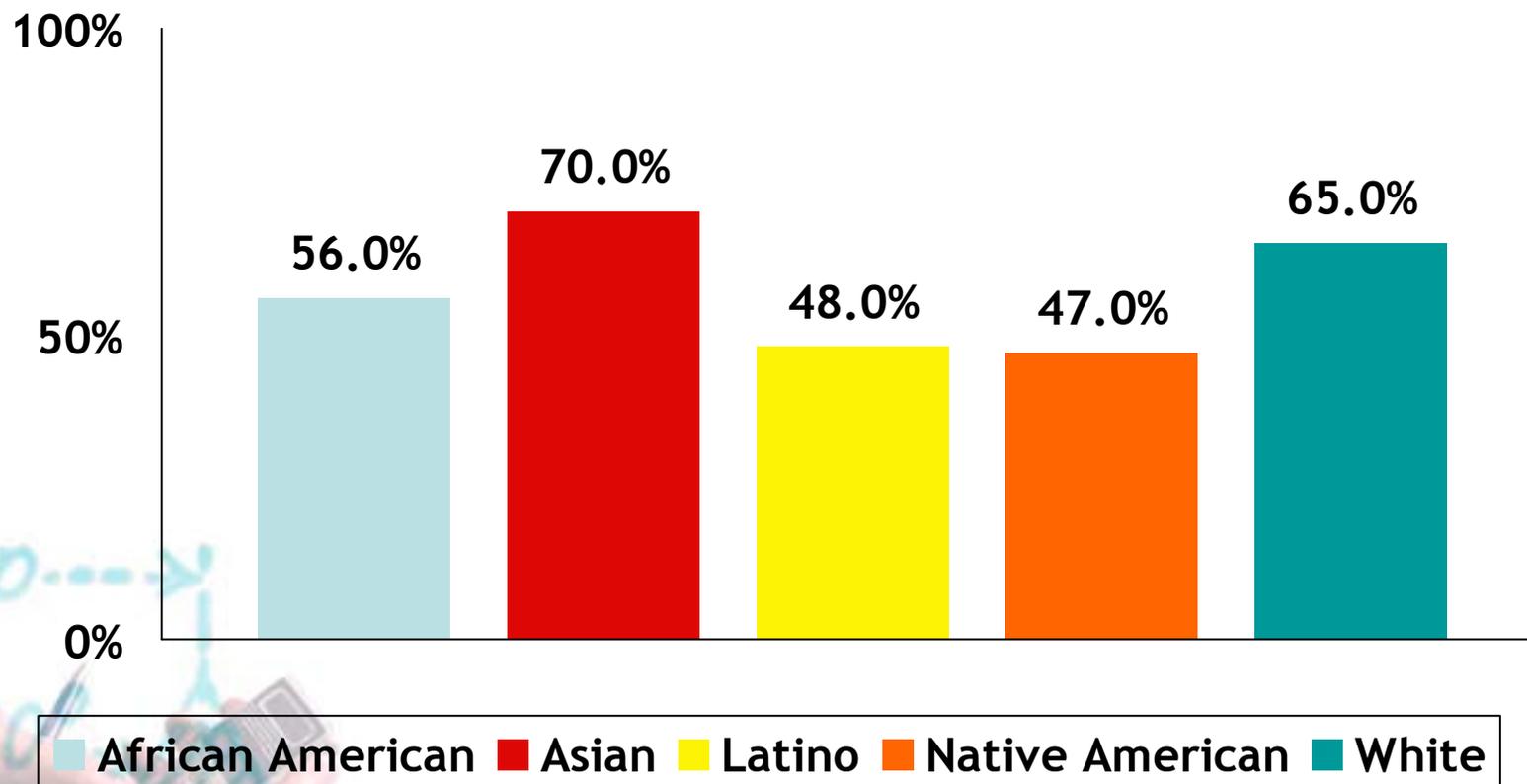
High School Graduates Taking More Mathematics



Source: HS&B, HSTS, NELS data, in NCES Digest of Education Statistics, 2000, Table 140.



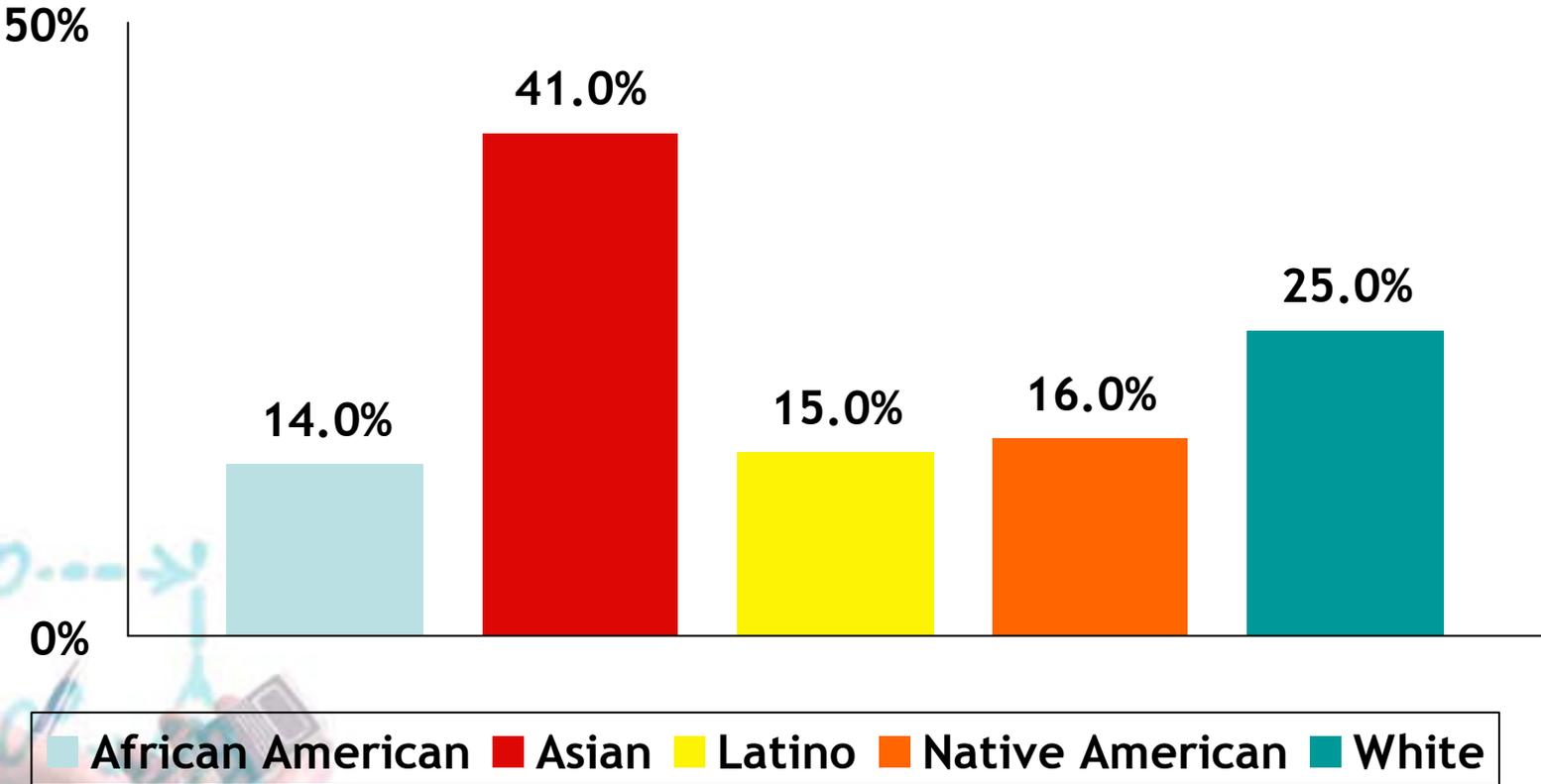
Percentage of High School Graduates Completing Algebra II, 1998



Source: HS&B, HSTS, NELS data, in NCES, Digest of Education Statistics, 2000.



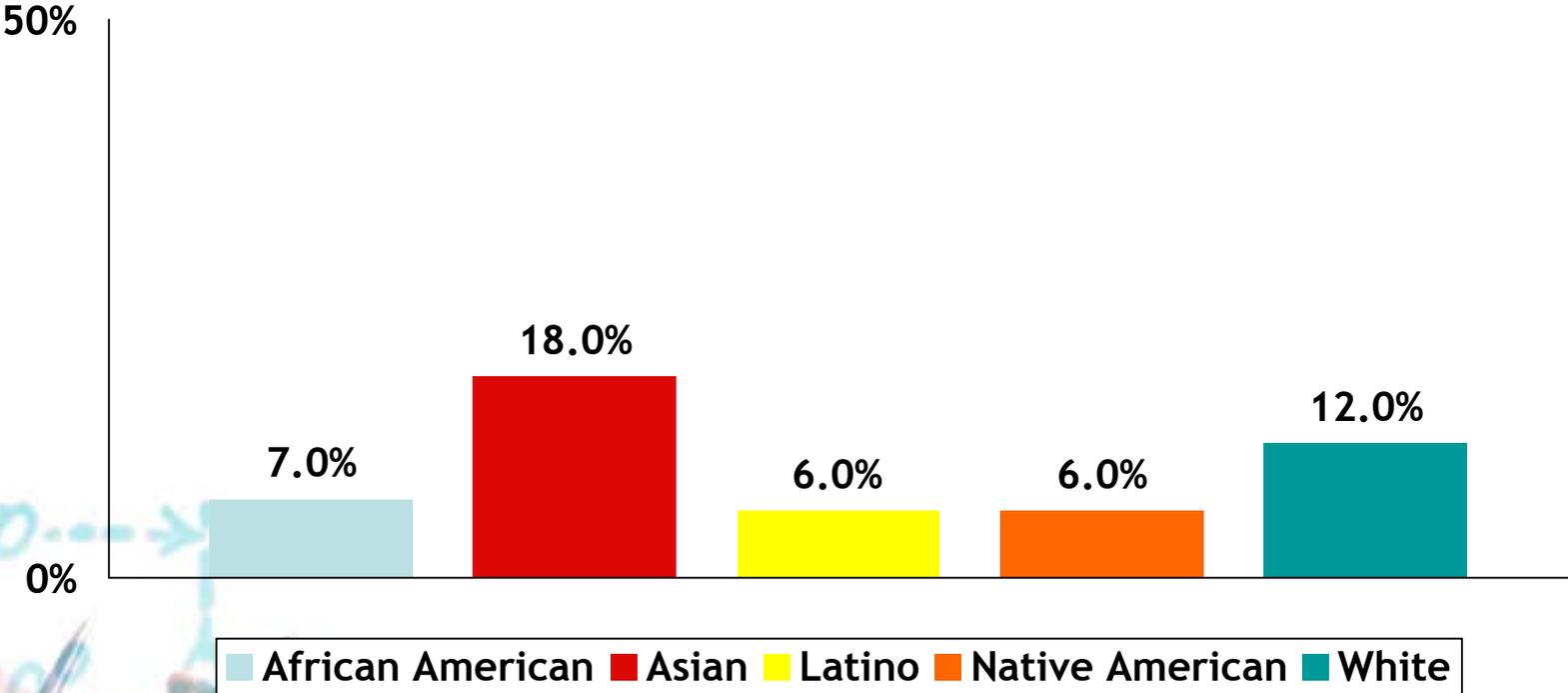
Percentage of High School Graduates Completing Pre-calculus, 1998



Source: HS&B, HSTS, NELS data, in NCES, Digest of Education Statistics, 2000.



Percentage of High School Graduates Completing Calculus, 1998



Source: HS&B, HSTS, NELS data, in NCES, Digest of Education Statistics, 2000.



CURRICULUM: Higher Education

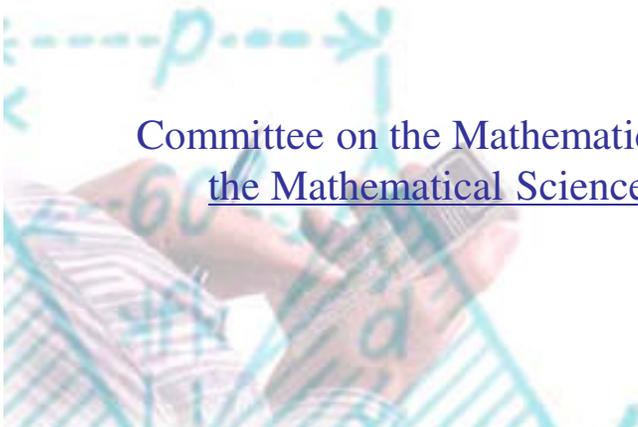


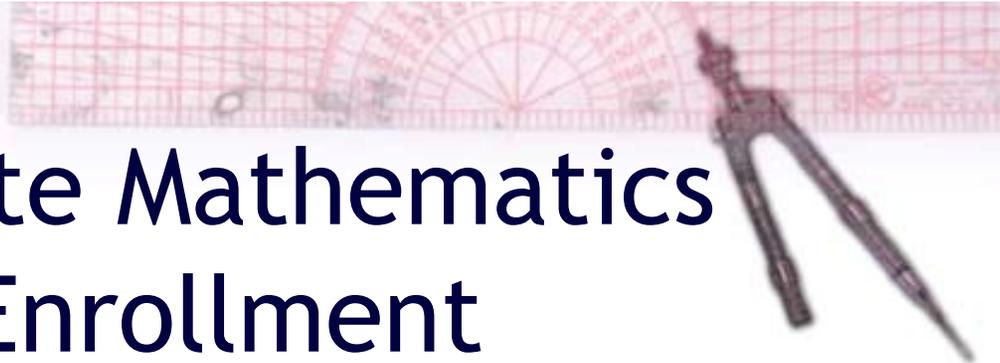


UNDERGRADUATE MATHEMATICS COURSE ENROLLMENT

📄 Enrollments in mathematical sciences courses doubled in the 70s and 80s, but the increases were all at the lower levels, with remedial enrollments leading the way.

Committee on the Mathematical Sciences in the Year 2000, [A Challenge of Numbers: People in the Mathematical Sciences](#). National Academy Press: Washington, D.C., 1990.



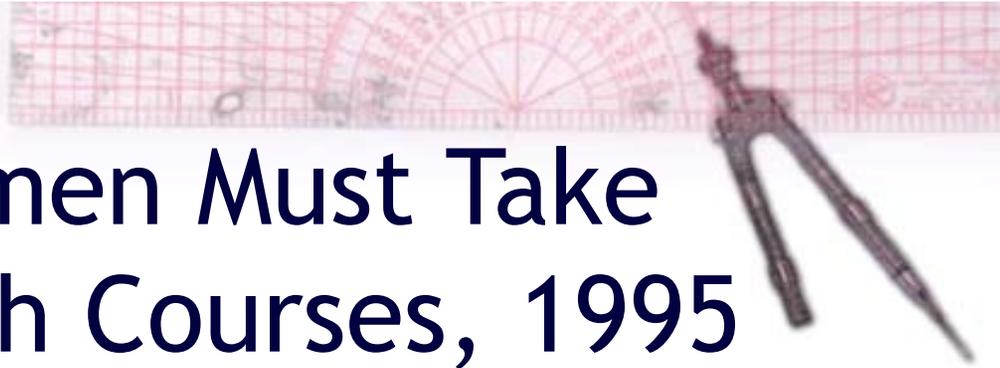


Undergraduate Mathematics Course Enrollment

- Even at top rated doctoral granting public universities*, nearly 20% of total student enrollment in mathematics is at the Remedial or Precalculus levels.

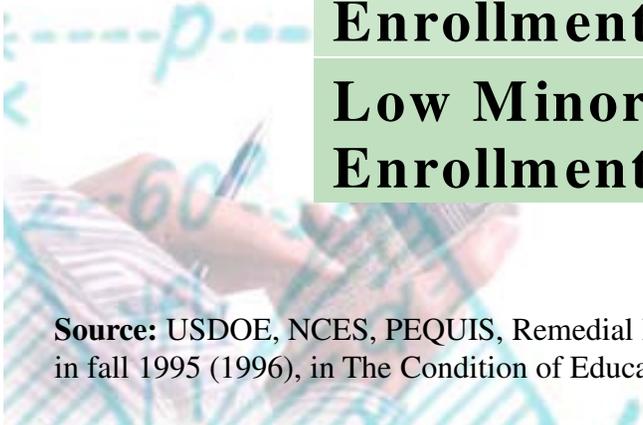
*Group IA

Source: Towards Excellence: Leading a Mathematics Department in the 21st Century, American Mathematical Society, 2001.



Many Freshmen Must Take Remedial Math Courses, 1995

All institutions	24%
Public 2 year	34%
Public 4 year	18%
High Minority Enrollment	35%
Low Minority Enrollment	21%



Source: USDOE, NCES, PEQUIS, Remedial Education at Higher Education Institutions in fall 1995 (1996), in The Condition of Education 1999, p. 88



TEACHERS: K-12





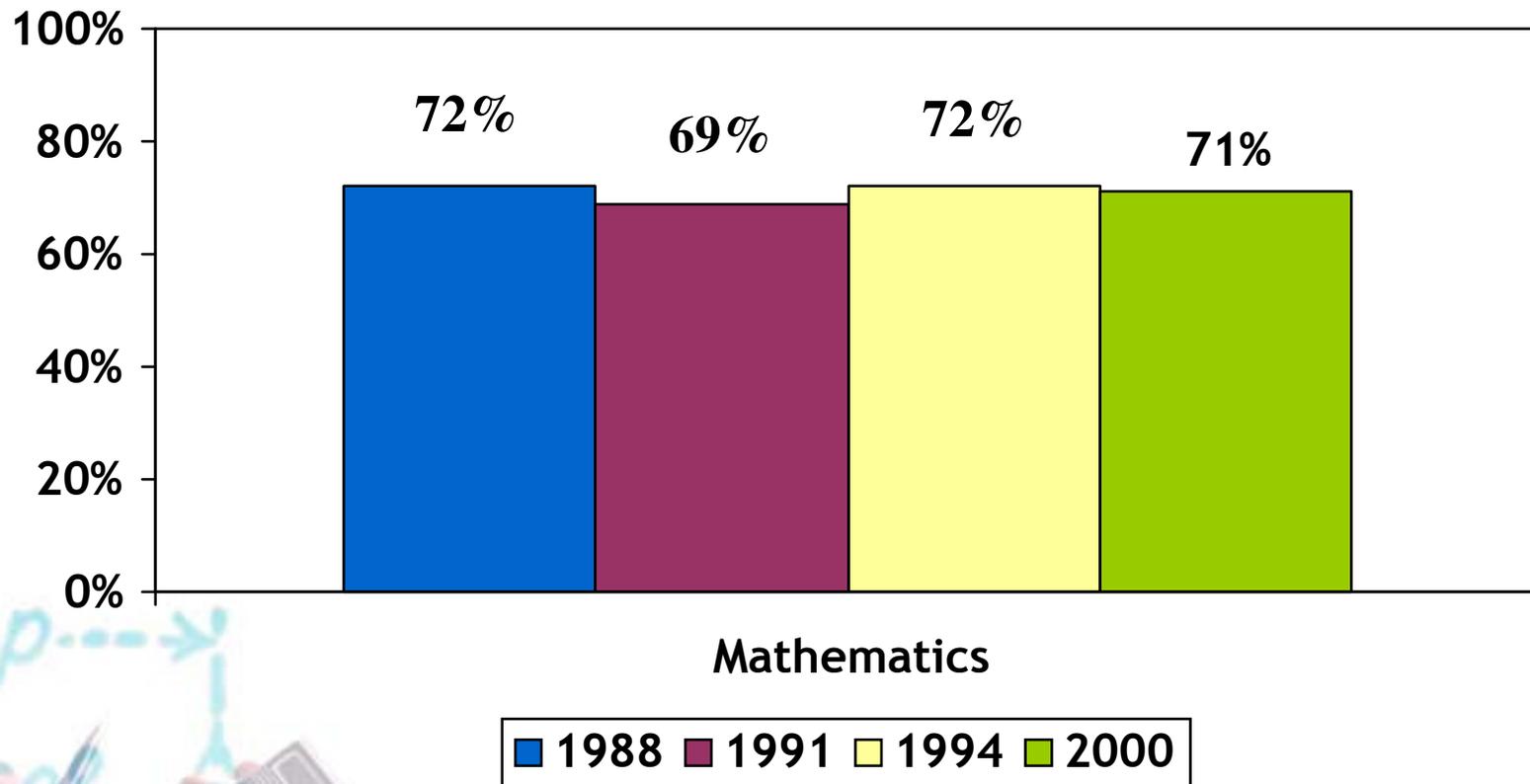
“The number of teachers with a substantive background in math and science will increase by 50%”

–National Education Goal #5, Objective 2



How Far Have We Come?

Percentage Public High School Math Teachers With a Major or Minor in Field



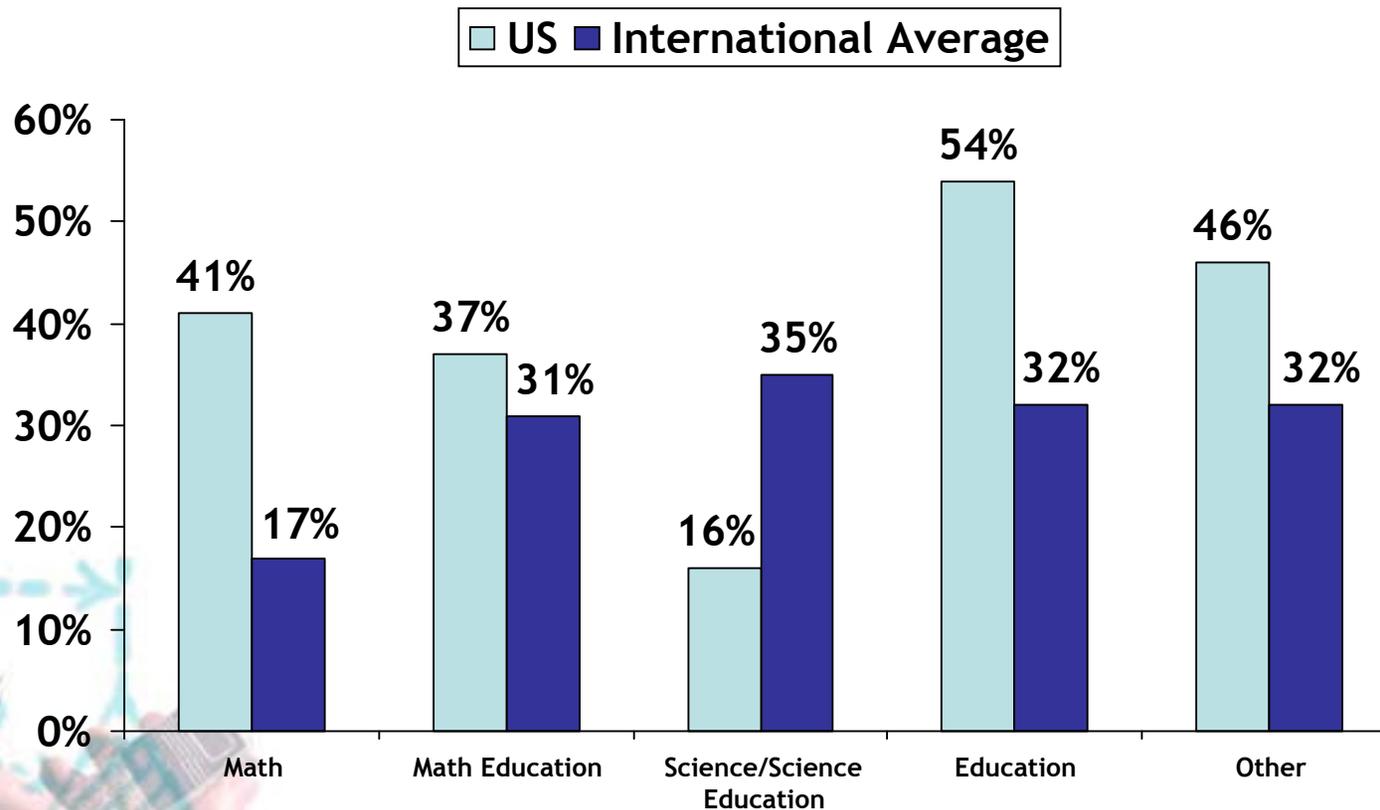
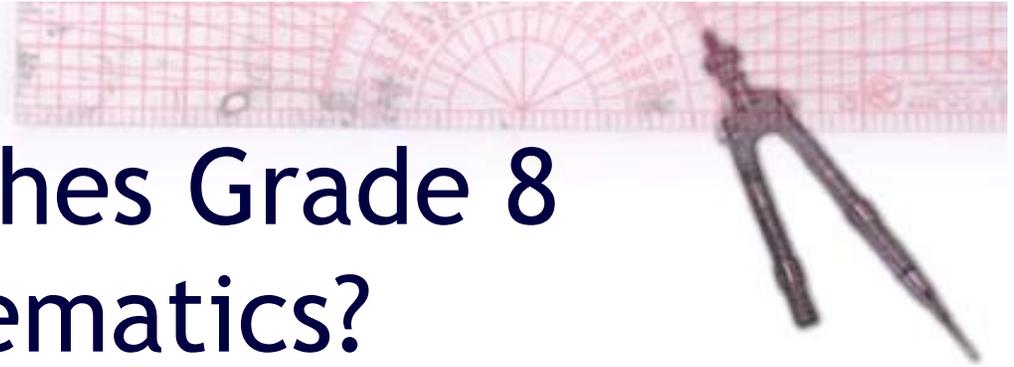
Source: Richard M. Ingersoll, "The Problem of Underqualified Teachers in American Secondary Schools," Educational Researcher, Vol. 28, Number 2, March 1999



International Problem?



Who Teaches Grade 8 Mathematics?



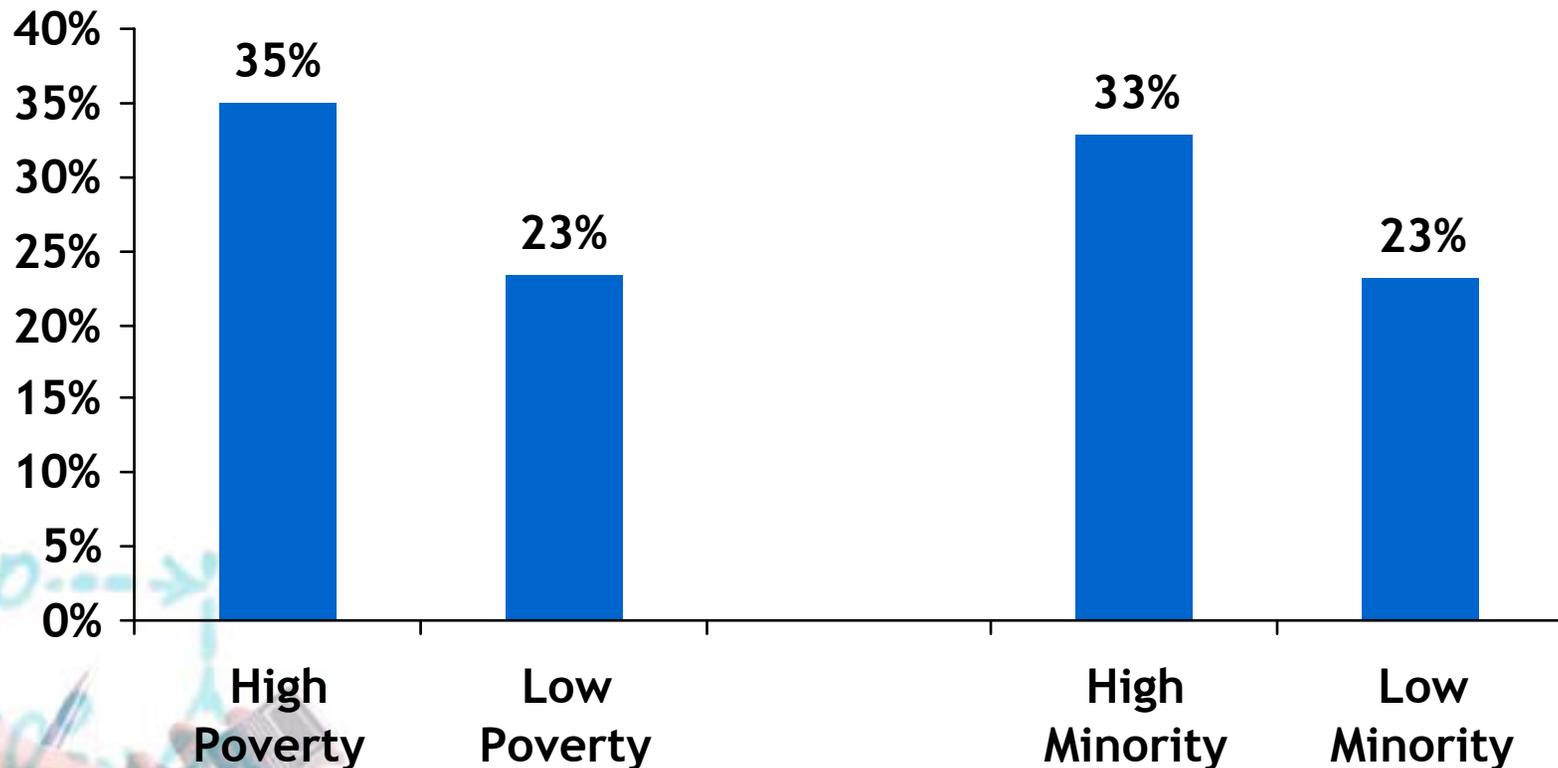
Source: ISDPE, OERI, Pursuing Excellence: Comparison of International Eighth-Grade Mathematics and Science Achievement from a US Perspective, 1999, 2001.



If teachers without sufficient content are a problem, that problem affects different groups of students differently.

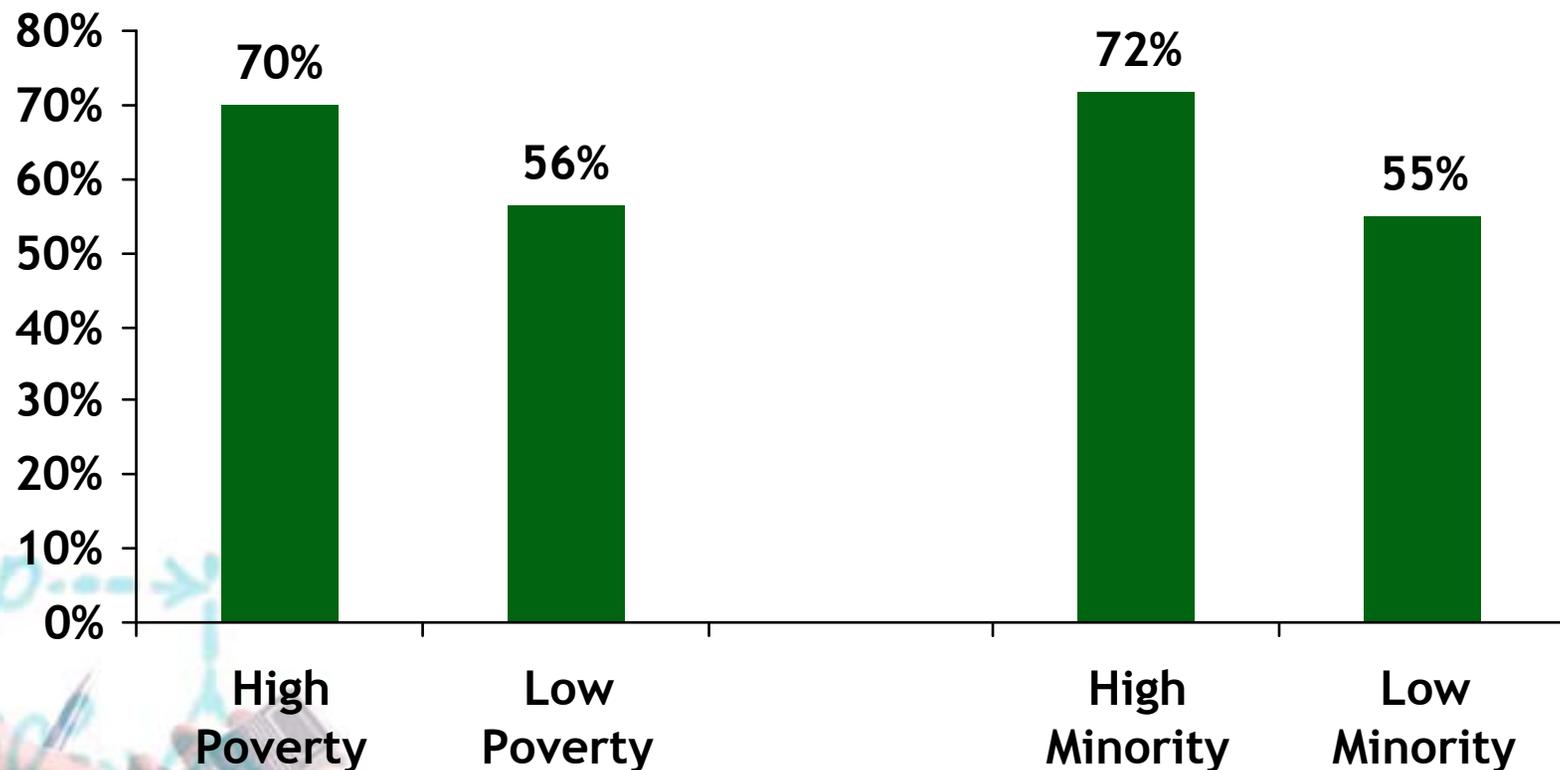


Percent High School Math Classes Whose Teachers Have No Major or Minor in Math



Source: Schools and Staffing Survey 1999-2000, calculations by Richard Ingersoll for the the Education Trust, 2002.

Percent Middle School Math Classes Whose Teachers Have No Major or Minor in Math



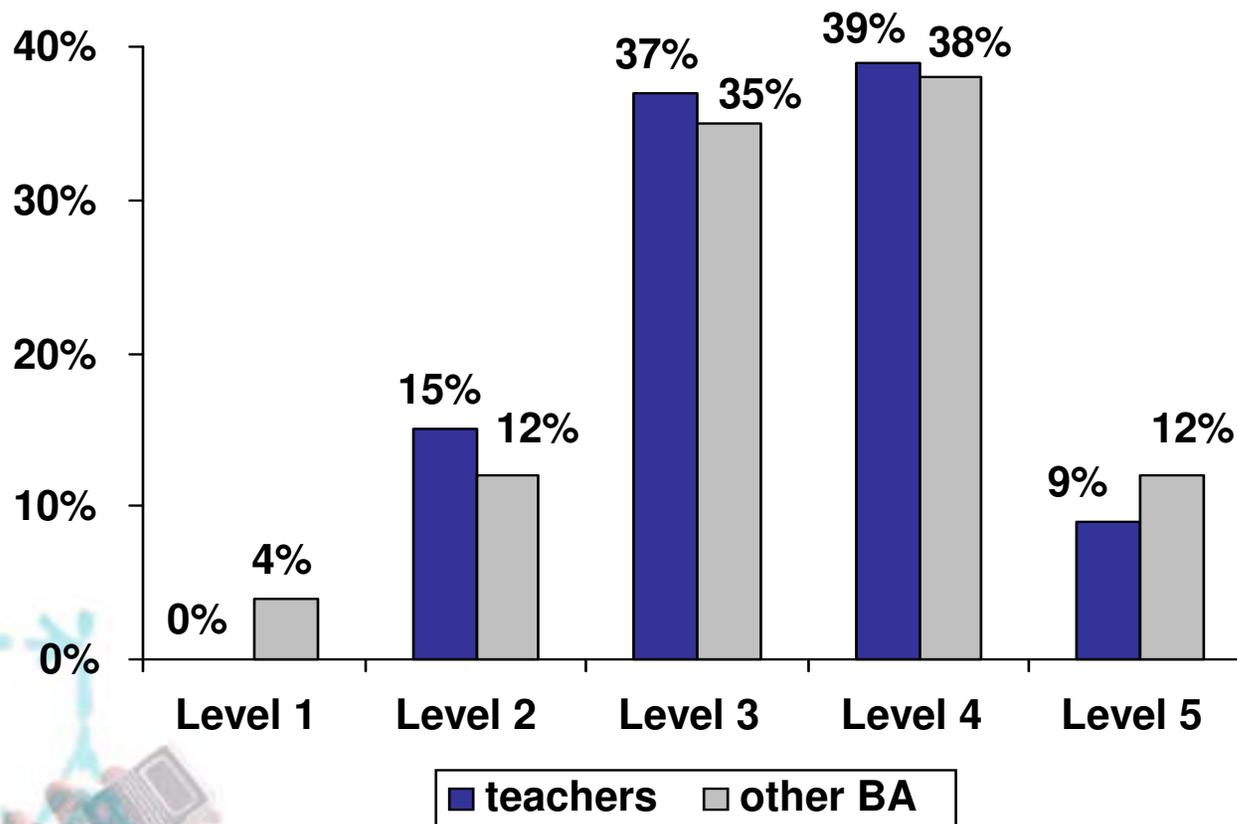
Source: Schools and Staffing Survey 1999-2000, calculations by Richard Ingersoll for the the Education Trust, 2002.



Teachers in general compared to other BA's?



Math Literacy of Teachers Versus Other BAs



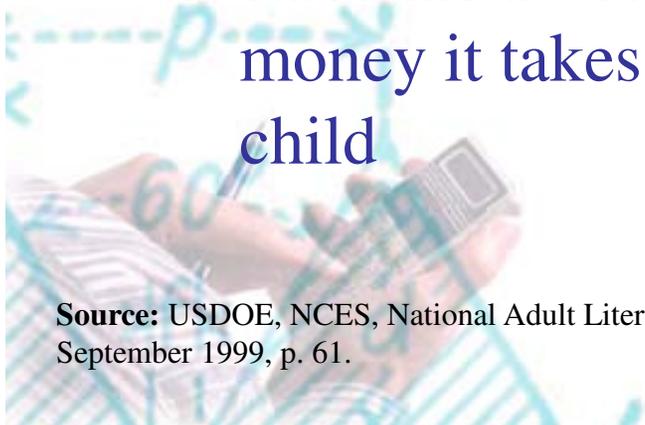
Source: ETS, Barbara A. Bruschi and Richard J. Coley, "How Teachers Compare: The Prose, Document and Quantitative Skills of America's Teachers", Princeton, NJ, 1999, p. 6.



Description:

Quantitative Literacy Level 3

- **CAN** Determine correct change using information on a menu
- **CAN** Use information stated in news article to calculate amount of money it takes to raise a child
- **CAN'T** Determine shipping and total costs on an order form for items in a catalog
- **CAN'T** Use information in news article to calculate difference in time for completing a race



Source: USDOE, NCES, National Adult Literacy Survey, 1992, in Literacy in the Labor Force: Results from the NALS, September 1999, p. 61.

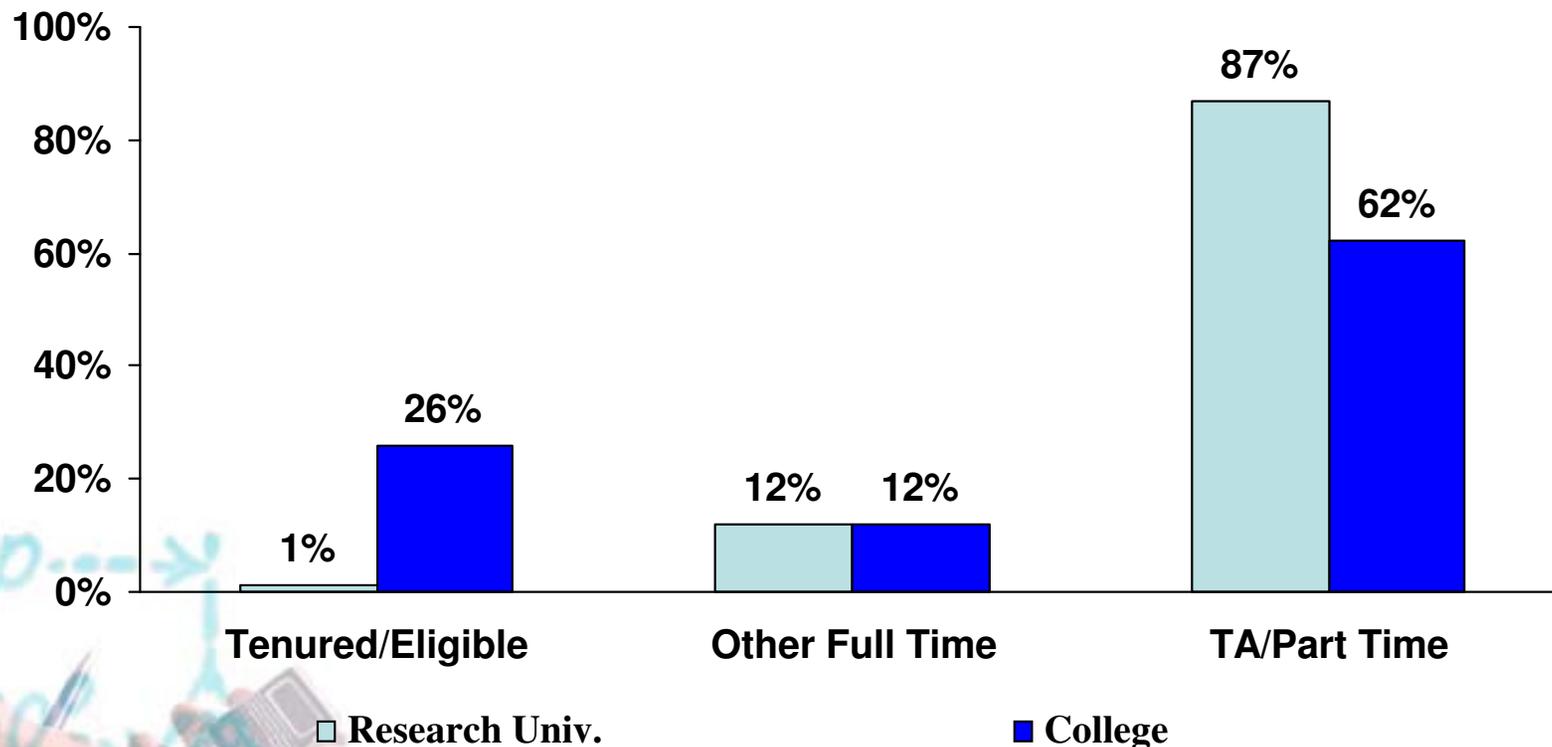


TEACHERS: Higher Education



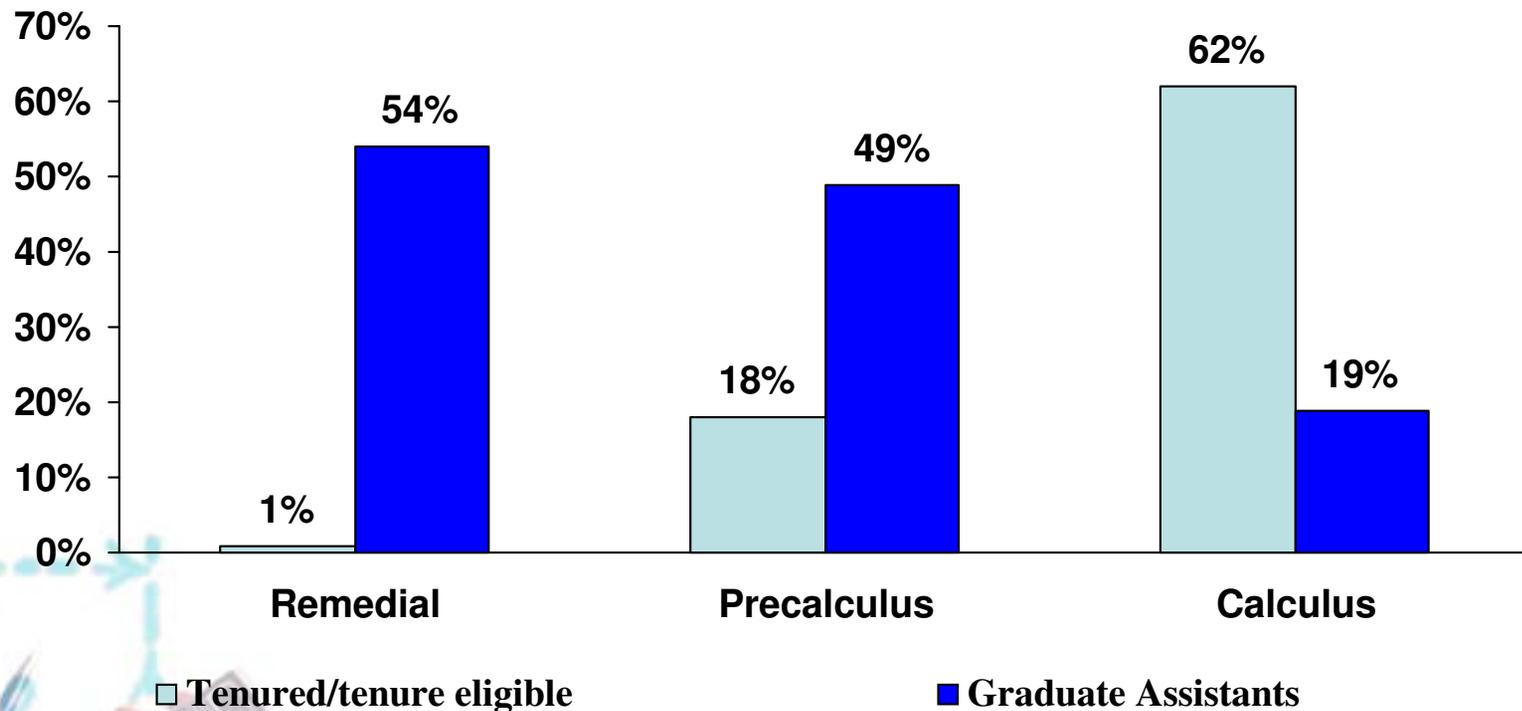


Who Is Teaching Remedial Mathematics?



Source: Fall 1995 Conference Board Mathematical Sciences Survey

Who's Teaching Freshman Mathematics In Research Universities?



Source: Fall 1995 Conference Board Mathematical Sciences Survey



Where are the Math Majors?

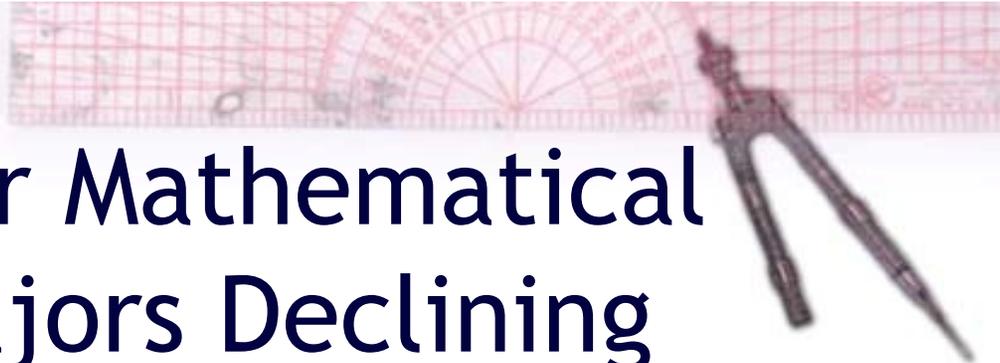




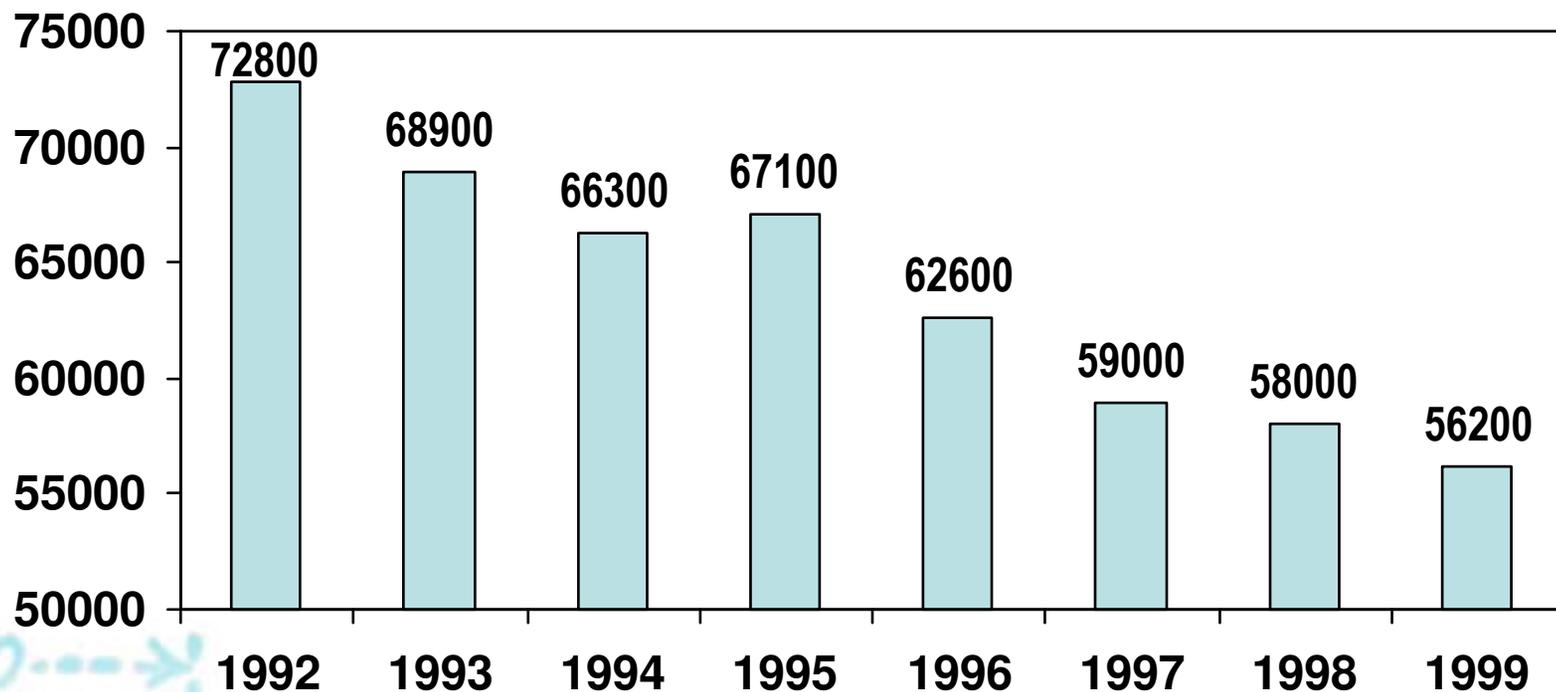
“The number of US undergraduate and graduate students, especially women and minorities, who complete degrees in mathematics, science, and engineering, will increase significantly.”

–National Education Goal #5, Objective 3





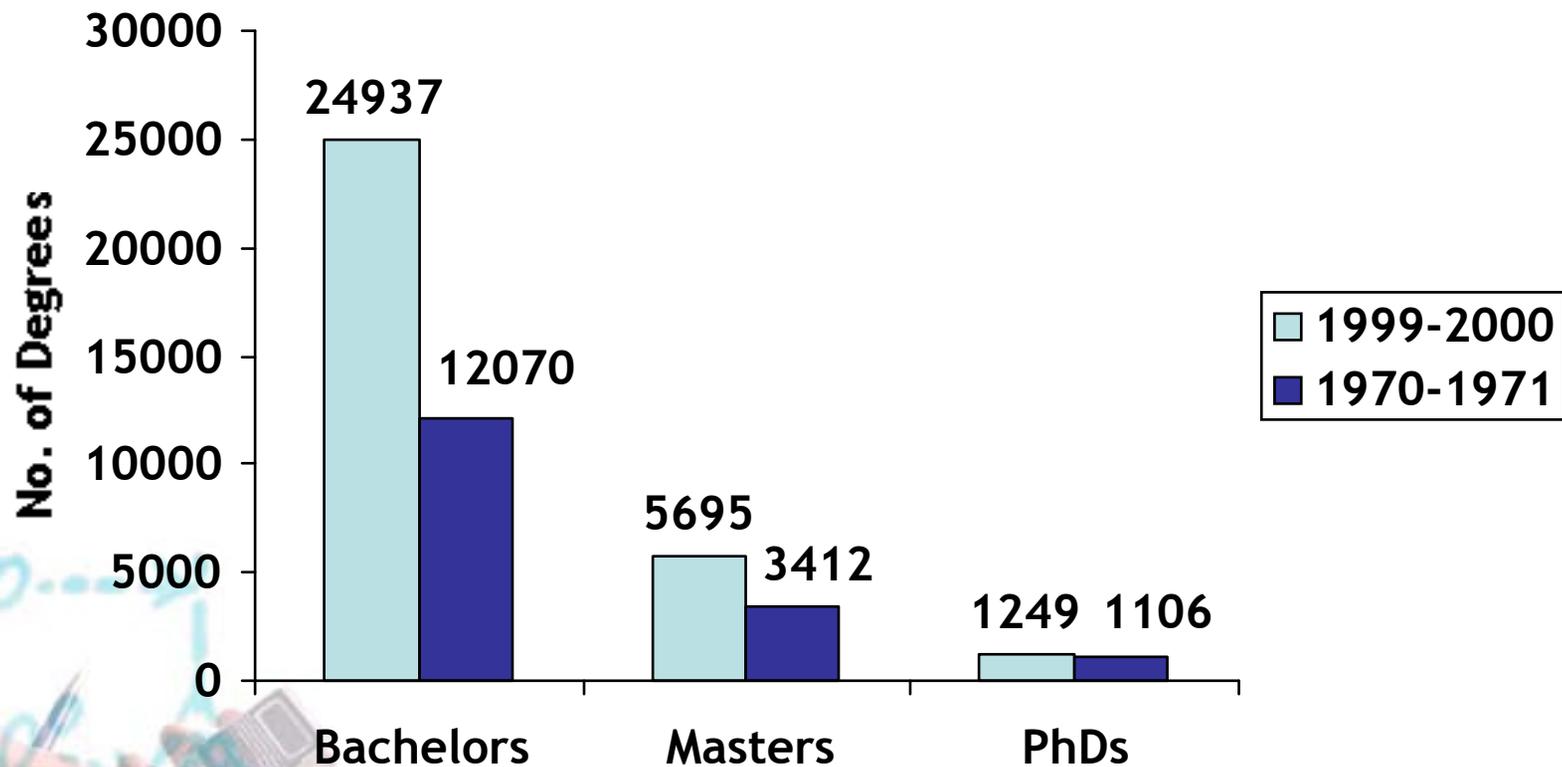
Junior/Senior Mathematical Sciences Majors Declining



72,000 >> 56,200 = -22%

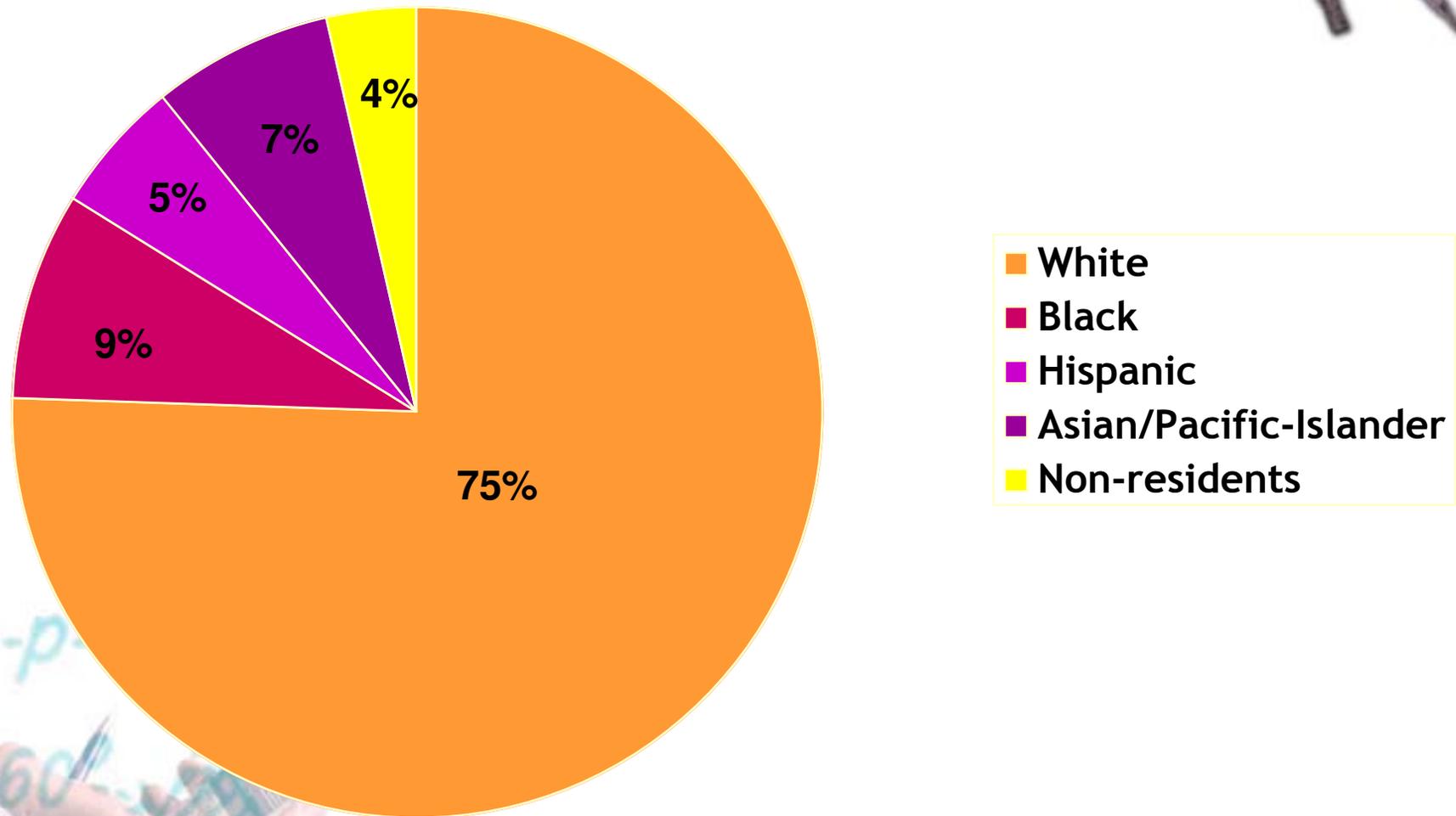
Source: 1999 Annual Survey of the Mathematical Sciences (Second Report), AMS, Vol. 47, Number 8.

Math Degrees Declining, 1971-2000



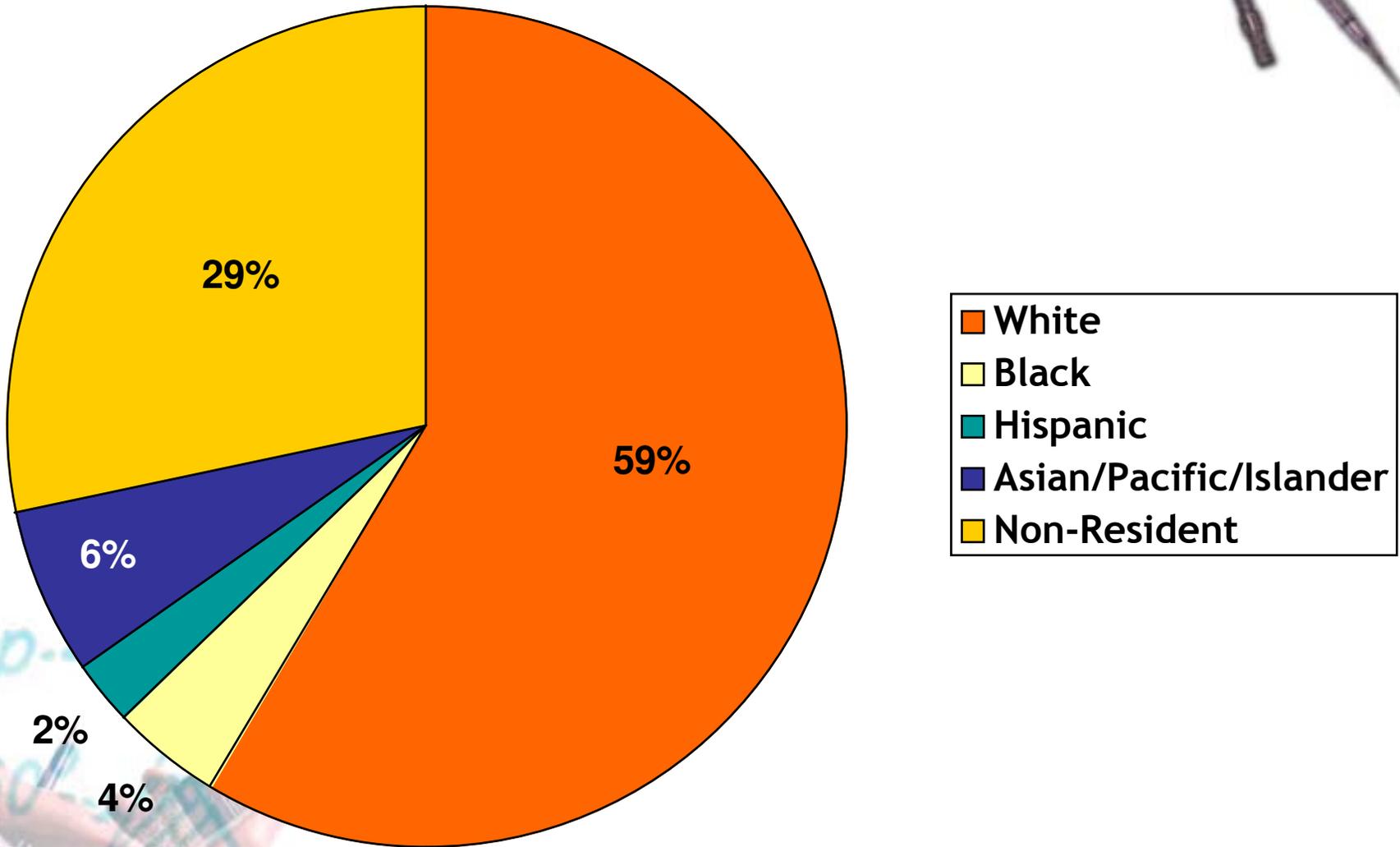
Source: US Department of Education, NCES, Digest of Education Statistics, 2001, Tables 257.

1997-98 Bachelor's Degrees Awarded In Mathematics



Source: NCES, Digest of Education Statistics, 2000.

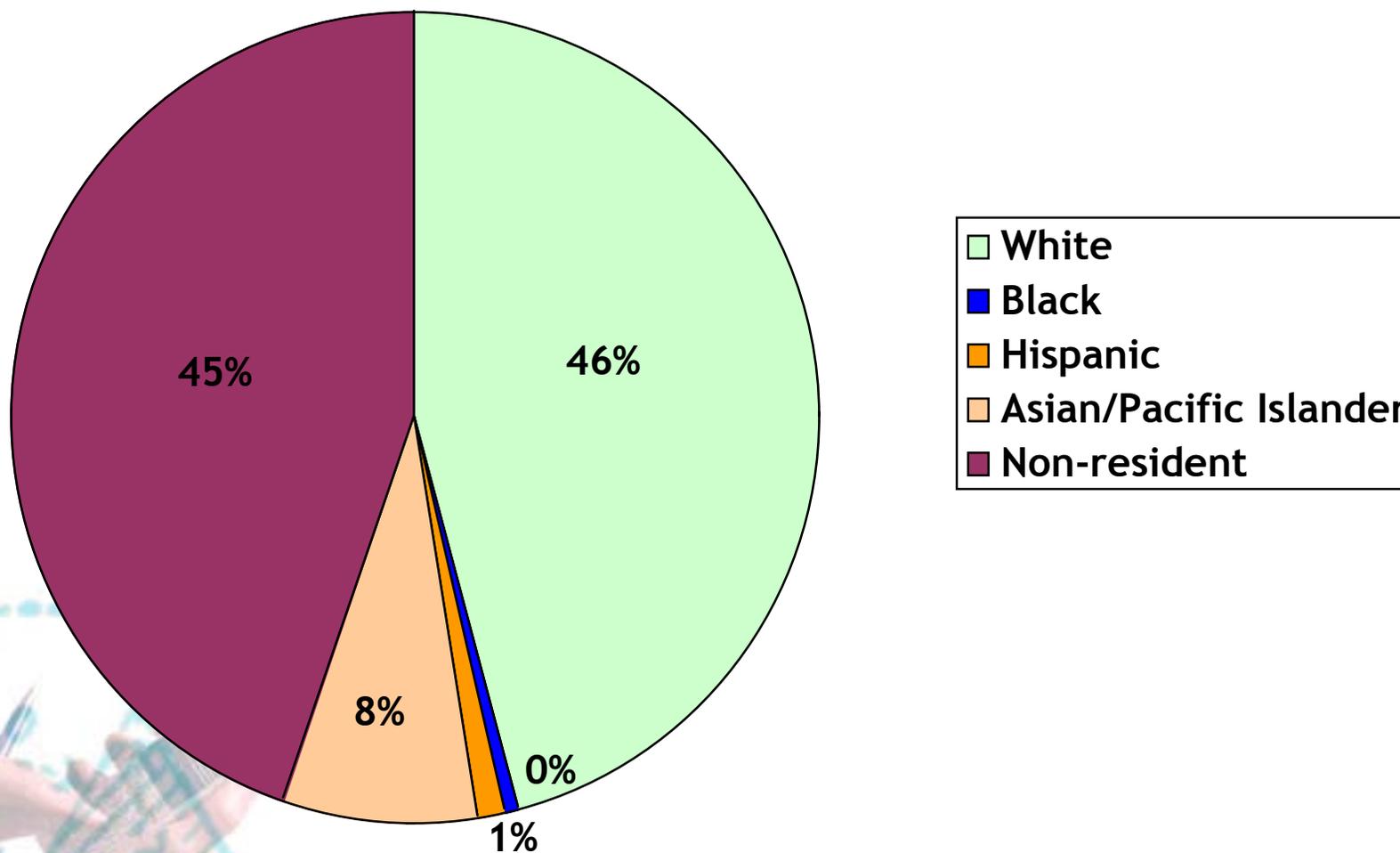
1997-98 Master's Degrees Awarded In Mathematics



Source: NCES, Digest of Education Statistics, 2000.



1994-95 Doctor's Degrees Awarded In Mathematics



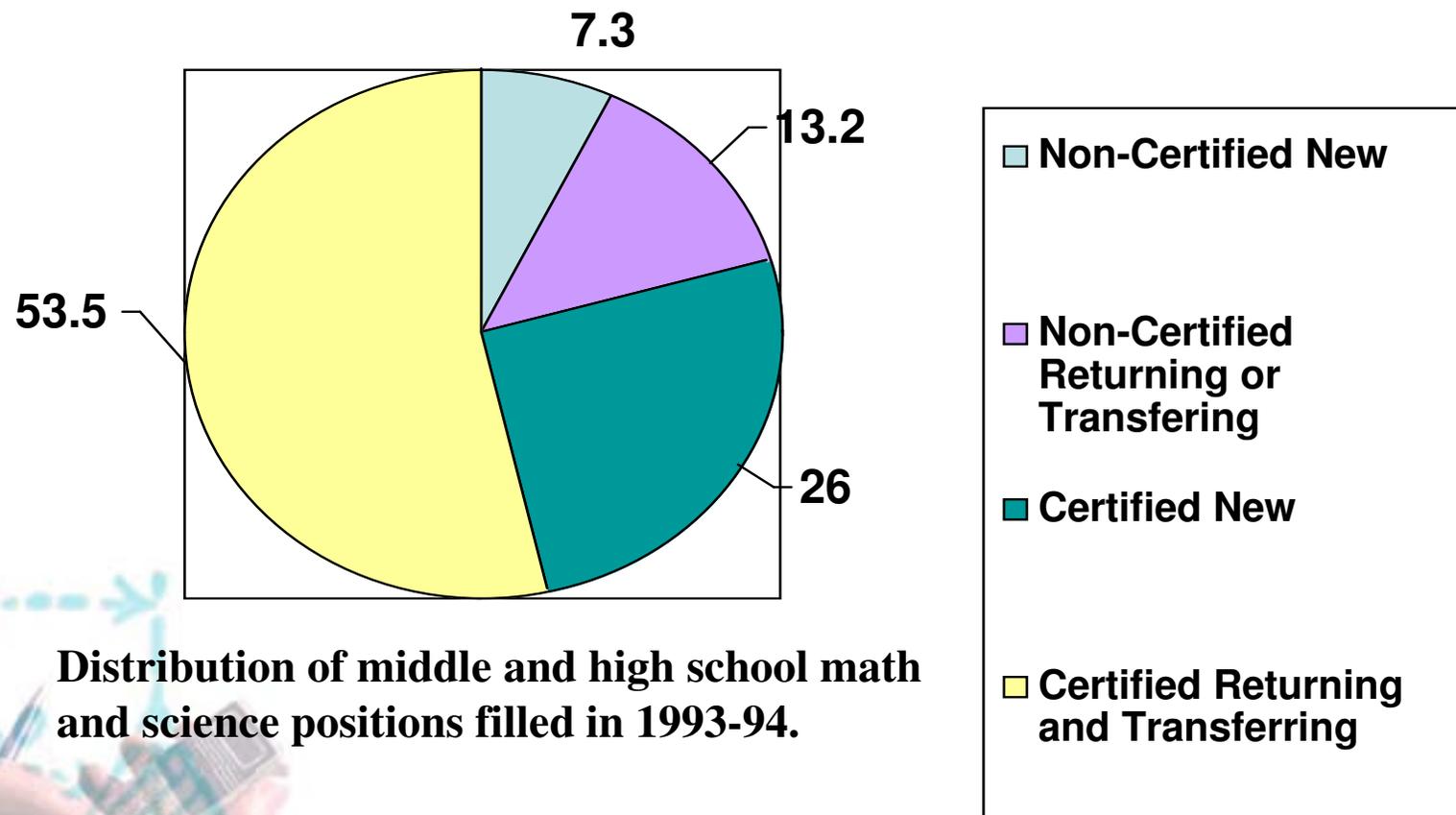
NCES, Digest of Education Statistics 1997.



MATH TEACHER DEMAND



Shortage of Certified and Fully Qualified Math Teachers



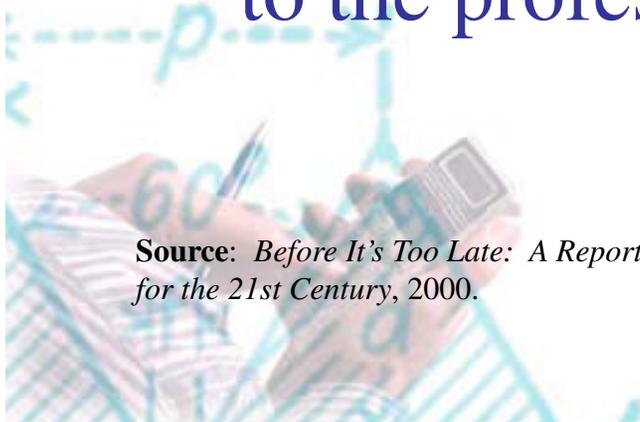
Distribution of middle and high school math and science positions filled in 1993-94.

Source: NCES, SASS data, in *Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, 2000.



Demand is Far Outpacing Supply

- An estimated 240,000 middle and high school mathematics and science teachers will be needed over the next 10 years.
- Of this total, nearly 70% will be newcomers to the profession.



Source: *Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, 2000.



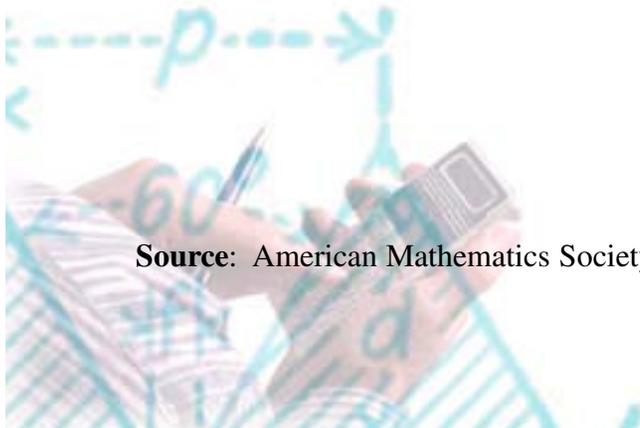
Over a Decade...

We might produce as many as 120,000 math MAJORS. BUT, we may have to fill upwards of 130,000 math teaching positions.





And in the 1990s, only about 29% of mathematics majors taught at either level, with only about 15% teaching at any time.



Source: American Mathematics Society, “Data from the National Science Foundation on Bachelor’s Degree Recipients,” 1993.



Ways OUT





1. Start with the data--
especially YOUR data.

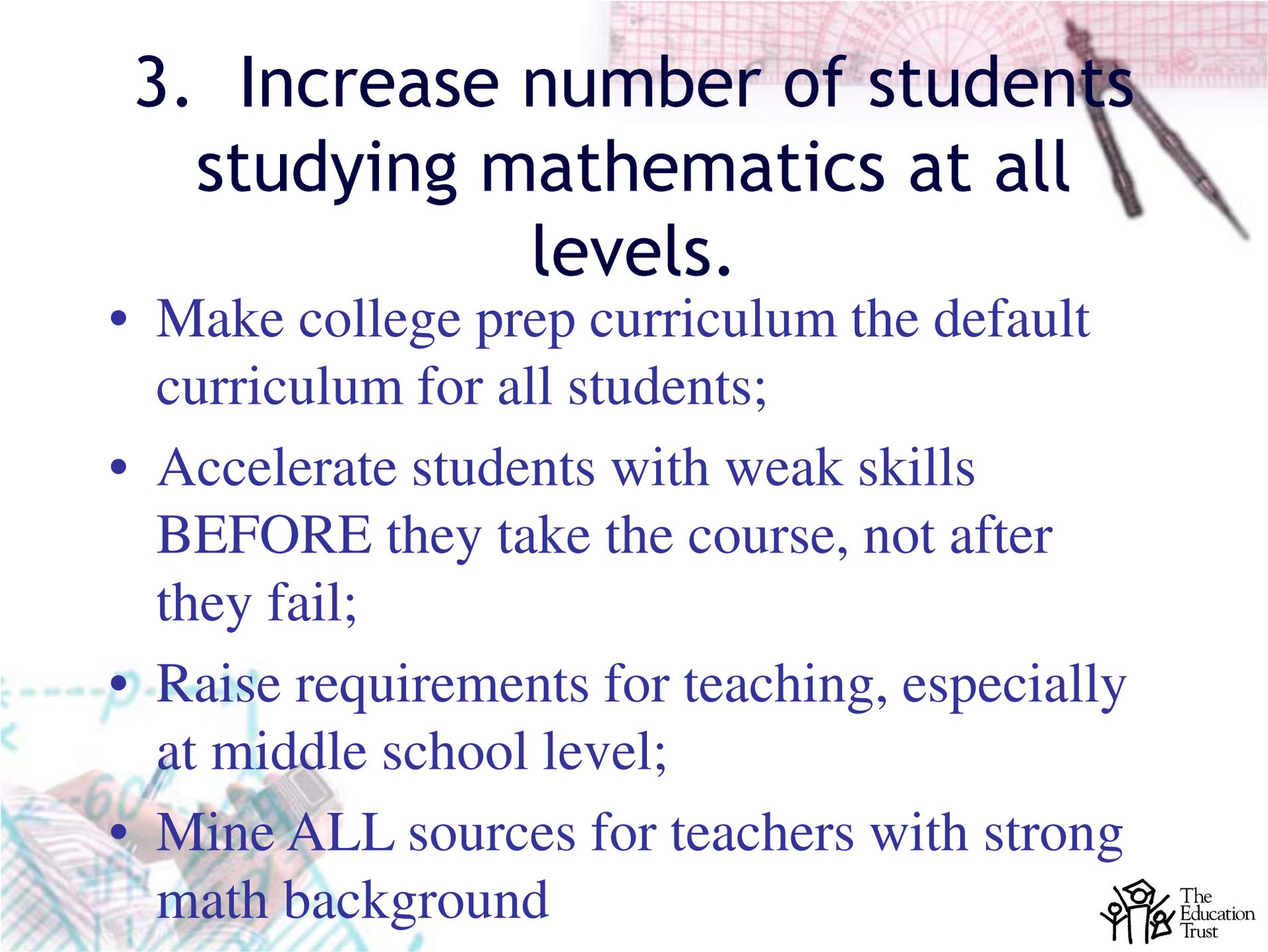




2. Provide Assistance to Current Teachers

- Identify most important standards;
- refocus curriculum, assessment and professional development on most important standards





3. Increase number of students studying mathematics at all levels.

- Make college prep curriculum the default curriculum for all students;
- Accelerate students with weak skills BEFORE they take the course, not after they fail;
- Raise requirements for teaching, especially at middle school level;
- Mine ALL sources for teachers with strong math background



- Enroll strongest students in college math, rather than AP;
- Teach “remedial” math in high school





4. In higher education?

- Goals, incentives, rewards for increased production of bachelors degrees in math;
- Engage mathematics faculties in strategizing about how to produce more and better teachers of mathematics;
- Work on the mathematical literacy of ALL college students.





The Education Trust

www.edtrust.org

202-293-1217

