

# EXECUTIVE SUMMARY OF MATHEMATICS EQUALS OPPORTUNITY

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In the United States today, mastering mathematics has become more important than ever. Students with a strong grasp of mathematics have an advantage in academics and in the job market. The 8th grade is a critical point in mathematics education. Achievement at that stage clears the way for students to take rigorous high school mathematics and science courses—keys to college entrance and success in the labor force. However, most 8th and 9th graders lag so far behind in their course taking that getting on the road to college is a long way off.

This report highlights the following findings:

- **Students who take rigorous mathematics and science courses are much more likely to go to college than those who do not.** Data from the National Educational Longitudinal Study (NELS) reveal that 83 percent of students who took algebra I and geometry went on to college within two years of their scheduled high school graduation. Only 36 percent of students who did not take algebra I and geometry courses went to college. While nearly 89 percent of students who took chemistry in high school went to college, only 43 percent of

students who did not take chemistry went to college.

- **Algebra is the “gateway” to advanced mathematics and science in high school, yet most students do not take it in middle school.** Students who study algebra in middle school and who plan to take advanced mathematics and science courses in high school have an advantage: approximately 60 percent of the students who took calculus in high school had taken algebra in the 8th grade. However, 1996 NAEP data reveal that only 25 percent of U.S. 8th graders enrolled in algebra, and that low-income and minority students

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*(The essay above is the Executive Summary of a white paper, Mathematics Equals Opportunity, prepared for U. S. Secretary of Education Richard W. Riley, 20 October, 1997.)*



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Dick Riley was governor of South Carolina from 1978 to 1986 and served in the state legislature prior to that. His goals for education include voluntary national tests to ensure that all students master the basics of reading and mathematics, and organizing one million volunteer reading tutors across the nation.

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were even less likely to take algebra in the 8th grade.

- **Taking rigorous mathematics and science courses in high school appears to be especially important for low-income students.** Low-income students who took algebra I and geometry were almost three times as likely to attend college as those who did not. While 71 percent of those who took algebra I and geometry went to college, only 27 percent who did not take those courses went on to college. By way of comparison, 94 percent of students from high-income families, and 84 percent of students from middle-income families who took algebra I and geometry in high school went on to college. Sixty percent of students from high-income families and 44 percent of students from middle-income families who did not take algebra I and geometry went to college.

- **Despite the importance of low-income students taking rigorous mathematics and science courses, these students are less likely to take them.** Students from higher-income families are almost twice as likely as lower-income students to take algebra in middle school and geometry in high school. They are more than twice as likely to take chemistry.

Other important findings include:

- **Mathematics achievement depends on**

**the courses a student takes, not the type of school the student attends.** Students in public and private schools who took the same rigorous mathematics courses were equally likely to score at the highest level on the NELS 12th grade mathematics achievement test.

- **Students whose parents are involved in their school work are more likely to take challenging mathematics courses early.** Students whose parents were involved in their education were more likely to take courses like algebra and geometry in the 8th and 9th grade than students whose parents were not involved.

- **The results of the Third International Mathematics and Science Study (TIMSS) reveal that the middle school mathematics curriculum may be a weak link in the U.S. education system.** While U.S. 4th graders scored above the international average in mathematics and science, U.S. 8th graders scored below average in mathematics, and only slightly above the international average in science. Initial analysis of TIMSS data also shows that the middle school mathematics curriculum in the U.S. is less challenging than in other countries. The curriculum of average 8th-grade mathematics classrooms in the U.S. resembles 7th grade curriculum elsewhere. Although algebra and geometry are integral elements of the middle school curriculum in other countries, only a small fraction of U.S. middle schools offer their students these topics.

### Algebra in the Curriculum

Making a successful transition from arithmetic to more advanced mathematics, including algebra and geometry, has often been difficult for students. As a result, many mathematics programs in the U. S. are now systematically incorporating some fundamentals of algebra and geometry into the upper elementary grade curriculum. In these programs, 5th, 6th and 7th grade students are representing and solving equations, characterizing patterns and rates of change among variables, and using other fundamental algebraic concepts.

In addition, some middle and high schools are taking a new approach to advanced topics. While many schools offer the traditional model of separate courses for pre-Algebra, Algebra I, Geometry, Algebra II, Trigonometry, pre-Calculus and Calculus, these schools are integrating them. This approach is consistent with practices in other industrialized nations, which integrate algebra, geometry, and other topics throughout the elementary, middle, and high school years and offer a significant component of algebra in the 8th grade. Building a firm foundation in algebra during the elementary and middle school years eases the shift from arithmetic to advanced topics, whatever the format of students' new curriculum. NELS and NAEP, the two sources of national mathematics course-taking data analyzed in this brief, employ traditional courses titles, such as "algebra I" and "geometry." Thus, these titles are used throughout the brief. ●

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