

Introduction

The National Math Advisory Panel's final report, issued on March 13, 2008, contains 45 findings and recommendations on curricular content, teachers and teacher education, instructional practices and materials, learning processes and assessments. Among these findings, the report offers benchmarks as guideposts for when students should acquire the foundational topics leading to algebra, noting, for example, that students should develop proficiency with addition and subtraction of whole numbers in the early grades, moving on to proficiency with fractions in middle school. The benchmarks should be interpreted flexibly to allow for the needs of students and teachers as students acquire the mathematical prerequisites necessary for algebra (<http://www.ed.gov/about/bdscomm/list/mathpanel/index.html>).

The pages that follow are a brief overview of the findings from the U.S. Department of Education Study by the Mathematics Advisory Panel. The panel's charge was to improve the teaching and learning of mathematics in the United States. Expert panelists, including a number of leading mathematicians and educators, reviewed more than 16,000 research studies before preparing a final report containing policy advice on how to improve mathematics achievement for all students in the United States.

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Parent Crenshaw HS

From The Final Report of the National Mathematics Advisory Panel 2008
U.S. Department of Education
ED Pubs, Education Publications Center,
U.S. Department of Education, P.O. Box 1398, Jessup, MD 20794-1398

Use should be made of what is clearly known from rigorous research about how children learn, especially by recognizing a) the advantages for children in having a strong start; **b) the mutually reinforcing benefits of conceptual understanding, procedural fluency, and automatic (i.e., quick and effortless) recall of facts**; and c) that effort, not just inherent talent, counts in mathematical achievement (p. xvi)

A major goal for K–8 mathematics education should be **proficiency with fractions** (including decimals, percent, and negative fractions), for such proficiency is **foundational for algebra** and, at the present time, seems to be **severely underdeveloped**. Proficiency with whole numbers is a necessary precursor for the study of fractions, as are aspects of measurement and geometry. **These three areas—whole numbers, fractions, and particular aspects of geometry and measurement—are the Critical Foundations of Algebra**. By the term *proficiency*, the Panel means that students should understand key concepts, **achieve automaticity** as appropriate (e.g., with addition and related subtraction facts), develop flexible, accurate, and automatic execution of the standard algorithms, and use these competencies to solve problems (p. xvii)

To prepare students for Algebra, the curriculum must simultaneously develop conceptual understanding, computational fluency, and problem solving skills. Debates regarding the relative importance of these aspects of mathematical knowledge are misguided. These capabilities are mutually supportive, each facilitating learning of the others. (p. xix)



Response to National Math Panel: The Importance of Effective Teachers

Pedagogical knowledge, much of which is acquired and shaped through instructional practice, helps teachers understand how students learn mathematics, become facile with a range of different teaching strategies and instructional materials, and organize and manage the classroom. Teachers need to understand the big ideas of mathematics and be able to represent mathematics as a coherent and connected enterprise (Schifter 1999; Ma 1999). Their decisions and their actions in the classroom—all of which affect how well their students learn mathematics—should be based on this knowledge.

Response to National Math Panel: Factors That Boost Mathematical Achievement

NCTM's long-standing position has been that conceptual knowledge, skills, and problem solving should be developed concurrently. The Panel affirms this position by stating, "The curriculum must simultaneously develop conceptual understanding, computational fluency, and problem solving skills." The Council not only endorses this important finding, but also supports students making sense of the mathematics they are learning as well as connections to mathematical applications—regardless of instructional strategies used. Learning mathematics with understanding is essential. Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

NCTM has long advocated the importance of recall of the basic facts, including the expectation that "Children should master the basic facts of arithmetic that are essential components of fluency with paper-and-pencil and mental computation and with estimation." (*Curriculum and Evaluation Standards, NCTM 1989, p. 47*).

Foundations for Success
Findings and recommendations from the NMAP 2008
U.S. Department of Education
Brochure available at <http://www.ed.gov/Math> Panel

Core Principles of Math Instruction

The areas to be studied in mathematics from pre-kindergarten through eighth grade should be **streamlined and a well-defined** set of the most **critical topics should be emphasized in the early** grades. Any approach that revisits topics year after year without bringing them to closure should be avoided. Other important findings and recommendations for mathematics instruction are:

Critical Foundations. Proficiency with whole numbers, fractions, and certain aspects of geometry and measurement are the critical foundations of algebra.

Fractions. Knowledge of fractions is the most important foundational skill not currently developed among American students.

Conceptual understanding, computational and procedural fluency, and problem-solving skills are equally important and mutually reinforce each other. Debates regarding the relative importance of each of these components of mathematics are misguided.

Automaticity. Students should develop immediate recall of arithmetic facts to free the “working memory” for solving more complex problems.

Major Topics of School Algebra include Symbols and Expressions; Linear Equations; Quadratic Equations; Functions; Algebra of Polynomials; and Combinatorics and Finite Probability. More students should be prepared for and offered an authentic algebra course in Grade 8.

Other Key Findings

Effort matters. A focus on the importance of effort will improve outcomes. If children believe that their efforts to learn make them “smarter,” they show greater persistence in mathematics learning and their performance improves.



Section: [National](#) > [Printer-Friendly Version](#)

Panel Has Recommendations To Better Nation's Math Skills

By NANCY ZUCKERBROD, Associated Press | March 14, 2008

<http://www.nysun.com/national/panel-has-recommendations-to-better-nations-math/72903/>

WASHINGTON ♦ **SCHOOLS COULD IMPROVE STUDENTS' SLUGGISH MATH SCORES BY HAMMERING** home the basics, such as addition and multiplication, and then increasing the focus on fractions and geometry, a presidential panel recommended yesterday.

"Difficulty with fractions (including decimals and percents) is pervasive and is a major obstacle to further progress in mathematics, including algebra," the panel, appointed by President Bush two years ago, said in a report.

Because success in algebra is linked to higher graduation rates and college enrollment, the panel focused on improving areas that form the foundation for algebra. Average American math scores on a variety of tests drop around middle school, when algebra coursework typically begins. That trend led the panel to focus on what's happening before kids take algebra.

A major goal for students should be mastery of fractions, since that is a "severely underdeveloped" area and one that's important to later algebra success, the report states.

It goes on to say that other critical topics ♦ such as whole numbers and aspects of geometry and measurement ♦ should be studied in a more in-depth way.

When it comes to whole numbers, the report states that students must have a clear grasp of the meaning of basic operations of addition, subtraction, multiplication, and division, among other things.

With geometry and measurement, students should be able to find unknown lengths, angles, and areas, the report states.

In general, American math curricula ought to be streamlined, according to the report.

"There is I think a tendency in American curricula to cover too many things too shallowly," the panel's chair and the former president of the University of Texas, Larry Faulkner, said in a briefing with reporters.

The report takes a diplomatic stance when it comes to taking a position on the best methods to teach math to kids.

In recent years, there has been a dispute over whether children should learn a sequence of basic skills in math, including multiplication tables and some memorization, or should understand the theory behind math problems and come up with solutions on their own.

The report says both quick and effortless recall of facts and conceptual understanding of math are

beneficial.

In addition, the back-to-basics camp has tended to favor "teacher-directed" instruction, in which teachers do all the explaining, while the opposing side has backed "student-centered instruction," in which students have the main responsibility for learning math ♦ often through working with peers.

The panel found students can benefit from both styles.

"You need some element of discovery to allow kids to secure concepts in their minds, and you need to be able to have a reasonably efficient approach to be able to cover the material," Mr. Faulkner said.

Teachers need to emphasize that effort pays off, because too many kids feel that they are just not good at math and give up too early, according to the report.

"In many ways this country seems to have a culture of belief in talent, or a talent-driven approach to math ♦ that either you can do it or you can't," Mr. Faulkner said.

He added that much more research is needed to understand why certain teachers are able to boost their students' math skills. "Very little is known about these things, surprisingly little I think to this panel ♦ given the importance of that question," Mr. Faulkner said.

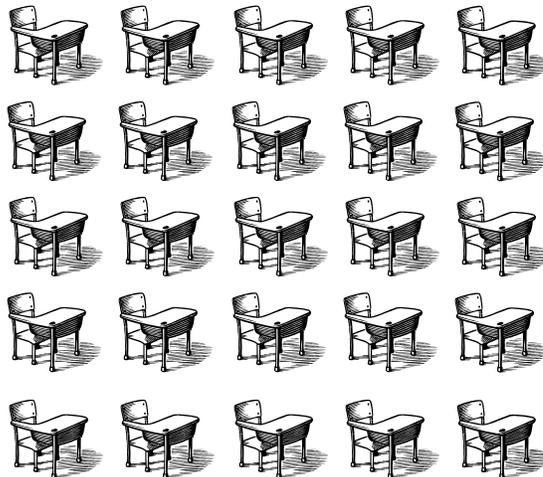
The report did note that elementary- and middle-school teachers need more math preparation.

It took aim at math textbooks, saying they are too long and lack coherence.

Textbook publishers say they are just trying to cover all the things in various state standards. Like for other subjects, each state sets its own math standards dictating what students should learn and when. Many critics say students would be better off with a single national standard, but the panel didn't weigh in on that.

Basic Skills Procedure

1. Pass out worksheet (s) (the worksheets are double sided). Have students place their names and date at the top of each worksheet before you begin. Instruct the students that when you give instructions to start you should turn over your paper and begin. It does not matter which side you do first, but you must turn over your paper.
2. As the second hand of the clock reaches 12 instruct the students to turn over their worksheet and begin, otherwise start the stopwatch if you have one.
3. As the students complete their worksheet they will raise their hand and you will call out the elapsed time in minutes and seconds. Students should record their time in minutes and seconds in the space provided on the worksheet. Students should not call out that they are finished as that will distract the other students.
4. After 3 minutes announce that time is up and those students who did not complete the sheet should place 3 minutes as their elapsed time.
5. Repeat steps 2, 3, and 4 for the remaining sides of the uncompleted worksheets.
6. Collect the worksheets and pass them out per the table below.
Row 5 Switches With Row 3
Row 3 Switches With Row 1
Row 2 Switches With Row 4
8. Have the students correct each worksheet as you call out the answers. Each incorrect answer should be marked with an X.
9. Give the students a short break and repeat steps 1–7 for the second worksheet.
10. Collect all the worksheets and file them away for later when they will be analyzed.

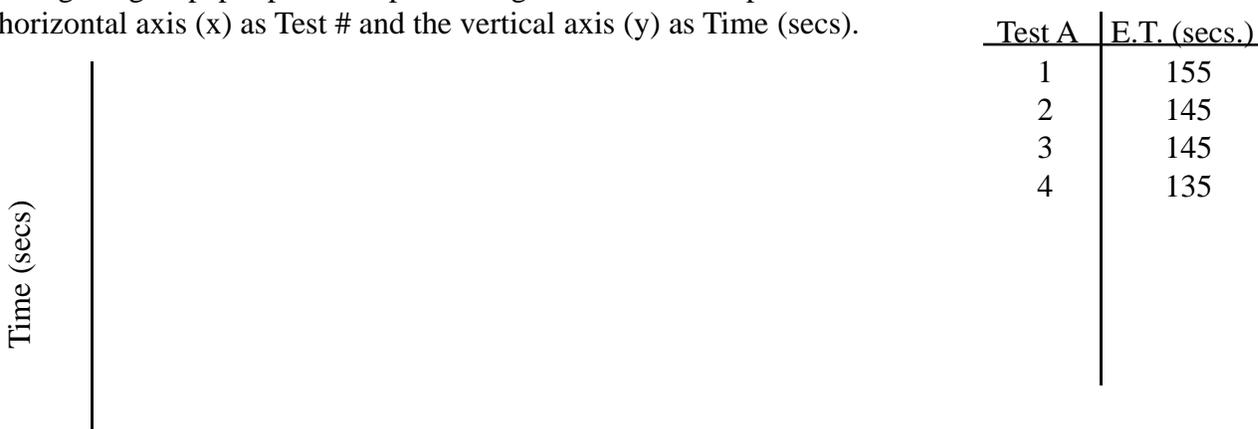


Front of the Room

Student Analysis of Worksheets

This plan is to assist students in analyzing their progress in their mastery of basic skills. The process begins by passing out the completed worksheets that were filed away to each student. Each student should have completed at least five exercises before analysis.

1. Begin by each pupil placing all test A sheets together.
2. Organize the sheets in date order with the oldest sheet first to the most recently completed sheet last.
3. Number the sheets consecutively from oldest (1) to youngest (n).
4. Have students convert their elapsed time at the top of the sheet from minutes and seconds to seconds, and place the result in seconds at the top of each sheet.
5. Have students construct a data table as shown below using the data from their worksheets.
6. Using the grid paper provided place the grid in the landscape orientation and label the horizontal axis (x) as Test # and the vertical axis (y) as Time (secs).

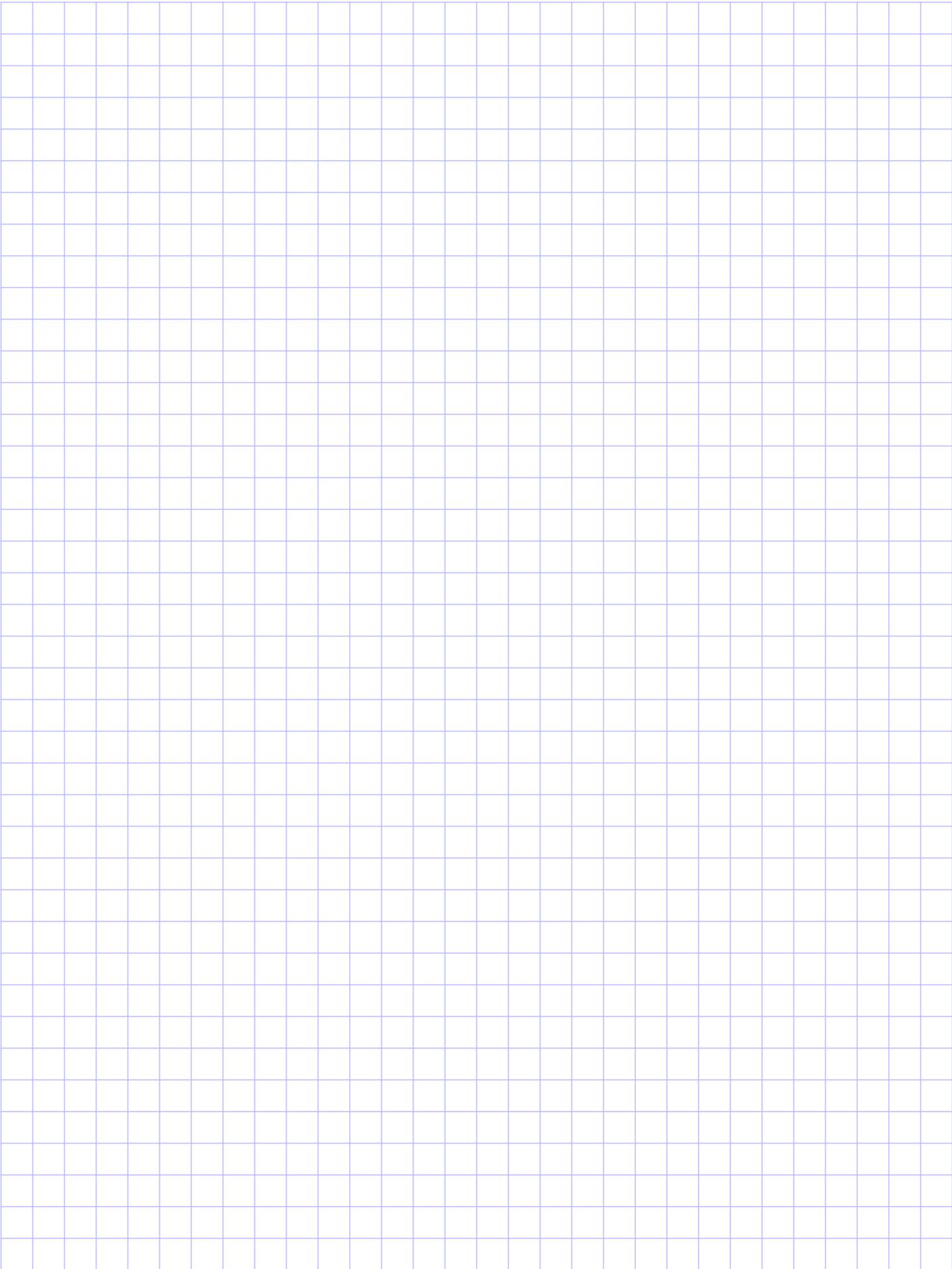


7. The time axis should be labeled to 300 secs. While the x axis should be labeled to 30
8. Have students graph the Test A values on the grid. Have them use a triangle for each data point. For students who did not complete all the problems in the 300 second time limit have them make another graph with the number of problems worked for the y axis.
9. Repeat steps 1,2,3,4, and 8 for the other worksheets using different shapes for each data point. (i.e. for test H use a circle, for test B use a dot, etc.)

Sample Student Questions

Below are some possible questions related to this exercise that are related to the algebra standards.

1. Over time what should your graph look like? (A downward sloping line)
2. What type of function would that be? (A decreasing function)
3. What is the slope of your graph?
4. At what test # should you reach the goal of completing your worksheets in less than 120 seconds?
5. Any other questions that you might think of.



Benchmarks

The benchmarks set forth by the Panel should help to guide classroom curricula, mathematics instruction, textbook development and state assessments that will lead to proficiency with whole numbers and fractions, and competence with certain aspects of geometry and measurement.

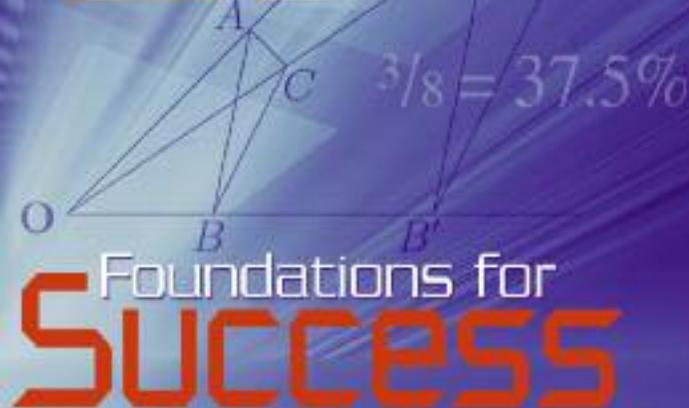
Grade Level (by the end of)	Mathematics Learning Goal
Grade 3	Proficiency with addition and subtraction of whole numbers.
Grade 4	Ability to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals.
Grade 5	Proficiency with multiplication and division of whole numbers. Proficiency with comparing fractions and decimals and common percents, and with the addition and subtraction of fractions and decimals. Ability to solve problems involving perimeter and area of triangles and all quadrilaterals having at least one pair of parallel sides (i.e., trapezoids).
Grade 6	Proficiency with multiplication and division of fractions and decimals. Proficiency with all operations involving positive and negative integers. Ability to analyze the properties of two-dimensional shapes and solve problems involving perimeter and area, and analyze the properties of three-dimensional shapes and solve problems involving surface area and volume.
Grade 7	Proficiency with all operations involving positive and negative fractions. Ability to solve problems involving percent, ratio, and rate and extend this work to proportionality. Familiarity with the relationship between similar triangles and the concept of the slope of a line.

$$x^2 - y^2 = (x-y)(x+y)$$

$$1.67 > 1\frac{2}{3}$$

$$3x - 1 = 4 + x$$

$$y \leq 10 - 2x$$



Foundations for SUCCESS

Findings and Recommendations From the
National Mathematics Advisory Panel

$$f(x) = x^2 + x - 1$$



$$x^2 = \frac{5}{2}$$

$$4 \overline{)2581}$$

$$y \geq 7x + 15$$



$$\begin{array}{r} 796 \\ + 58 \\ \hline 854 \end{array}$$

$$42 \times 13 = 546$$

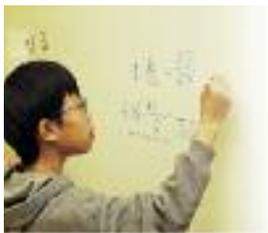
The National Mathematics Advisory Panel
<http://www.ed.gov/MathPanel>

For electronic copies of the Math Panel's final report and the report of the task groups and subcommittees, please visit www.ed.gov/mathpanel or order copies at <http://edpubs.ed.gov/>, by e-mail at edpubs@inet.ed.gov and by phone at 1-877-433-7827 (TDD/TTY 1-877-576-7734).

$$3s + 1 = 4 + s$$

$$61 - 24 = 37$$

About the National Mathematics Advisory Panel



For students to compete in the 21st-century global economy, knowledge of and proficiency in mathematics are critical. Today's high school graduates need to have solid mathematics skills—whether they are headed to college or to the

workforce. To help ensure our nation's future competitiveness and economic viability, President George W. Bush created the **National Mathematics Advisory Panel** (National Math Panel) in April 2006. The Panel was charged with reviewing the best available scientific evidence and making recommendations on improving mathematics education with a focus on readiness for and success in algebra.

The National Math Panel's final report, *Foundations for Success: The Final Report of the National Mathematics Advisory Panel*, was issued on March 13, 2008. It contains 45 findings and recommendations on numerous topics, including curricular content, learning processes, instructional practices and materials, teachers, assessments and future research priorities. Highlights of the findings and recommendations are briefly summarized below. For a complete discussion of these topics, the public may read the final report as well as the reports of the task groups and subcommittees by visiting www.ed.gov/mathpanel or by ordering copies at <http://edpubs.ed.gov/>, by e-mail at edpubs@inet.ed.gov and by phone at 1-877-433-7827 (TDD/TTY 1-877-576-7734).

Core Principles of Math Instruction

The areas to be studied in mathematics from pre-kindergarten through eighth grade should be **streamlined** and a well-defined set of the most **critical topics** should be emphasized in the early grades. Any approach that revisits topics year after year without bringing them to closure should be avoided. Other important findings and recommendations for mathematics instruction are:

- **Critical Foundations.** Proficiency with whole numbers, fractions, and certain aspects of geometry and measurement are the critical foundations of algebra.

- **Fractions.** Knowledge of fractions is the most important foundational skill not currently developed among American students.
- **Conceptual understanding, computational and procedural fluency, and problem-solving skills** are equally important and mutually reinforce each other. Debates regarding the relative importance of each of these components of mathematics are misguided.
- **Automaticity.** Students should develop immediate recall of arithmetic facts to free the “working memory” for solving more complex problems.
- **Major Topics of School Algebra** include Symbols and Expressions; Linear Equations; Quadratic Equations; Functions; Algebra of Polynomials; and Combinatorics and Finite Probability. More students should be prepared for and offered an authentic algebra course in Grade 8.

Other Key Findings

- **Effort matters.** A focus on the importance of effort will improve outcomes. If children believe that their efforts to learn make them “smarter,” they show greater persistence in mathematics learning and their performance improves.
- **Most children develop considerable knowledge of mathematics before they begin kindergarten.** Children from families with low incomes and low levels of parental education and those of single parents often have less mathematical knowledge when they begin school than do children from more advantaged backgrounds. This tends to

hinder their learning for years to come. There are promising interventions to improve the mathematical knowledge of these young children before they enter kindergarten.

- **Teachers' mathematical knowledge is important for students' achievement.** The preparation of elementary and middle school teachers in mathematics should be strengthened. Teachers cannot be expected to teach what they do not know.
- **Teachers who consistently produce significant gains in students' mathematics achievement should be recognized.** When students are taught by a series of effective teachers, the positive outcomes on their mathematics learning are compounded.
- **Teachers' regular use of formative assessment improves their students' learning,** especially if teachers have additional guidance on using the assessment to individualize instruction.
- **Explicit instruction** with students who have mathematical difficulties has shown consistently positive effects on performance with word problems and computation.
- **More research is needed.** The nation must continue to build the capacity for more rigorous research in mathematics education to more effectively inform policy and practice.



Next Steps

The findings and recommendations of the Panel are a first step in the process toward fixing the delivery system in mathematics education in this country.

The United States has genuine opportunities to improve mathematics education, but these improvements can be realized only if educators, policymakers, researchers and parents all work together to ensure that our students master the mathematical foundations that are so critical for achievement in algebra and beyond.

The National Mathematics Advisory Panel

24 expert panelists, including a number of leading mathematicians, cognitive psychologists and mathematics educators, reviewed more than 16,000 research studies before preparing a final report containing policy advice on how to improve mathematics achievement for all students in the United States.

QUICK TIPS

ATTITUDES ABOUT MATHEMATICS LEARNING

- Encourage your child to have a positive attitude about learning mathematics.
- Stress the importance of effort. Prompt your child to face challenges positively and to see mathematics as a subject that is important.
- Avoid statements like “I wasn’t good at math” or “Math is too hard.”

EARLY YEARS

- Introduce your baby and toddler to numbers, counting and shapes.
- Prior to kindergarten, help your child explore shapes and their features to gain a basic understanding of the language related to mathematics, such as “more than,” “less than” and “equal to,” and “light” and “heavy.”
- Ask your child’s caregivers or preschool teachers about activities that can develop your child’s mathematical knowledge and skills, including beginning activities in counting and joining (adding) and separating (subtracting) objects.
- For a list of suggested activities please visit *Helping Your Child Learn Mathematics* online at www.ed.gov/parents.

THE NATIONAL MATHEMATICS ADVISORY PANEL

In April 2006, President George W. Bush created the National Mathematics Advisory Panel (National Math Panel) to improve the teaching and learning of mathematics in the United States. Expert panelists, including a number of leading mathematicians and educators, reviewed more than 16,000 research studies before preparing a final report containing policy advice on how to improve mathematics achievement for all students in the United States.

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The information in this brochure is a summary of the relevant findings of the final report. The findings and recommendations of the Math Panel do not make particular claims for the best teaching methods or curriculum to be used.

To view the entire report online or to obtain a hardcopy and/or additional copies of this brochure in English or Spanish, please visit www.ed.gov/mathpanel. For further information, visit www.ed.gov or call 800-USA-LEARN.

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HOW PARENTS CAN HELP
THEIR CHILDREN LEARN MATHEMATICS



RECOMMENDATIONS FROM THE NATIONAL MATHEMATICS ADVISORY PANEL

$$61 - 24 = 37$$

$$11 \times 6 = 66$$

$$\begin{array}{r} 796 \\ + 58 \\ \hline 854 \end{array}$$

$$y \leq 10 - 2x$$



QUICK TIPS



It is more important than ever that our students receive solid math instruction in the early grades to prepare them to take and pass algebra and other challenging courses in middle and high school.

—U.S. Secretary of Education Margaret Spellings



In today's highly competitive economy, solid skills in mathematics, including algebra, are a necessity—not just for scientists and engineers, but for everyone. Being proficient in mathematics helps to improve students' college and career options and to increase their future income levels. Beyond the education, career and economic benefits, a solid background in mathematics helps students to better understand their world and to become good citizens.



As a parent, you may be anxious about your own math skills or perhaps feel challenged by the difficulty of your child's math homework, but your child will benefit greatly if you maintain a positive, encouraging attitude. And whether or not you completely understand your child's math assignments, you can still help as he or she progresses through school by asking the right questions, helping your child approach the problems with the right attitude, and getting extra help from the teacher or a tutor as needed.

We now know from the findings of the National Mathematics Advisory Panel that there are several things parents can do and must do to help ensure that their children succeed in mathematics. Read on for some suggestions.

POSITIVE PARENT ATTITUDES ABOUT MATHEMATICS EDUCATION ARE IMPORTANT TO STUDENT SUCCESS

- Research shows that a child's goals for and beliefs about learning are related to his or her performance in mathematics. Even if you as a parent feel you are not good in math or perhaps feel uncomfortable with the mathematics being taught in a given day's lesson, you can still support your child's mathematics learning by showing you value mathematics. Your child will follow suit.
- Students who believe that their hard work makes them "smarter" are more likely to try harder in mathematics, and their efforts result in better performance. On the other hand, students who believe that intelligence is inborn generally do not achieve as well, and they do not take full advantage of feedback or constructive criticism regarding their performance.

MATHEMATICS EDUCATION BEGINS AT HOME

- In the early years, your child has an opportunity to jump-start his or her mathematics learning through informal activities. Talking about mathematics in a positive manner and involving your child in activities that incorporate basic mathematical concepts will lay the foundation for your child's success in mathematics at the preschool and elementary school levels.
- Before kindergarten, most children can acquire considerable knowledge of numbers and other core mathematical concepts. For example, young children can understand certain basic aspects about fractions, like sharing half a sandwich with a friend.
- The more mathematical knowledge that kindergartners bring with them to school, the greater their chances for success in mathematics in elementary, middle, and high school.

Just as with reading, the math knowledge children bring to school at an early age is linked with their performance in later grades.

—U.S. Secretary of Education Margaret Spellings

WHY ALGEBRA IS IMPORTANT

- Math does make a difference. Whether your child is headed for college or the workforce, he or she needs to graduate from high school with solid mathematics skills. Job growth in the fields of science and engineering is outpacing overall job growth by a rate of three to one, which means there is a critical need for proficiency in higher-level mathematics now more than ever before.
- Students need to learn the mathematical building blocks for algebra. Algebra represents the key to entry into higher-level mathematics, which often correlates with success in higher education and the potential for greater earnings.

IN THE CLASSROOM

- To prepare for algebra, whether in middle or high school, students must be proficient in Critical Foundations of Algebra. This means they must have fluency in
 - Whole numbers;
 - Fractions (including decimals and percent); and
 - Particular aspects of geometry and measurement.

While not meant to comprise all of what students should know prior to algebra, the Critical Foundations deserve ample time in any mathematics curriculum.

- Students with mathematical difficulties, including students with learning disabilities, show consistent, positive results in performing computation and in solving word problems when teachers provide *explicit* instruction. This includes providing clear models for solving a problem type, practice in the use of newly learned skills, opportunities to think aloud, and extensive feedback.
- Mathematically gifted students with sufficient motivation should be allowed to learn mathematics much faster than students proceeding through the curriculum at a normal pace.
- Using technology can make a difference. Technology-based drill and practice activities can improve student performance in specific areas of mathematics.

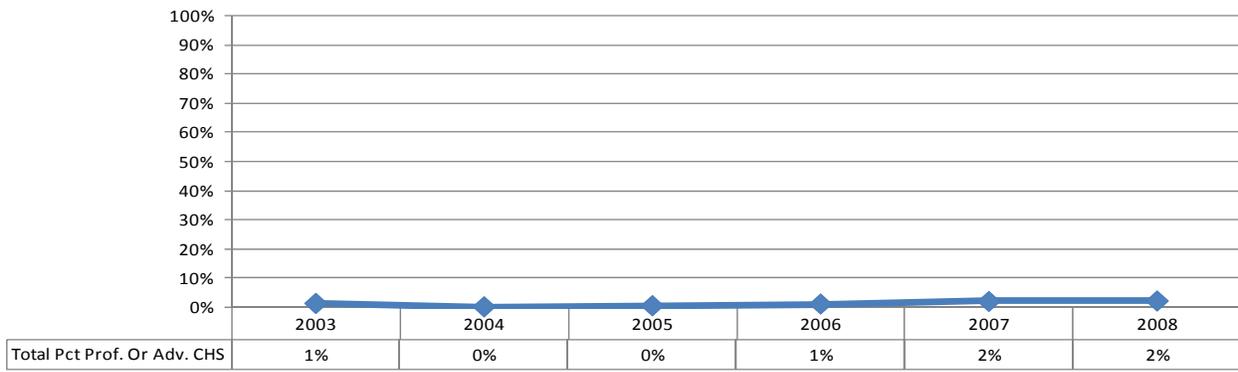
ELEMENTARY AND MIDDLE SCHOOL YEARS

- Review the National Math Panel's suggested benchmarks to monitor your child's progress toward the Critical Foundations of Algebra.
- Algebra is much more than a single course, and the way algebra is taught in schools can vary greatly. Talk to your child's teacher about the algebra topics being covered in class and how they compare with the Panel's Major Topics of School Algebra.
- Seek help from the school or teacher if your child needs additional support to acquire proficiency in the mathematics being taught.
- Learn about the classroom practices your child's teacher uses to support learning mathematics. Ask how you can enhance your child's learning outside of the classroom.
- Take advantage of opportunities to test your child's mathematical skills. For example, after a purchase, ask your child to estimate and then calculate the amount of change he or she should receive from the cashier. Make learning fun by creating mathematical problems to solve together at home or on trips.

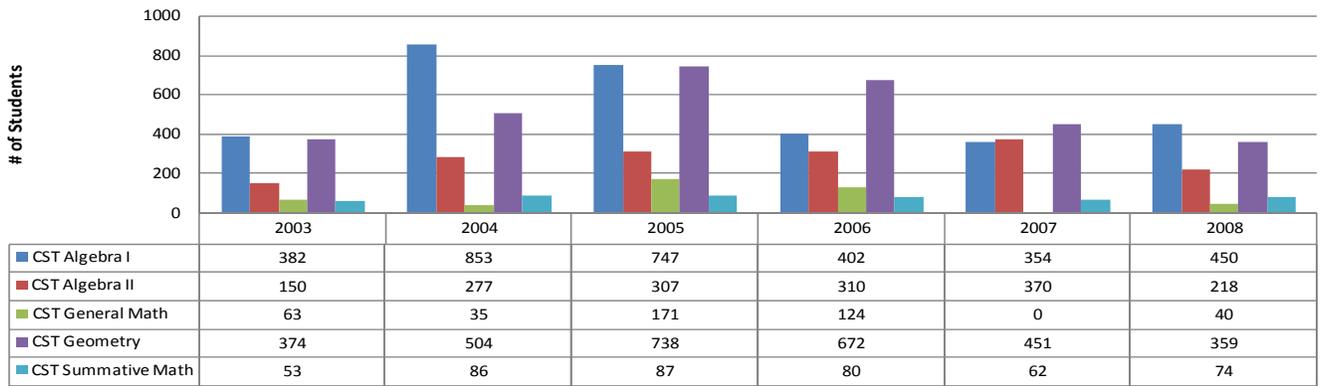


Crenshaw HS CST Math Scores 2003-2008

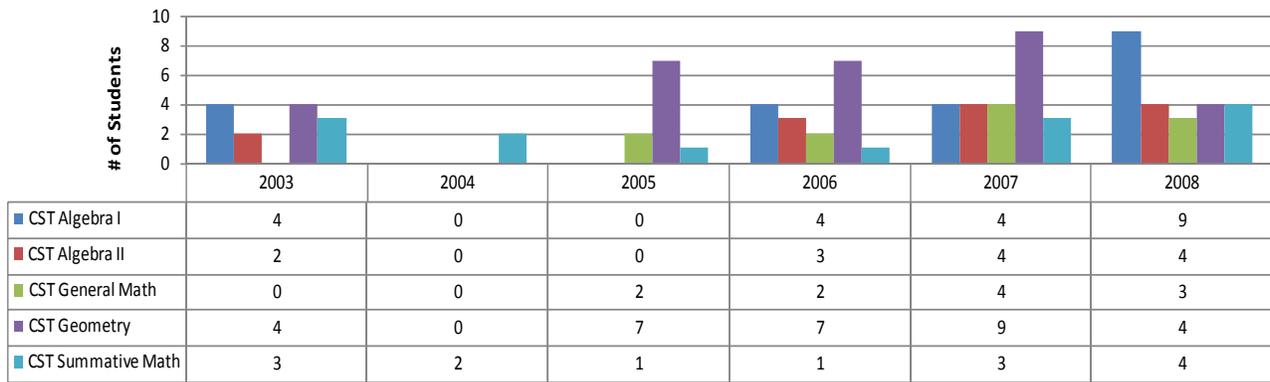
Percentage of Students at Crenshaw HS Testing Proficient or Advanced on All CST Math Courses



Number of Students Tested at Crenshaw HS for All CST Math Courses



Number of Students Testing Advanced or Proficient at Crenshaw HS for All CST Math Courses



Total Students Tested at Crenshaw HS for All CST Math Courses

