



GEORGIA
DEPARTMENT OF
EDUCATION

Kathy Cox
State Superintendent of Schools

DO YOU REALLY WANT TO CHANGE?
A CLOSER LOOK AT GEORGIA'S MATHEMATICS CURRICULUM





We will lead the nation in improving student achievement.

Why Change?

Using Data to Drive Decisions

WE WILL LEAD THE NATION IN IMPROVING STUDENT ACHIEVEMENT.



Georgia's Achievement Gap



- **Elementary School: Grade 5 Math (CRCT)**
 - White Students: 94%
 - Hispanic Students: 82%  Gap: 12 points
 - Black Students: 83%  Gap: 11 points
- **Middle School: Grade 8 Math (CRCT)**
 - White Students: 87%
 - Hispanic Students: 68%  Gap: 19 points
 - Black Students: 66%  Gap: 21 points

Georgia's Achievement Gap

- High School: E-GHSGT: % meets & exceeds
 - White Students: 85.7%
 - Hispanic Students: 67.4% → Gap: 18.4 points
 - Black Students: 58.6% → Gap: 27.1 points
- High School E-GHSGT: % exceeds
 - White Students: 72.9%
 - Hispanic Students: 50.1% → Gap: 22.8 points
 - Black Students: 38.7% → Gap: 34.2 points

Georgia's Achievement Gap

- **High School: Algebra 1 End of Course Test**
 - White Students: 80%
 - Hispanic Students: 58%  **Gap: 22 points**
 - Black Students: 47%  **Gap: 33 point**

- **High School: Geometry End of Course Test**
 - White Students: 80%
 - Hispanic Students: 58%  **Gap: 22 points**
 - Black Students: 40%  **Gap: 40 points**

Math: The Impact

- **Percent of SAT Test Takers w/ 4 yrs. of Math**
 - ✓ **NATION: 62 percent**
 - ✓ **GEORGIA: 69 percent**
- **Score for SAT Test Takers w/ 4 yrs. of Math.**
 - ✓ **NATION: 529 on math portion**
 - ✓ **GEORGIA: 500 on math portion**
- **What kind of Math are we teaching?**

Math: The Impact

Course Work	NATION	GEORGIA
Algebra	517	495
Geometry	519	498
Trigonometry	553	520
Precalculus	571	557
Calculus	608	584
Other Math Courses	510	487
Computer Math	539	479
AP/Honors Courses	599	585

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Georgia Performance Standards Increasing Rigor & Relevance

Aligned with *Curriculum Focal Points* developed by
the National Council of Teachers of Mathematics

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Comparison of QCC to GPS Math Standards

Grades	Old	New
6th Grade	53	18
7th Grade	43	15
8th Grade	45	18

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NCTM Curriculum Focal Points

“The Curriculum Focal Points are designed to promote a discussion on the refinement of mathematics curricula and address the impression that various state and district curricula are ‘a mile wide and an inch deep.’ The Curriculum Focal Points present a vision for the design of the next generation of state curriculum standards and state tests, and they present a way to bring needed focus to what is taught in mathematics.”

- NCTM President Francis (Skip) Fennell.

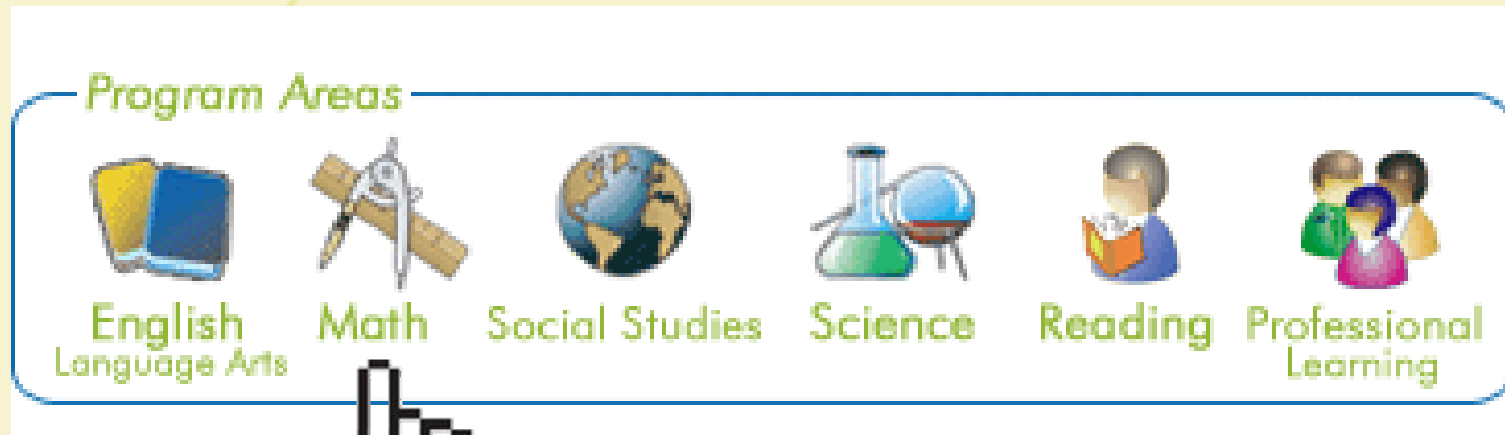
NCTM Curriculum Focal Points: Grade 7

- *Number and Operations and Algebra:*
Developing an understanding of operations on all rational numbers and solving linear equations

GPS: 7th Grade Mathematics

- Understand and use rational numbers, including signed numbers
- Solve linear equations in one variable
- Analyze the characteristics of linear relationships

Georgia Performance Standards Mathematics



Claire Pierce
Math Program Manager

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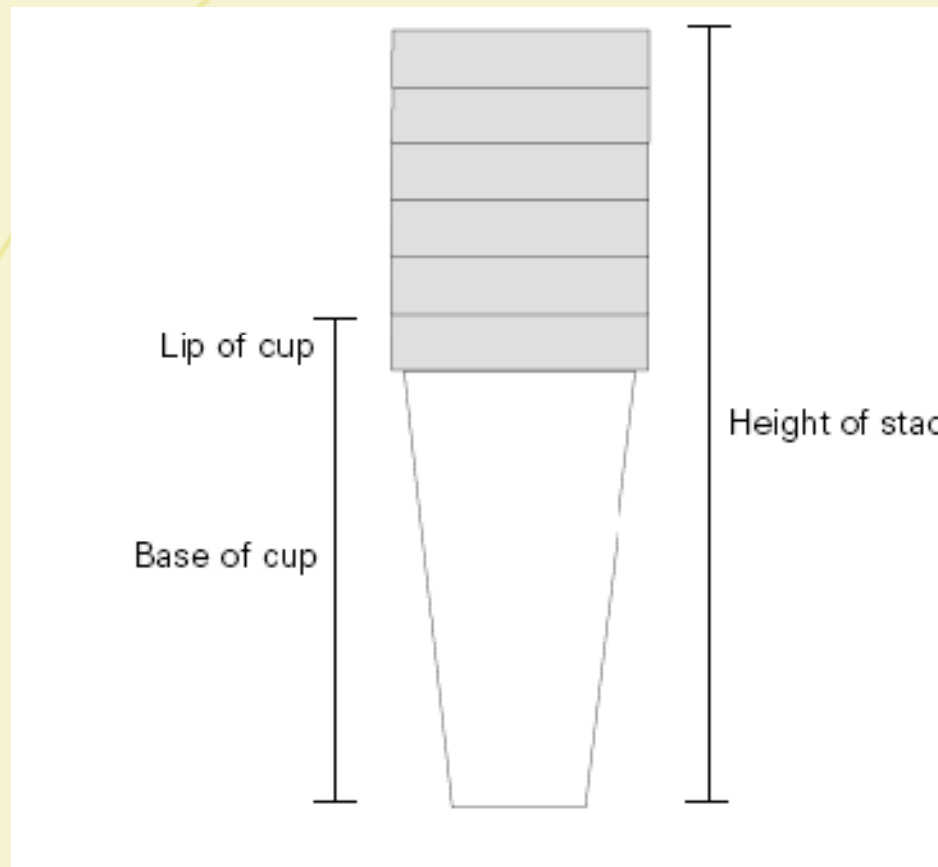
The Mathematics of the GPS

How is it different?

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"PAPER CUPS"

The paper cups shown here are identical. By making appropriate measurements, you are to represent the relationship between the number of cups and the height of the stack using a table, a coordinate graph, a formula and a written description. In the case of each representation, discuss the advantage of that representation over the other three (e.g., What does the table tell you that the graph does not?)



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Use your representations to answer each of the following questions.

What is the height of 60 cups? Show how you know.

How many cups will fit on a shelf that is 18 inches tall? Show how you know.

The Process

- Expert Advisory Panel
- Teacher teams
- High School Advisory Committee
- Revisions
- State Board approval

Endorsements

- Vice Chancellor for Academic Affairs
- Board of Georgia Council of Teachers of Mathematics
- Board of Regents Academic Advisory Committee on Mathematical Subjects
- High school department chairs

WHAT is it?

Balance of concepts, skills, and
problem solving emphasizing
understanding and relevance

Performance Standards

- Content and process standards
- Tasks
- Student work
- Teacher commentary

Underlying Principles

- Lean
- Rigorous
- Coherent
- Student focused

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Climbing the Ladder

- 6th-Surface area and volume of right rectangular prisms and right circular cylinders
- 7th-Cross sections and shadows
- 8th-Surface area of pyramids and cones as an application of the Pythagorean Theorem
- Math 1-Comparing quadratic and cubic functions using surface area and volume

Strengths of the Curriculum

- Internationally benchmarked
- Aligned to national and international standards
- Relevant to student needs and to the 21st century
- Provides clear expectations for student performance
- Allows alignment of instruction and assessment

Implications for the Classroom

- Students actively engaged in mathematics
- Explaining thinking
- Justifying work
- Using multiple representations
- Making connections
- Choosing appropriate technology

WHAT is it?

- K-2: Four strands: number and operations, measurement, geometry, and data analysis
- 3-5: Algebra strand is added
- 6-8: In-depth treatment of algebra and geometry begins in grade 6; traditional first-year algebra and much of the traditional geometry course completed by the end of grade 8.

WHAT is it?

High School Mathematics

- Integrated curriculum
- Common level of mastery
- Multiple paths of study

High School Course Chart

Core Mathematics	Mathematics	Accelerated Mathematics
Core Mathematics 1	Mathematics 1	Accelerated Mathematics 1
Core Mathematics 2		
Core Mathematics 3	Mathematics 2	Accelerated Mathematics 2
Core Mathematics 4		
Other courses available: Discrete mathematics AP Statistics Advanced Placement Calculus AB Advanced Placement Calculus BC	Mathematics 3	Accelerated Mathematics 3
	Mathematics 4	Accelerated Mathematics 3

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High School Course Chart

Mathematics	Accelerated Mathematics
Mathematics 1	Accelerated Math 1
Mathematics 2	
Mathematics 3	Accelerated Math 2
Mathematics 4	Accelerated Mathematics 3
Other courses available: Discrete Mathematics AP Statistics Advanced Placement Calculus AB Advanced Placement Calculus BC	

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Graduation Rule

- Elimination of Core Mathematics
- Four years of math for all students
- Math 3 or higher

Mathematics Rollout

Year	Teacher Training	Classroom Implementation
2004	Grade 6	
2005	Grades K-2, 7	Grade 6
2006	Grades 3-5, 8	Grades K-2, 7
2007	High School	Grades 3-5, 8
2008		Grade 9
2009		Grade 10
2010		Grade 11
2011		Grade 12

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Resources

- Mathematics webpage
- Frameworks
- Concept maps
- Parent letters
- Videos
- Webcasts

Partnerships/Collaboration

- **University System of Georgia**
 - Partnership for Reform in Science and Mathematics (PRISM)
 - Academic Advisory Committee on Mathematical Subjects
 - Learning and Performance Support Lab (UGA)
 - Center for Proficiency in Mathematics Teaching (UGA)
 - Center for Education Integrating Mathematics, Science and Computing (Georgia Tech)
 - Math/Science Partnerships
 - Teacher Quality Grants
 - Mathematics and Mathematics Education Faculty

Partnerships/Collaboration

- Georgia Department of Technical and Adult Education
- Georgia Department of Early Care and Learning
- Governor's Office of Workforce Development
- Governor's Office of Student Achievement
- Regional Education Services Agencies
- Georgia Council of Teachers of Mathematics
- Georgia Public Broadcasting

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High School Implementation

- Instructional frameworks
- Training
- Implementation guidelines
- On-going teacher support

Instructional Frameworks

- Course content “chunked” into units
- Relevant tasks
- Student work with commentary
- Extensive teacher notes

Training

High School Teachers

- 3 consecutive days in the spring of 2007
- 2 follow-up days during the 2007-2008 school year
- 16 sites based on RESA regions
- Trainers will be DOE staff and others selected and trained by DOE staff

Training

- One team of four teachers from every Georgia high school.
 - 3 mathematics teachers and 1 special education teacher
 - Strong content expertise in algebra, geometry, and statistics among 3 mathematics teachers
 - All teachers must be on contract for the 2007-08 school year
 - Teachers should be teacher leaders; provide quality instruction; have high expectations for all students; and be known to motivate learners

Training

- Designed and delivered using components of research-based best practice for professional learning:
 - **Content-based.** Content will be based on the Mathematics 1 Instructional Framework.
 - Modeled using research-based best practice related to student learning
 - Utilizing classroom materials and resources, including appropriate technology

Training

- Focus on intervention strategies for struggling students
- Suggested implementation plan for 2007-2008 school year

Training

High School Administrators

- Held in conjunction with teacher training
- One half-day session specifically for administrators
- School and classroom strategies for struggling students
- One half day with their teacher team

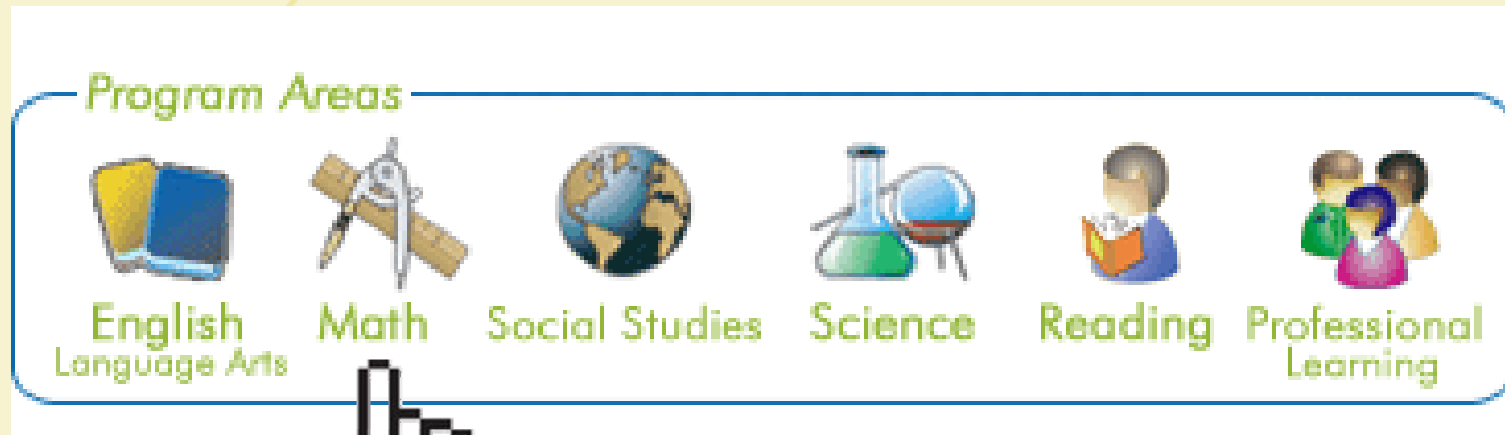
Implementation Guidelines

- Flowchart indicating paths of study
- Course descriptions for transfer students and Higher Education interface
- Transition course for transfer students through Georgia Virtual School
- Intervention strategies for struggling students
 - continual progress monitoring
 - scheduling ideas/support classes
 - flexible grouping in the regular classroom

On-Going Teacher Support

- On-line content modules
- Videos illustrating effective classroom practice
- Webcasts related to appropriate use of technology
- On-line sharing of resources and teacher created lessons

A Perspective from Higher Education



Bradford R. Findell
University of Georgia

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Early Issues in the Process

- The GPS writing teams (i.e., Teacher Teams) were too narrow in composition
- The “Japanese model” needed adaptation, particularly in grades 9-12
- The timeline was too short
- The “integrated curriculum” raised concerns
- The “Foundations” (later Core Math) courses raised implementation concerns

The High School Mathematics Advisory Committee

- Convened to recommend needed changes in the GPS
- Included a diversity of perspectives and expertise
 - Teachers, mathematics supervisors, and university faculty in mathematics, mathematics education, and statistics
- Considered availability of textbooks
- Developed, by consensus, a complete rewrite of the high school standards
- Revised the middle school standards to improve clarity and the transition to high school
- Served (and continues to serve) as a sounding board for GaDOE staff

Integrated Mathematics

- Felix Klein recommended (c. 1900) that the secondary curriculum be unified around the concept of function; many countries followed that advice
- In the 1970s, Howard Fehr observed that the U.S. was the last developed country to have a separate H.S. geometry course
- In practice (and in textbooks), the Algebra, Geometry, Algebra “sandwich” includes considerable repetition
- In the 1990s, several NSF-funded curriculum projects chose integrated approaches
- Some states suggest integrated approaches as an option, and integrated texts are in use in almost all states

Mathematics for All

- The H.S. Math Advisory Committee concluded that the Core Math sequence was politically necessary
- Now the Georgia DOE is moving to eliminate the Core Math sequence—before initial implementation
- What has precipitated this shift?
 - Ask Claire and Kathy
 - The American Diploma Project, Achieve, NGA, ...
- What will it take to support this shift?
 - Good materials, tasks, and teaching suggestions
 - Professional development, learning communities, ...
 - Successful models for supporting struggling students

What Does the Research Say?

- Mathematical proficiency involves concepts, skills, problem solving, reasoning, and a tendency to make sense of math
- Learning is difficult, but kids can do remarkable things, when given a chance
- Implementation matters
 - Innovations are not adopted but rather are adapted (and possibly diluted, distorted, sterilized, ...)
 - Innovations become slogans, which are powerful marketing tools but ineffectual agents of change
- Focus on the classroom: interactions among the teacher, the students, and the mathematics
- Change is difficult, but remarkable things can happen when teachers work together and with the community

A Changing View of Mathematics

- A caricature of algebra in the U.S.:
 - Grades K-8: Patterns, mostly “Guess my rule”
 - Grades 9-11: Functions, mostly “formulas”
 - Grade 12: Sequences (advanced topic)
 - *Students see these as separate topics*
- Algebra in the GPS
 - Grades 6-8: Quantities that vary together
 - Generalizing, going backwards, reasoning from the context
 - Grades 9 & 10: Formal introduction to functions
 - Function notation, families, transformations, patterns of change
 - Grades 8-12: Sequences as functions
 - Patterns as sequences, domain, connecting the dots

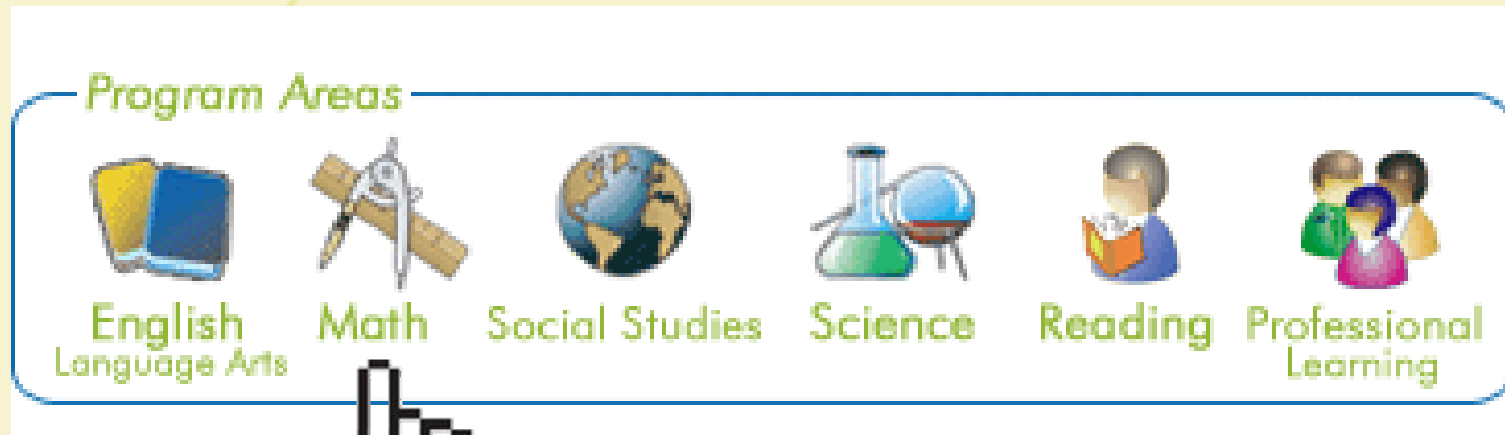
Changes in Higher Education

- PRISM activities throughout the state
- Learning communities, partnerships, and workshops involving teachers, and university faculty in mathematics, mathematics education, and statistics
- Using the GPS to guide redesign of courses and programs for teachers
- Using the GPS explicitly in courses for teachers
- Response to the new Georgia Examinations for the Certification of Teachers (GACE)

Ongoing Challenges

- Will the assessments support teacher learning and instructional improvement?
- Teachers' beliefs
 - Some students just can't learn algebra.
 - I'm a geometry teacher.
 - *The GPS challenges their identity, their core.*
- Parents' beliefs
 - A curriculum for all students is not good enough for my child.
 - *The GPS challenges their identity.*
- Getting the message into all schools, all classrooms, and all communities

Georgia Performance Standards Mathematics



Building Trust
Building Momentum

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Building Trust

State Board of Education Votes on Adopting GPS Mathematics Curriculum:

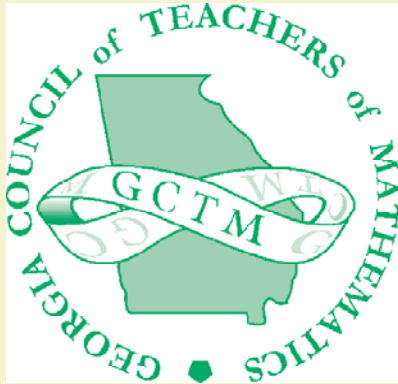
- In July 2004, Board vote on the K-8 GPS Mathematics Curriculum was 10-3.
- In May 2005, the Board vote on the revised High School GPS Mathematics Curriculum was 13-0.

Thomas B. Fordham Institute: *The State of State Standards:* Overall Performance

- Overall Grade:
 - 2006: B+
- Overall Rank
 - 5th in the nation
 - Up from 21st in 2000
- One of the “most improved” set of standards in the nation.

Thomas B. Fordham Institute: *The State of State Standards:* Mathematics

- Overall Grade
 - 2006: B
- Comments
 - “Georgia’s relatively new math standards are strong.”
 - “The K–8 standards especially are clear, concise, and are generally free of edu-jargon.”



Reflections - Fall 2006

“Teachers in Sumter County and across the state are beginning to ‘think outside the box’ and use ordinary, everyday items and events to teach extraordinary lessons in mathematics. Once the teachers make the connections, students tend to enjoy mathematics and overcome their fear of the subject.”

--Gayla Braziel, Sumter County

Mr. Benford's 6th Grade Math Class

Social Circle Middle School
Social Circle City Schools



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Reflections - Fall 2006

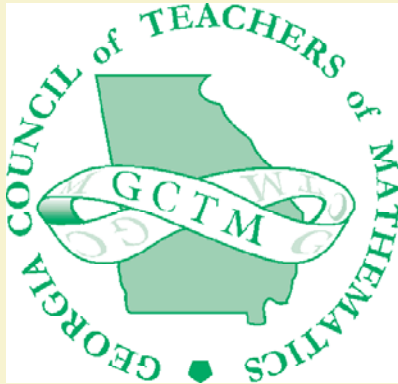
“Students have taken ownership in their learning. They have learned to think about the ‘whys.’ The GPS have brought a higher level of active engagement into our classrooms.”

--Naomi Strickland, Bartow County



**Ms. Acree's 6th Grade Math Class
East Central Elementary School
Rome City Schools**

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Reflections - Fall 2006

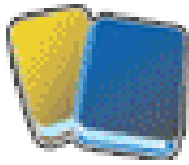
“When they learn the why and really understand, it opens their eyes to a new world that some have never experienced before.”

--Pam Quinn, Chickamauga City

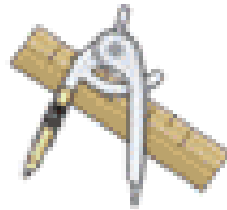
Georgia Performance Standards

What Have We Learned?

Welcome to GeorgiaStandards.org



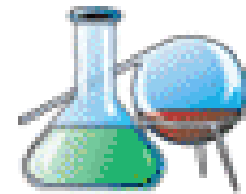
English
Language Arts



Mathematics



Social Studies



Science

Best Practices

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Professional Development

- Planned collaboratively – horizontal and vertical planning
- Coupled content training with GPS training
- Bottom-up approach – asked teachers what they needed to feel comfortable with GPS training
- Focused on areas of weakness during their training

Instructional Strategies

- Real world application of content
- Exploratory teachers supported content of core classes
- Used data to drive instruction – identify struggling students and remediate them
- Used all available technology to research topics and manipulate/analyze data from hands-on labs
- Ideal inclusion models used – true collaborative teaching, daily differentiation through flexible grouping
- Used textbook as a guide, coupled with hands-on learning experiences, visual guides and graphic organizers (benefits all levels of learners)

Time and Resources

➤ Time:

- Adjusted school schedule to provide more instructional time in low-performing areas
- Used class time after CRCT to pre-teach next year's first standards
- Leveraged time/human resources to allow for collaborative planning and teaming

➤ Resources:

- GYSTC, PRISM, RESA, *CRCT Coach*, Learning Focused Schools, etc.

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Georgia Performance Standards



Communicating with parents and other stakeholders about changes to the curriculum is essential to our work.

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