



# Lexington Public Schools

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To: Dr. Paul Ash  
Members of the Lexington School Committee

From: Carol A. Pilarski  
The Mathematics Curriculum Review Committee (see attached member list)

Re: **Executive Summary:**  
*Update on Year Two of the Mathematics Curriculum Review*

Date: June 17, 2008

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## **I. Introduction**

I am, once again, delighted to report that the Mathematics Curriculum Review Committee has accomplished a tremendous amount of work during this, the 2<sup>nd</sup> year of the mathematics review process. I would like to acknowledge the many efforts of our committee members. Attached to this document (Appendix A), is a list of individuals who have given expertly and unselfishly of their time and energy to this important task. This group continued to spend many days and hours working together collecting data, exploring the research, probing issues, conversing, and discussing varying and challenging points of view. The entire committee assembled for full-days on the following dates: October 30, 2007, January 30, 2008, March 12, 2008, and April 30, 2008. Additionally, the 3 grade level sub-committees (K-5, 6-8, 9-12) met multiple times throughout the course of the year to pursue individual assignments. I believe I speak on behalf of the entire group when I say that it has been an exhilarating experience for all of us. We have learned much from our collective work and from each other. We are enthusiastic about continuing our efforts in Year 3 of the process. I would like to re-state as I begin this report that our guiding principle throughout the process is represented in the Mission Statement we developed in Year 1 and have quoted below:

*The goal of the Lexington Public Schools mathematics program is to offer to all students a rich and engaging mathematics curriculum that focuses on important and essential mathematics, learned with understanding and depth. The program's aim is to enable every student to achieve full potential as a mathematics learner, based on a conviction that everyone can succeed when challenged by high expectations and offered strong support. The program takes a balanced approach to developing proficient skills, conceptual understanding, and mathematical habits of mind. Students are given opportunities to explore and discover mathematical ideas, to build their mathematical knowledge, and to cultivate their thinking, creativity, reasoning, and problem solving*

*capabilities. Teachers seek to create learning experiences that are developmentally appropriate; to address varied learning styles, and use a variety of mathematical approaches and representations. Students are encouraged to communicate their mathematical ideas, to become confident and perseverant in using mathematics, and to appreciate the power, relevance, and beauty of mathematics.*

The above stated mission is strongly in keeping with recommendations issued by the Mathematics National Research Council in 2001, entitled: *Adding It Up: Helping Children Learn Mathematics*, in which five attributes were associated with the concept of mathematical proficiency:

- *Conceptual understanding*: comprehension of mathematical concepts, operations, and relations.
- *Procedural fluency*: skills in carrying out mathematical skills accurately, efficiently, and appropriately.
- *Strategic competence*: ability to formulate, represent, and solve mathematical problems.
- *Adaptive reasoning*: capacity for logical thought, reflection, explanation, and justification.
- *Productive disposition*: habitual inclination to see mathematics as sensible, useful and worthwhile and a confidence in one's own mathematical effectiveness.

## **II. Mathematics Curriculum Review: Year 2**

In the information provided herein and in a presentation that I will be making before you on Tuesday, June 17th, I will summarize and highlight the accomplishments of the Mathematics Curriculum Review Committee for **Year Two**.

It should be noted that upon entering Year 2 of the review, the committee had accomplished 90% of its Year 1 goals. We began the work related to: “standards-based benchmarks and assessments” in June at the K-5 level, and proceeded with the “study of research-based recommended practices” in Year 2.

The **Goals for Year 2**, as outlined in a document previously shared with the School Committee regarding **all** programmatic reviews, include the following:

- Continue writing revised, coordinated curriculum based upon final data analysis.
- Project budgetary implications of full implementation of new curriculum.
- Identify professional development needs to successfully implement new curriculum and train all faculty appropriately.
- Identify continued, sustained, professional development/consultation to support implementation of new curriculum.
- Share overview of program goals of new curriculum with all stakeholders.
- Determine the use of technology as a learning tool for both students and teachers.
- Discuss implementation of new curriculum with task force, grade level teams, and curriculum specialists to share best practices.
- Provide opportunities for lesson modeling, coaching, and mentoring around new curriculum.
- Produce final curriculum documents for staff and community. Make available on LPS website.
- Decide on pilot or full implementation of new curriculum.

### III. The Process

In Year 1 of the review process, the larger committee was divided into three (3) sub-groups to focus attention on particular areas of study: 1. Review of Research and Literature 2. Analysis of Student Performance 3. Review of Local Alignment with the Massachusetts State Frameworks. During Year 2, the committee addressed those areas cited as in “need of improvement” from the Year I report and was sub-divided by levels: elementary, middle school, and high school in order to work more specifically on targeted grade/content level goals. While time was appropriated at the all-group meetings for grade level work, K-12 discussions were appropriately scheduled on the agenda to review and share work and to discuss issues related to vertical articulation as these pertain to both content and approach.

### IV. Accomplishments:

Overall: The curriculum review process has worked as a Professional Learning Community (PLC) insofar as the committee has researched, reviewed, and analyzed test data, research studies, and a variety of different materials at various grade levels in an effort to assess and positively impact learning. The work of the district in formulating and furthering the work of Professional Learning Communities (PLCs) has greatly served to enhance the overall efforts of the review process as it has brought every school and teacher to look at the inherent value of collaboration, informative assessment, and data driven decision-making in looking at student performance. In addition to this initiative, the creation of the Achievement Gap Task Force has emphatically raised the focus on instructional interventions designed to appropriately and effectively advance the performance levels of students of color, of English Language Learners, and struggling students. These district-wide efforts coupled with the curriculum review process have served to enhance our mutually beneficial goals and outcomes and have demonstrated the importance of collaboration and acknowledged interdependence.

#### **Elementary, K-5:**

- Creation of a K-5 DRAFT Curriculum Document in a one-week summer workshop in June of 2007; revised and edited this DRAFT based on feedback throughout the course of the 07-08 academic year. The current and attached version is edited as of May 2008. (Appendix B).
- Professional Development for all K-5 classroom teachers included sharing the above cited document and processing feedback about the Draft.
- Discussion by grade level teachers of “entering” and “exiting” expectations and goals to further refine the DRAFT K-5 curriculum document throughout the months of October 2007 through May of 2008.
- Grade-level and cross-grade discussions to bridge the overall understanding of the continuum of mathematics learning between grade levels.
- An LEF program grant offered a study group, led by Department Head, Karen Tripoli in *Assessment Driven Instruction*, specifically targeting assessment in Kindergarten. The study group involved five (5) K teachers who, as a result of their studies, have created a “*Kindergarten Scope and Sequence.*” (Appendix C). This document supports the work of the Mathematics Curriculum Review.
- An LPSA (LEF sponsored) course entitled *Assessment Driven Instruction and Intervention* for grades K-2 was taught by Department Head, Karen Tripoli over the course of the 07-08 academic year, meeting monthly with thirteen special education and general education teachers. The course was designed to instruct teachers in the use of three formative assessment protocols, along with the complementary and appropriate use of targeted instructional interventions.

- Approval of an additional 1.3 FTE K-5 Mathematics Specialists in the FY09 budget, bringing the district to a total of six specialists, thereby enhancing and enriching the opportunity for specialists to consult with classroom teachers, offer direct instruction to students, and provide content and instructional leadership in mathematics education at the building level.
- Increased collaboration between regular classroom teachers, Mathematics Specialists, and special education teachers occurred as a result of an effort funded by the Title V grant. Three-person teams comprised of each of the above teachers from each of our elementary schools came together monthly. The purpose of the team was to establish and deliver a model for collaborated service delivery for one class period per week in grades 1 and 2. The teams used assessment data to plan manipulative experiences for students to increase their skills in the number sense strand. The overall outcome of this work was positive in many ways. First, from a professional development perspective, three professionals met regularly with defined goals to address the needs of a targeted group of students. These discussions broadened their understanding of the needs of these students and provided an opportunity to implement new strategies and materials to address identified needs. All three teachers participated in the discussions and explored ways to differentiate instruction for the whole spectrum of abilities of students within the classroom. Additionally, a structure for assessment driven instruction was developed and implemented. Individual “interviews” were conducted with each student in order to determine the instruction that would follow. Another evident result was measured by the level of participation, motivation, and growth on the part of students. Each school reported enhanced interaction and collaboration among classroom teachers, special educators, and Mathematics specialists.
- Review of various textbooks and ancillary materials for possible piloting in Year 3.
 

*Resulting recommendations:*

  - Continue with Everyday Mathematics (EDM) as our core elementary curriculum.
  - Purchase pilot ancillary materials to address identified program gaps and needs of special populations. Both Singapore Math and Saxon Math, teacher and student materials, will be purchased by the special education department to pilot with various students based on individual needs.
  - Purchase print materials and manipulatives to supplement the geometry strand of EDM.
  - Purchase pilot software “FASTT Math”- “**F**luency and **A**utomaticity through **S**ystemic **T**eaching with **T**echnology” designed to help struggling students develop fluency with basic math facts in addition, subtraction, multiplication, and division. The decision about where and at what grade level/s the pilot will be used has not, as yet, been determined.

### **Middle School, 6-8:**

- Two Math Intervention specialists were hired, one at each middle school to provide “double-dosing” opportunities for struggling Math students as of September 2007. All students who scored NI or W on MCAS were selected to be in the program. Depending on individual schedules, students received anywhere between two and four additional instructional time per week. The two intervention specialists collaborated with each other and the mathematics teachers in preparing and reviewing student needs. This year’s MCAS scores will not be available until late in the summer of 2008. The effectiveness of this intervention for students will be more critically assessed and analyzed at that time. However, it should be noted that in the pre- and post-tests administered to students, scores increased on the average by 10%. Additionally, anecdotal feedback from students indicated that they felt more comfortable with MCAS

this year and that in general, they feel more able to explain how a problem should be completed and why. A software program entitled “Study Island” was also used to provide practice and analysis with MCAS questions.

- Introduction of an “Executive Functioning” class in each middle school to address intervention strategies related to students’ capacities to organize, manage, and perform more efficiently and successfully in all programmatic areas.
- Continued writing for grades 6-12 of the revised coordinated curriculum based on final data analysis. Necessary adjustments have been made and the 6-8 curriculum has been adjusted to place more emphasis on functions and linear equations, with a special focus on the measurement and geometry strands which had been assessed as in “need of attention” in Year 1 of the review.
- After-school homework clubs have been organized by mathematics teachers, including one club staffed by volunteer high school students, many of whom are national Honor Society members.
- Content meeting time has been provided for teachers to create common grade level assignments to better inform individual instruction, as well as to evaluate curricular effectiveness.
- Regular and special education co-teaching model classes have been instituted to provide more collaboration between regular and special education teachers on a daily basis.

### **High School, 9-12:**

- As part of the K-12 curriculum review and NEASC re-accreditation process, the high school mathematics department completed the final drafts of curriculum documents for all mathematics courses (Appendix D – copy available to review upon request). These are working documents that will be revised and reviewed annually to ensure consistency across all sections of the same course and provide continuity for all students across the high school mathematics curriculum.
- A significant amount of time was dedicated during the curriculum review meetings discussing varying perspectives on “conventional” and “reform-based” curricula and programs. The high school is extremely interested in the potential of several balanced “reform-based” programs that emphasize both procedural and conceptual understanding and embed instruction in a context that helps students make connections both within mathematics and across disciplines. These programs have the added value of incorporating a strong statistics strand, discrete mathematics, and technology.
- The 9-12 sub-committee identified three reform-based school programs that have recently been revised and are being considered for field test next year. The programs are Core-Plus Mathematics published by Glencoe, SIMMS Integrated Mathematics published by Kendall/Hunt, and CME project (Center for Mathematics Education at EDC) published by Prentice Hall. In a workshop scheduled for this June 2008, a field test steering committee will choose two of these programs from which we will choose curriculum units for a comprehensive field test by teachers in the department. All sections of Algebra 1, Geometry, and Algebra 2 will be targeted for the field test in order to make the observations and discussions among the teachers as inclusive as possible. Part of the field test will include visits to other schools currently using these programs and receive training from teacher consultants skilled in the teaching of these materials.

## **V. Research and Literature**

The review of the research and literature in the area of Mathematics Education was extensive. This work primarily occurred in Year 1 of the review process. A compilation of this research was reported to the

School Committee in May of 2007 in the Executive Summary of Year 1. However, it should be noted that the “backdrop” of our committee’s work must be and continues to be informed by research and studies at regional, national and international levels. In other words, the research review never ends. As we continue our local work, we concurrently remain focused on on-going studies that serve to inform our decision-making and thinking. A significant national committee was convened by the U.S. Department of Education as requested by the President of the United States. This National Mathematics Advisory Panel was charged by the President to research and investigate the state of mathematics education in the United States and to offer ways to improve and advance learning in this area. The panel recently issued the findings of its 20-month study in early 2008. You may read the complete report by going to the following website: <http://www.ed.gov/about/bdscomm/list/mathpanel/index.html>

The Panel Report does not reveal any significantly “new” information in this field. What it does do, however, is cite and emphasize the findings of previous research and concludes that “more collaborative work needs to be done.” Most importantly, in their view, the National Panel made a strong recommendation for the need to increase networking among many participants through interacting national associations, including classroom teachers, university professors, engineers, mathematicians, and other educational leaders. A coordinated national approach towards improved mathematics education with an annual forum of their leaders for at least a decade was deemed as essential to advancing learning and achievement in this area. The Panel has recommended that the “U.S. Secretary of Education take the lead in convening such a forum initially, charge it to organize in a way that will sustain an effective effort, and request a brief annual report on the mutual agenda adopted for the years ahead.”

I have chosen to highlight some of the items of the ninety page report in the section below in an effort to give a brief overview of the study.

Specific **highlights** of the of the Panel’s twenty-month study are as follow:

- The mathematics curriculum in grades K-8 should be streamlined and should emphasize a well-defined set of the most critical topics in the early grades. The overall curricular content should represent a focused, coherent progression of mathematics learning, with an emphasis on proficiency with key topics. By *focused*, the Panel means the curriculum must include and engage with adequate depth, the most important topics underlying success in school algebra. By the term *coherent*, the Panel means that the curriculum is marked by effective, logical progressions from earlier, less sophisticated topics into later, more sophisticated ones.
- 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.
- Research on the relationship between teachers’ mathematical knowledge and students’ achievement confirms the importance of teachers’ content knowledge. Educational leadership should recognize mathematically knowledgeable classroom teachers as having a central role in mathematics education and should encourage rigorously evaluated initiatives for attracting and preparing prospective teacher and for evaluating and retaining effective teachers.
- State assessments should be improved in quality and should carry increased emphasis on the most critical knowledge and skills leading to Algebra. The Panel’s research has shown that Algebra is a demonstrable gateway to later achievement and that completion of Algebra II correlates significantly with success in college. Students who complete Algebra II are more than twice as likely to graduate from college compared to students with less mathematical preparation. (It should be noted that while this correlation exists, researchers do not know if there is a causal link.)
- Teachers’ regular use of formative assessment improves their students’ learning.

- Children’s goals and beliefs about learning are related to their academic performance. Experimental studies have demonstrated that changing children’s beliefs from a focus on ability to a focus on effort increases their engagement in mathematics learning, which, in turn, improves mathematics outcomes: When children believe that their efforts to learn make them “smarter,” they show greater persistence in mathematics learning. (We need to strive daily in our classrooms to defeat the erroneous idea that success is largely a matter of inherent talent or ability, not effort.)
- Finally, the Panel concludes that curriculum **MUST** simultaneously develop conceptual understanding, computational fluency, and problem-solving skills. Debates about the relative importance of these aspects of mathematical knowledge (reformed vs. traditional mathematics) are “misguided.” “These capabilities are mutually supportive, each facilitating the learning of the others. Teachers should emphasize these interrelations; taken together, conceptual understanding of mathematical operations, fluent execution of procedures and fast access to number combinations jointly support effective and efficient problem solving.” **The Lexington Public Schools Mathematics Review Committee strongly supports this principle and views the refined integration and reinforcement of both sets of skills as integral to the success of its overall K-12 program.**

**Further clarification:**

The National Council of Teachers of Mathematics (NCTM) standards are subdivided into **5 standards describing content** (areas of mathematics in which students should develop proficiency) and 5 standards describing processes (aspects of mathematical capability for students to develop). The content standards are *Number and Operations*, *Algebra*, *Geometry*, *Measurement*, and *Data Analysis and Probability*. Each of these content standards spans the K-12 range; for example, Algebra is not solely a secondary topic, foundational algebraic ideas are included as early as grades K-2.

The chart below depicts a more integrated approach to topics with several areas appearing at each grade level. These topics are to be developed in “connection” with each other rather than in “isolation,” re-appearing at various grade levels in increasingly sophisticated forms.

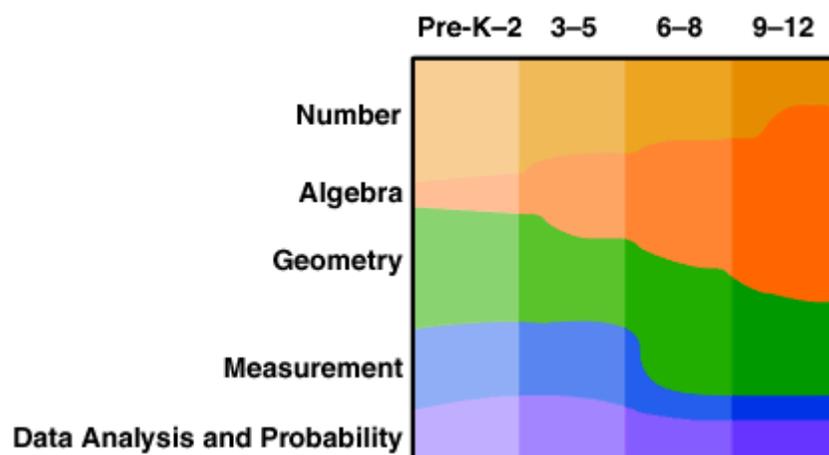


Fig. 3.1. The Content Standards should receive different emphases across the grade bands.

Similarly, the **5 process standards** *Problem Solving, Reasoning and Proof, Communications, Connections, and Representation* are described as a progression across all the grades. Of particular note are the *Communications* standard, which encourage the development of students' abilities to read, write, listen, and speak about mathematics, and the *Connections* standard, which emphasizes connections both between mathematical topics and to areas where mathematics is applied.

Combined, the CONTENT and PROCESS standards evoke the essential elements of a highly effective program that includes: mastery of skills and concepts, mathematical communication and thinking, positive attitudes towards mathematics, and critical views of teaching and learning.

## **VI. Massachusetts State Frameworks**

In Massachusetts, The *Curriculum Frameworks* in mathematics were first published in the mid-1990s and revised subsequently. The *Frameworks* mostly reflect the educational philosophy of the NCTM documents, but are more prescriptive of specific topics to be covered in certain grade ranges. Specific topics covered at certain grade levels can and do vary considerably from state to state. Most recently, in 2006 the NCTM published *Curriculum Focal Points* identifying three key topic areas to be covered in each of the grades K-8 in order to more clearly articulate specific expectations for each grade level on a national level; however, neither the NCTM documents nor the Massachusetts *Frameworks* fully describe a mathematics curriculum for schools to follow. This has been left to local discretion.

Just as we completed reviewing and aligning local standards to the State Frameworks, the Massachusetts Department of Elementary and Secondary Education announced that it is planning a review of the Mathematics Frameworks, in view of recent national reports and recommendations. The Mathematics Curriculum Framework Survey is currently posted on the DOE website. All teachers in all school districts in Massachusetts have been invited to respond to the survey in order to acquire a broad response from practitioners to better inform decisions to be made relative to content and procedure at the state level (Appendix E). This invitation was extended to all Lexington Mathematics teachers. All members of the Mathematics Review Committee were asked to complete this survey at one of our all-day meetings.

## **VII. Scheduled Work: Summer 2008 and Beyond**

- The K-5 curriculum document will be expanded to identify and include essential vocabulary for each learning standard, to correlate EDM lessons with these learning standards, and to identify ancillary materials and/or lessons for those standards. (June 18-20)
- A team of twelve K-8 Lexington Public Schools special education teachers, administrators, mathematics specialists, and classroom teachers will attend a summer institute entitled "*Leading for Success: Building Capacity to Improve Mathematics Learning for Students with Special Needs*" This institute will be offered by the Educational Development Center (EDC) for two full days on July 16<sup>th</sup> and 17<sup>th</sup> in Newton, MA. The event is funded by a National Science Foundation grant and has a research component that involves participants completing an on-line survey before and after the institute. There will be a half-day follow-up seminar to this workshop scheduled for January of 2009.
- As part of the Full-Day Kindergarten implementation, one day of the four-day Full-Day Kindergarten Institute will be dedicated to instructing our Kindergarten teachers in the use of the Learning Stations, as a significant instructional setting in effective early education. This course will be conducted by K-5 Department Head, Karen Tripoli.
- Five K-5 Mathematics Specialists and one classroom teacher will be participating in an EDC course entitled: "*Coaching: A Matter of Influence*" for 4 days, July 29-August 1. The

course will focus on the skills required by coaches to influence effective teacher practices in mathematics.

- A team of five classroom teachers and one Mathematics Specialist will review and revise the current, “homegrown” *Differentiation Support Binders* to assist teachers in varying their instruction as they implement the updated EDM program and the recently revised local benchmarks and learning standards.
- All new grades 1-5 classroom teachers (approximately fifteen) will enroll in the Everyday Mathematics Training course offered by EDCO.
- Mathematics Specialist, Edie Lipinski, will offer an LPSA (LEF sponsored) course entitled: “*Mathematics and Mathematics Methods*” for three graduate credits designed to help teachers to make mathematical connections between strands and across grade levels. It will also help our K-6 teachers more clearly understand mathematics as a comprehensive, sequential, and connected body of knowledge.
- An LEF program grant will support the work of two Mathematics Specialists as they provide teachers (Grades 1-3) with an in-depth exploration of mathematics content and how it connects to “higher level” mathematics. These specialists will meet with teachers monthly to design and implement learning stations for their classrooms and its influence on student performance.
- In keeping with the recommendations of the committee and the curriculum alignment process, it has been determined that the Algebra 1A and Math 8 curricula need to be revised and updated. Topics within the two courses will be defined, supplemental materials will be explored, and common assessments will be discussed. Communication with current Algebra 1B teachers will assist in the planning and development of the content. This workshop will be led by Middle School Department Chairs, Lynda Laurenza (Diamond) and Loretta McCormack (Clarke).
- A workshop entitled “*Mathematics Curriculum Review Field-Test Steering Committee for grades 9-12*” will be convened with the high school mathematics department head and two teacher-leaders from each of three courses (Algebra1/1B, Geometry, and Algebra 2) for which the mathematics department will be field-testing curriculum units. The steering committee will choose two reform-based mathematics programs from which they will choose two units for each course listed above. The teacher-leaders will receive training in August in the implementation and pedagogy of the two programs and serve in a train-the-trainer model for the high school mathematics faculty. An assessment on student learning with the use of these programs will be conducted upon completion of the delivery. This effort is being led by High School Department Head, Gary Simon.

## **VIII. Next Steps: Year 3 and Recommendations**

- Continued work on finalizing the creation of a clearly articulated, comprehensive, and coherent K-12 curriculum document. The K-5 curriculum writing is in its final draft stages. We will build at grade levels 6 through 8 and then connect to the 9 through 12 NEASC curriculum documents over the course of academic year 2008-09.
- Two all-day meetings will be held with grade 5 & 6 teachers and grades 8 & 9 teachers to discuss the goals, outcomes, and assumptions about student benchmarks at transition periods to insure that grade level transitions into the middle school and high school curricular programs are smooth and seamless.
- Refining the role of the two middle school Mathematics Intervention Specialists in our continuing efforts to support the learning of at-risk students with a common, defined, and consistent curriculum.

- Continuing to address the expressed need for professional development and teacher training in curriculum-specific areas related to content expertise, use of informative assessment, and new teacher mentoring for increased efficacy and retention purposes.
- A recommendation to offer more time for program leaders and departmental members to meet is being requested. “Time” is recognized as a valuable commodity and a limited resource with multiple demands from varied sources: district-wide, school-based, and programmatic matters. Requests for more common meeting/sharing time in order to insure consistency and equity across the district has been urged.
- Need to schedule classroom visitations among all levels of our Mathematics teachers in order to collaborate and share the methodology of presenting common concepts in a similar manner.
- Continued and more extensive review of various textbook publications and material resources for possible implementation at the 6-12 level.
- An explicit need to address technology as it relates to content, process, and instruction at all grade levels. Committee members have expressed a common concern that implementing available technological advancements (both hardware and software) without on-site technology support is difficult, at best. Access to technology is often sporadic and unreliable. Currently owned mathematics software is becoming obsolete. There is a need to identify appropriate software, assess its compatibility with current hardware in order to support, enhance, and supplement our curriculum, particularly in the Geometry and Algebra strands.
- Work to address the goals of Year 3 of the review process through the four scheduled all-day committee meetings, as well as via sub-committee work, as outlined below:

### **YEAR 3 Curriculum Review Goals**

- Implementation of new curriculum
- Collect data using benchmark outcomes and expectations of the newly revised curriculum
- Share and discuss data based on outcomes.
- Determine student academic growth using data analysis.
- Based on the results of student data analysis, appropriate revisions will be made if and where appropriate
- Continue to identify professional development needs to successfully implement new curriculum and train all faculty appropriately.

In summary, this year has yielded valuable discussions between members of the Task Force, school staff, grade-level teams, and cross-grade groups. These discussions have helped to clarify grade-level expectations, help inform instruction, and lead to more consistency of mathematics instruction across grades and across schools at all levels. It is important to note that the level and intensity of these discussions mirror those that are taking place at the national level. We, here in Lexington, work together, in concert with national information and data to participate in these conversations about the future of mathematics instruction at the local, state, national, and international levels.

Our collective hope is that you will find this report helpful in understanding the status of the work accomplished by the committee in its first two years. I look forward, along with other members of the review committee, to answer any questions you might have when we meet on June 17<sup>th</sup>.

# Executive Summary:

*Update on Year Two of the  
Mathematics Curriculum Review*

*Lexington Public Schools  
June 17, 2008*

*Carol A. Pilarski  
Assistant Superintendent for Curriculum,  
Instruction, and Professional Development*

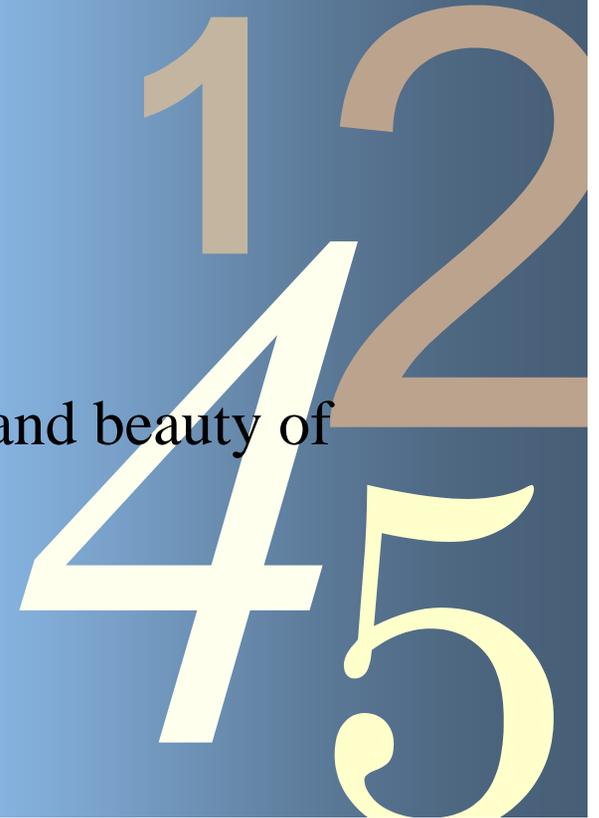


# “The Mission”

*The goal of the Lexington Public Schools mathematics program is to offer to all students a rich and engaging mathematics curriculum that focuses on important and essential mathematics, learned with understanding and depth. The program’s aim is to enable every student to achieve full potential as a mathematics learner, based on a conviction that everyone can succeed when challenged by high expectations and offered strong support. The program takes a balanced approach to developing proficient skills, conceptual understanding, and mathematical habits of mind. Students are given opportunities to explore and discover mathematical ideas, to build their mathematical knowledge, and to cultivate their thinking, creativity, reasoning, and problem solving capabilities. Teachers seek to create learning experiences that are developmentally appropriate; to address varied learning styles, and use a variety of mathematical approaches and representations. Students are encouraged to communicate their mathematical ideas, to become confident and perseverant in using mathematics, and to appreciate the power, relevance, and beauty of mathematics.*

# Statement of Purpose

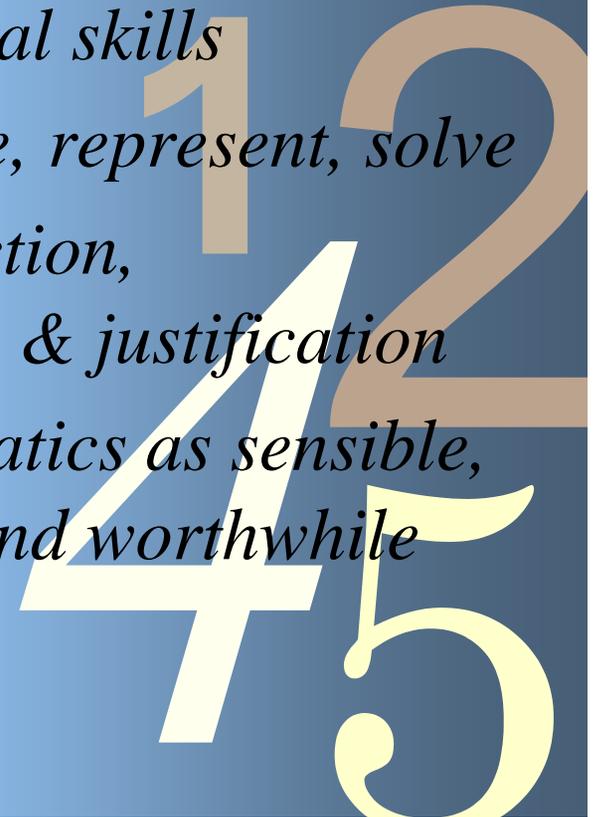
- Philosophical Framework
  - Essential Mathematics' Learning
  - Understanding and Depth
  - High Quality Standards
  - Achievement & Success for All
  - Varied Learning Styles
  - Lifelong Applications: the “power and beauty of mathematics in our daily lives”



Mathematics Research Council (2001):  
*“Adding It Up: Helping Children Learn Mathematics”*

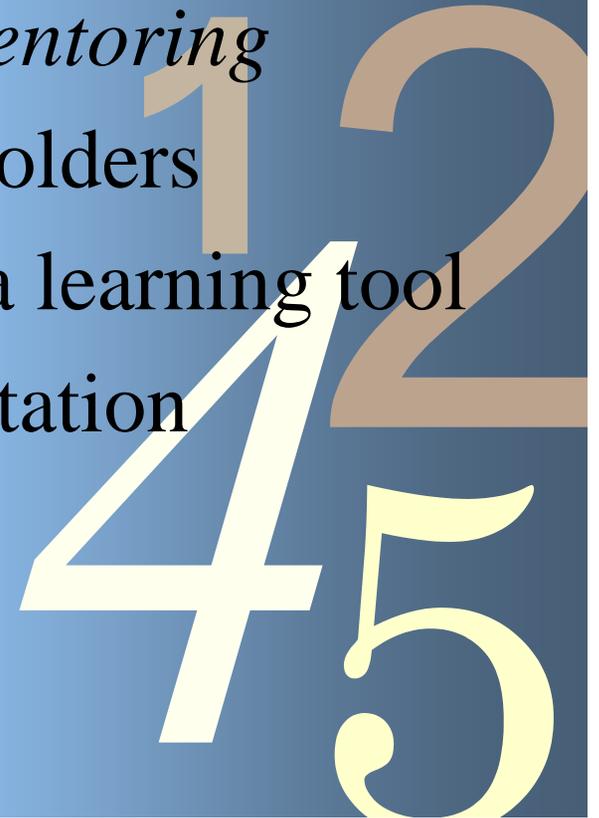
There are 5 elements essential to proficiency:

- Conceptual Understanding - *comprehension*
- Procedural Fluency – *mathematical skills*
- Strategic Competence – *formulate, represent, solve*
- Adaptive reasoning – *logic, reflection, explanation, & justification*
- Productive Disposition – *mathematics as sensible, useful, and worthwhile*



# Year Two Goals

- Continue writing curriculum
- Project budgetary implications
- Identify professional development:  
*training, modeling, coaching, mentoring*
- Share program goals with stakeholders
- Determine use of technology as a learning tool
- Decide on pilot or full implementation



# “The Process”

## Year 1 (3 groups):

- Research & Literature
- Analysis of Student performance
- Review of Local & State alignment

## Year 2 (3 groups):

- Elementary
- Middle
- High School



# Accomplishments

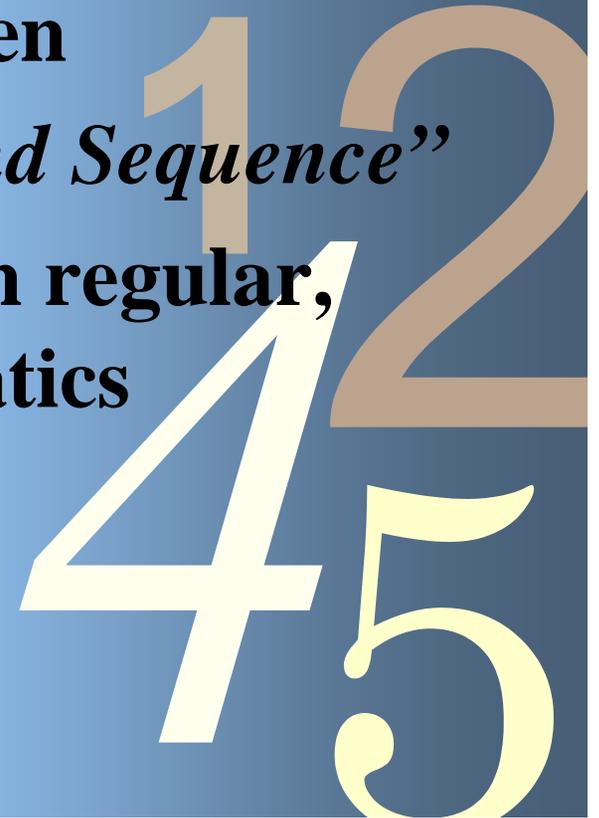
## Overall: Mutually Beneficial Goals

- Curriculum Review Process
- Professional Learning Community
- Achievement Gap Task Force
- NEASC re-accreditation
- Full-Day Kindergarten



# Accomplishments: K-5

- **K-5 Curriculum Document – *Appendix B***
- **Addition of 1.3 FTE Mathematics Specialists  
- *FY09***
- **Development of the Kindergarten  
“*Scope and Sequence*”**
- **Increased collaboration between regular,  
special education, and mathematics  
specialists – *Title V***



## Review of Textbooks and Ancillary Materials

### **Recommendations:**

- Continue with *Everyday Math* as our core program
- Purchase pilot software; “FASTT Math”

*Fluency and Automaticity through Systemic Teaching and Technology*

- Purchase pilot ancillary materials to address identified program gaps:
  - Singapore Math, Saxon Math
  - Manipulatives to enhance the geometry strand



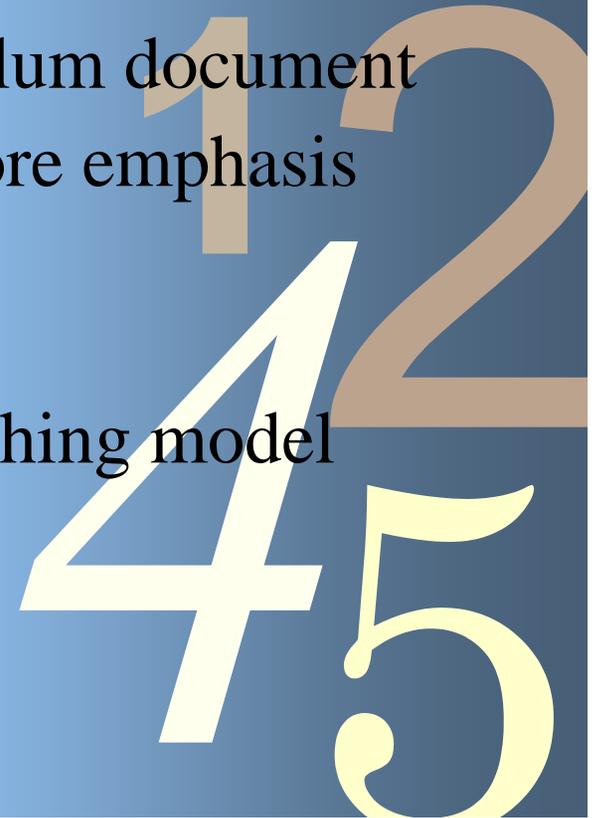
# Accomplishments - *continued*

- **Professional Development:**
  - *Grade level and Cross-grade level: sharing, discussing, revising*
  - *Assessment Driven Instruction and Intervention: K-2 (LPSA-LEF)*
  - *Professional Learning Communities – Numeracy based*



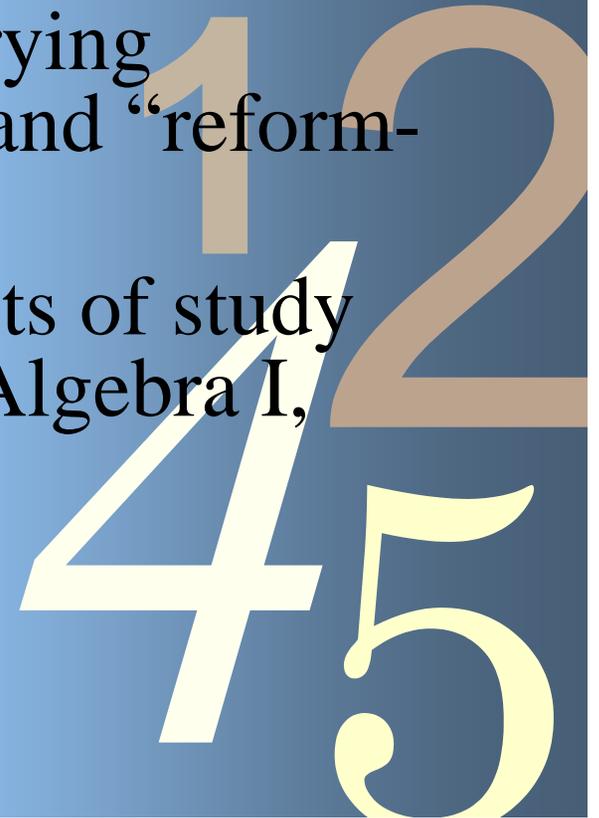
# Accomplishments – *Middle School,* *grades 6-8*

- Two Math Interventions specialists hired
- Double Dosing for struggling students
- Executive Functioning Class
- Continued writing of the 6-8 curriculum document
- Adjusted 6-8 curriculum to place more emphasis on functions and linear equations
- After-school homework clubs
- Regular & Special education co-teaching model classes



# **Accomplishments** – *High School, grades 9-12*

- Development of Curriculum documents for each HS course
- Continued discussion on the varying perspectives of “conventional” and “reform-based” curricula and programs
- Decision to “pilot/field test” units of study in 2 reform-based programs in Algebra I, Algebra II, and Geometry



# Research & Literature

## The National Mathematics Advisory Panel – 2008 report

- K-8 curriculum should be streamlined and well-defined with the most critical topics in early grades
- It should be:
  - Focused and engaged with adequate in-depth topics underlying success in Algebra
  - Marked by effective, logical progressions from earlier, less sophisticated topics to more sophisticated topics



## Panel Findings - *continued*

Use the rigorous research on HOW  
children learn best

- Advantages to having a strong start
- Mutually reinforcing benefits of conceptual understanding, procedural fluency and automatic recall
- Effort, not inherent talent, counts in mathematical achievement



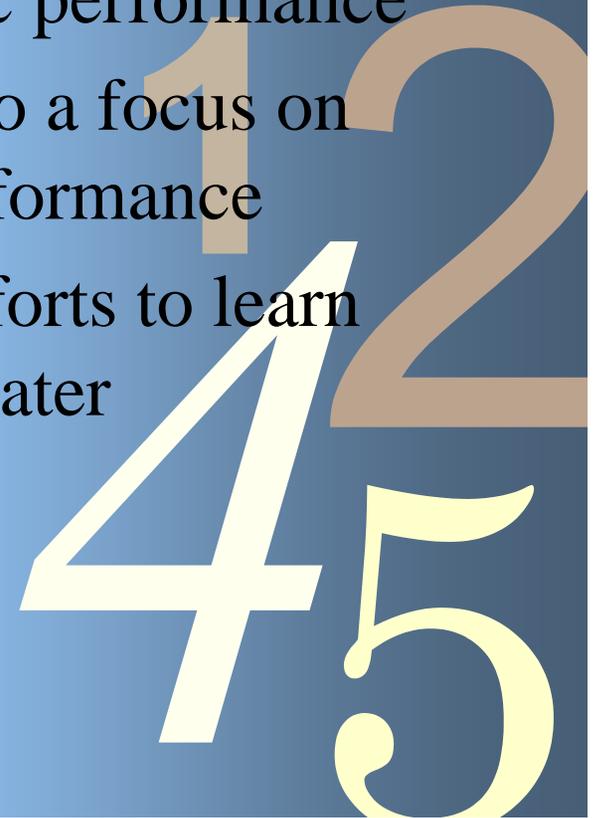
## Panel Findings - *continued*

- Research on the relationship between teachers' mathematical knowledge and students' achievement confirms importance of teachers' content knowledge
- Educational leadership needs to encourage initiatives for attracting, preparing, and retaining effective teachers
- State assessments need to be improved in quality and carry increased emphasis on critical knowledge and skills in algebra



## Panel Findings - *continued*

- Use of formative assessments improves student learning
- Children's goals and beliefs about their own learning are related to their academic performance
- Shift from a focus on innate ability to a focus on effort increases engagement and performance
- When children discover that their efforts to learn make them "smarter," they show greater investment and persistence



# Panel Findings - *continued*

## Most importantly

Curriculum **MUST** simultaneously  
develop:

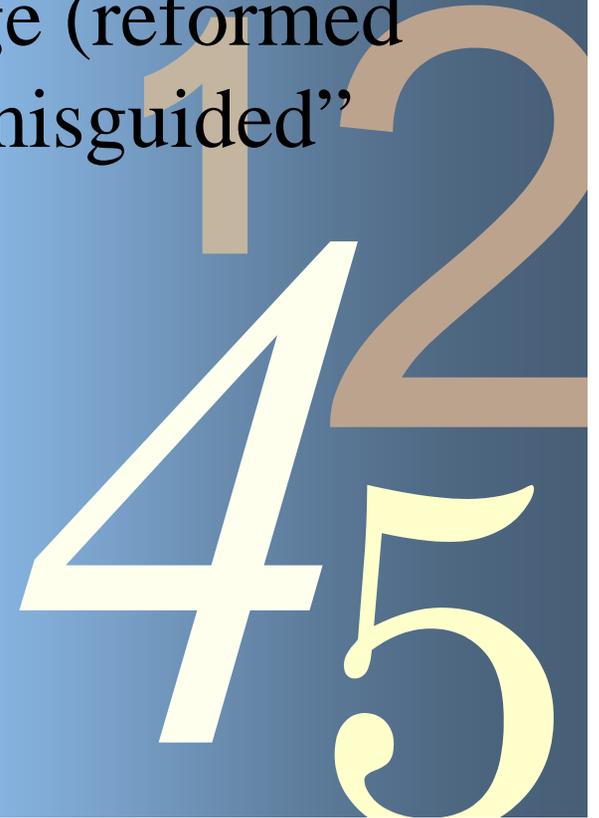
- Conceptual understanding
- Computational fluency
- Problem-solving skills



# *“Math Wars”*

## Panel conclusion

Debates about the relative importance of these aspects of mathematical knowledge (reformed vs. traditional mathematics) are “misguided”



## Panel Conclusion

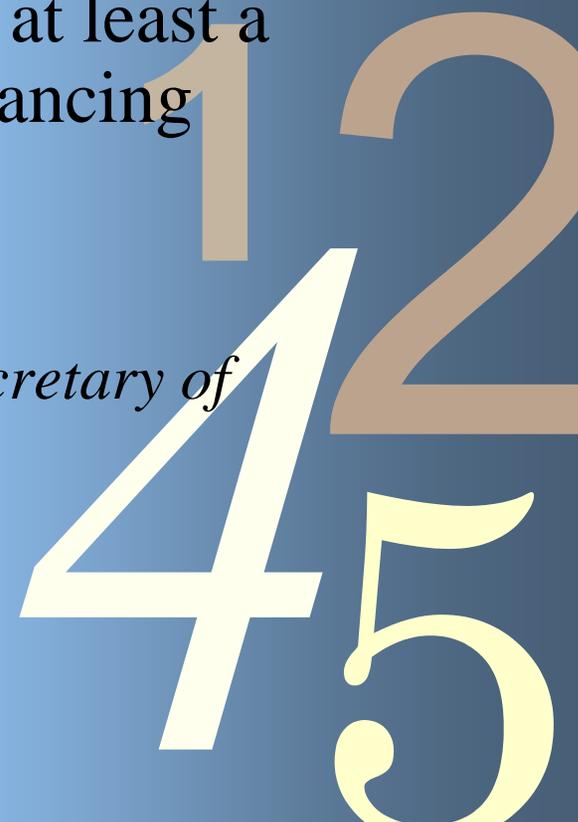
*“These capabilities are mutually supportive, each facilitating the learning of the others. Teachers should emphasize these interrelations; taken together, conceptual understanding of mathematical operations, fluent execution of procedures and fast access to number combinations jointly support effective and efficient problem solving.”*



# Panel Conclusion

“A coordinated national approach towards improved mathematics education with an annual forum of their leaders (national associations, classroom teachers, engineers, university professors, mathematicians, etc.) for at least a decade, was deemed essential to advancing learning.”

*(The Panel has recommended that the US Secretary of Education take the lead on this effort.)*



# NCTM Standards

- CONTENT

- Numbers & Operations
- Algebra
- Geometry
- Measurement
- Data Analysis & Probability

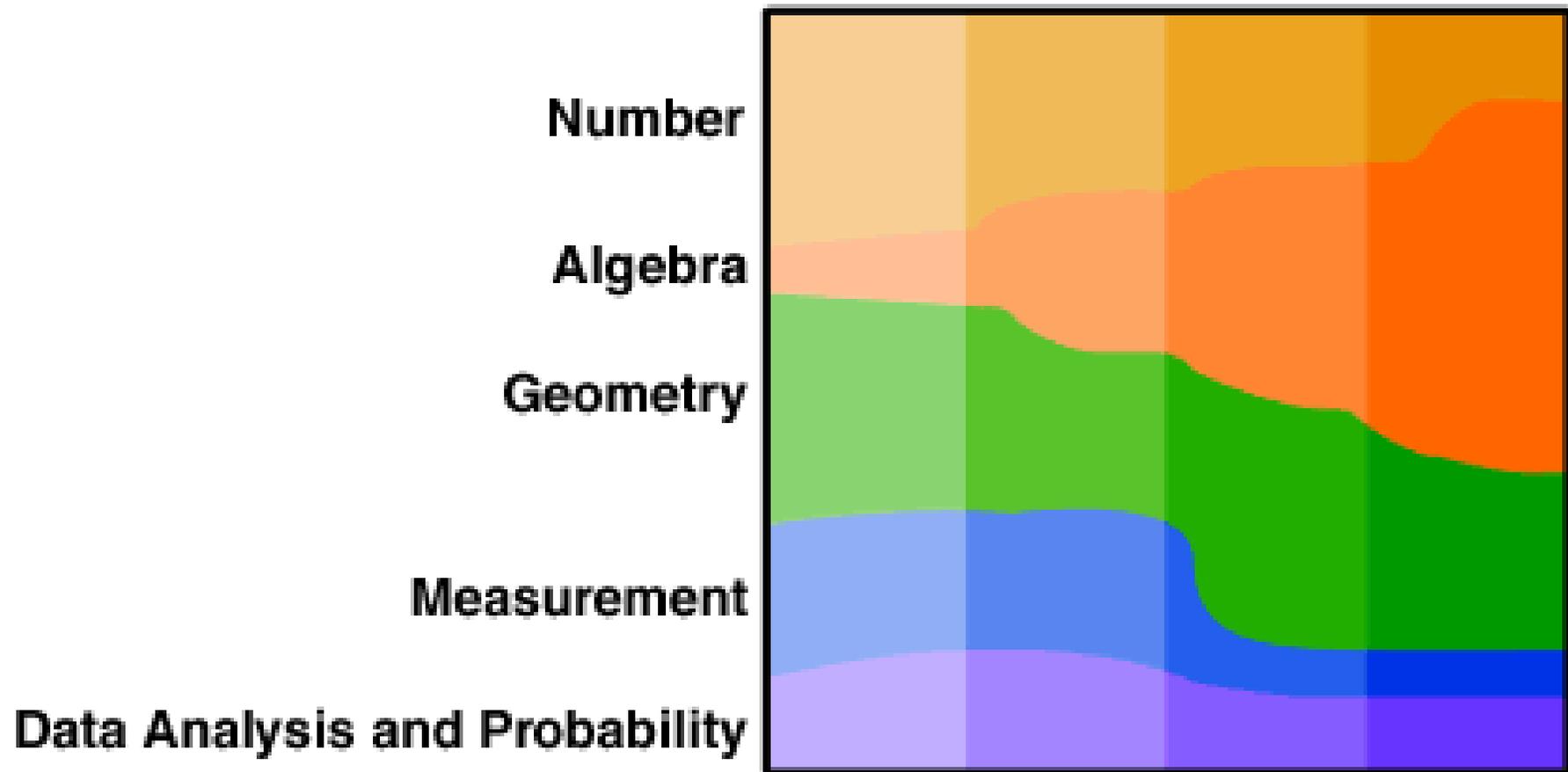
- PROCESS

- Problem Solving
- Reasoning & Proof
- Communications
- Connections
- Representation



# A Comprehensive Math Program

Pre-K-2    3-5    6-8    9-12



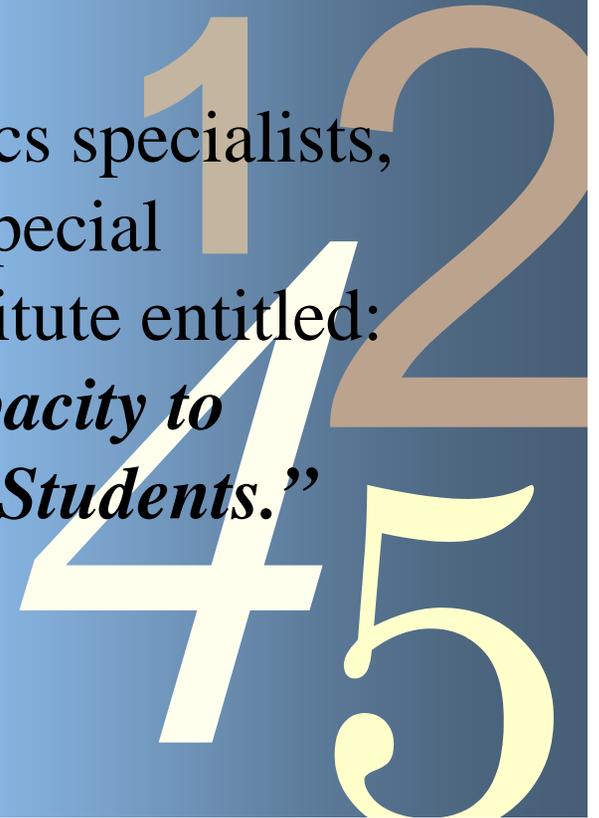
# Massachusetts State Curriculum Frameworks

- Planning a review of the Mathematics Curriculum frameworks
- Survey of Mathematics teachers



# *Summer 2008 and Beyond*

- Expand K-5 Curriculum document to include essential vocabulary for each learning standard
- Identify ancillary materials to accompany each learning standard
- Team of 12 teachers K-8 (mathematics specialists, administrators, classroom teachers, special educators) will attend a Summer Institute entitled: *“Leading for Success: Building Capacity to Improve Mathematics Learning for Students.”*



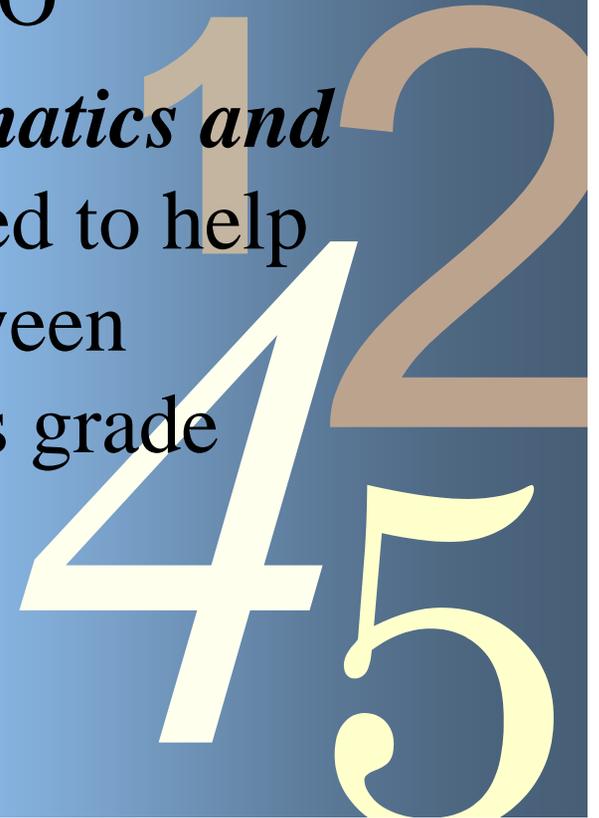
## *Summer 2008 . . . continued*

- Five K-5 Mathematics Specialists and a classroom teacher attending another EDC course entitled: “Coaching: A Matter of Influence for 4 days in July/August
- Full-Day Kindergarten – one day institute on K mathematics instruction – the use of “Learning Stations”



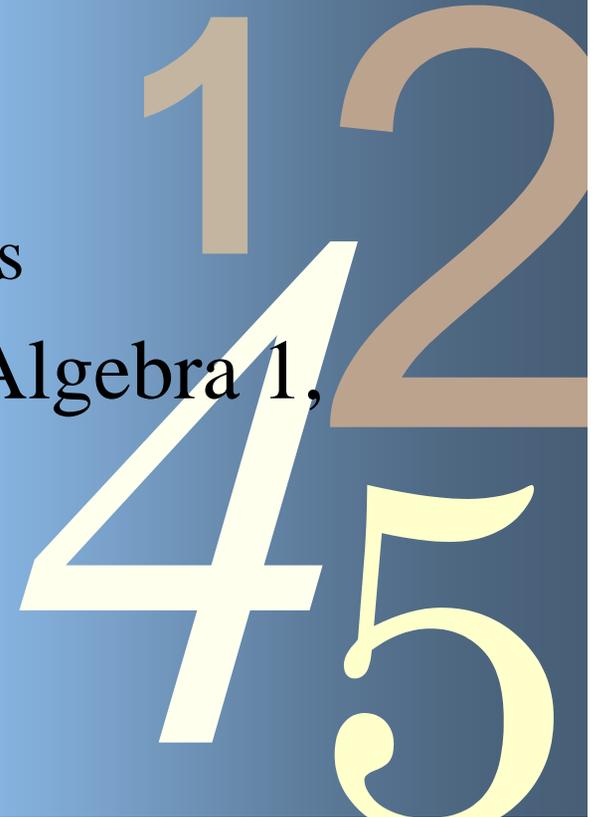
# *Summer 2008 . . . continued*

- Review and Revision of the *Differentiation Binders* – update
- All new teachers grades 1-5 will attend Everyday Math training at EDCO
- LPSA 3 credit course: “*Mathematics and Mathematics Methods*” designed to help teachers make connections between mathematical strands and across grade levels



# *Summer 2008 . . . continued*

- Revision of Algebra 1A and Mathematics 8 curriculum:
  - Definition of topics to be covered
  - Review of ancillary materials
  - Formation of common assessments
- Field testing for grades 9-12 in Algebra 1, Algebra 2, and Geometry



# “Next Steps:” Year 3

- Continued work on finalizing the creation of a well-articulated K-12 curriculum document
- Two all-day meetings with 5<sup>th</sup> & 6<sup>th</sup> grade teachers and 8<sup>th</sup> & 9<sup>th</sup> grade teachers to insure smooth transitions
- Refining the role of the 2 Middle School Mathematics Intervention Specialists with a common, defined, and consistent curriculum
- Continued efforts to support professional development and training in this area
- Need to schedule classroom visitations to encourage collaborative sharing and learning
- Explicit need to address technology; common concerns about the lack of on-site technical support, accessibility, incompatibility, obsolete equipment



## For more information

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