



# 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 Three of the Mathematics Curriculum Review*

Date: June 2, 2009

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## **I. Introduction**

Prior to delving into the details of this year's summary, I would, once again, 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 has spent many days and hours over the course of these past three years, working together, collecting data, exploring the research, probing issues, conversing, and discussing varying and challenging and oftentimes conflicting points of view. The entire committee assembled for 4 full-days on the following dates during this 2008-2009 academic year: October 21, 2008, March 3, 2009, March 11, 2009, and April 29, 2009. Additionally, the three grade level sub-committee groups (K-5, 6-8, 9-12) met multiple times throughout the course of the year to pursue individual assignments and professional development activities. In an effort to provide clarity and accurate information to teachers, parents, and students regarding the transitional years, critical to vertical curricular articulation, all 5<sup>th</sup> grade classroom teachers, along with all 6<sup>th</sup> grade mathematics teachers met for a full-day on October 21, 2008. A similar all-day meeting was held for all 8<sup>th</sup> and 9<sup>th</sup> grade teachers of mathematics on November 1, 2008. Both horizontal (same grade/course) and vertical (cross grade) articulation are significantly important in the development of curriculum, in general, but particularly so, in a district where six elementary schools feed into two middle schools whose students then funnel into one high school.

While the primary committee consisted of 30+ members, it should be noted that **ALL 128** elementary classroom teachers and **ALL 46** of our secondary Mathematics teachers (6-12) contributed their wisdom and expertise in this very inclusive process.

The Mathematics Curriculum Review Committee has completed its 3<sup>rd</sup> and final year of work in the review process. While this is "technically" the concluding year of the three-year process and the essence of our work is close to complete, some work remains outstanding and is scheduled to take place during the month of June and in the fall semester of the 2009-2010 academic year. Several summer workshops are currently scheduled to address these matters and several additional meeting times will be set aside in

the fall of next year to finalize decisions about our secondary Mathematics program. I will elaborate further on the details of these workshops and subsequent meetings in the ensuing sections of this report.

## II. Philosophical Framework

On an annual basis, in each of my end-of-year summaries, I feel compelled to re-state that our guiding principle throughout the process is represented in the Mission Statement that was developed in Year 1. These principles contained in the mission consistently provided the backdrop for our discussions and are 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 and is thoroughly embraced and endorsed by the review committee. You will note that I have highlighted several segments in the above Mission Statement:

- “enable every student to achieve full potential as a mathematics learner”
- “everyone can succeed”
- “mathematical habits of mind”

These convictions were pivotal to all of our discussions in all three years, but, most especially, in this last year where we worked hard to assure that Lexington's program would support and reinforce the work and objectives of the targeted mission of the newly formed ***Committee for Equity and Excellence***. At the same time, once the content-specific mathematical skills were identified, we worked hard to honor the often less emphasized “habits of mind” that serve as both the umbrella and foundation for true understanding in the practical applications of mathematics in the “real” world, in one's daily lives. It is only when we ultimately manage to capture this essence that all students will truly begin to see mathematics as sensible, useful, and worthwhile while developing confidence in their own mathematical effectiveness.

## III. The Challenge:

The challenge of our work was in finding the balance and sometimes the necessary imbalance in creating a program that combines both Content Standards (skills/benchmarks) AND Process Standards that emphasize thinking, questioning, experimenting, inventing, and visualizing. Mathematics instruction cannot be effective if it is based on either extreme . . . content or process. “Students become more proficient when they understand the underlying concepts of math and they understand the concepts more easily if they are skilled at computational procedures” (National Research Council – 2002 – *Helping Children Learn Mathematics*). I thought it would be important to give you a “taste” of our many discussions, by asking that you ponder an excerpt from an NSF (National Science Foundation) paper published by the Educational Development Center, Inc. (EDC) and authored by Al Cuoco, E. Paul

Goldenberg, and June Mark (<http://main.edc.org>). It is exactly this kind of thinking that our group paid a great deal of attention to while grappling with decisions around the kind of mathematics program we need to offer Lexington's students.

*Students entering Kindergarten in 2009 will graduate from high school in 2022. Educators can only guess at the problems that those graduates will face and the corresponding mathematical competencies that they will need. Still, educators must define and implement a K-12 mathematics curriculum in 2009 that will prepare students for the uncertain demands of 2022.*

*Mathematics curriculum standards documents – whether prepared by states, districts, or the publishers of instructional materials – often focus upon, or are limited to, consideration of what students are to learn. Some are grade specific; others are course specific. Some go so far as to address expectations for specific student groups or programs of study (curriculum tracks). Despite these varied efforts, the resulting (current) K-12 curriculum has been characterized as being “eight years of 11<sup>th</sup> century arithmetic followed by two years of 16<sup>th</sup> century algebra and a year of 3<sup>rd</sup> Century BCE geometry.” At the secondary school level, students perceive it as a smorgasbord of facts and procedures to be acquired one-by-one, applied to “types” of problems, and demonstrated successfully on a variety of tests (end-of-unit, end-of-course, statewide proficiency, scholarship, and college entrance/placement). Upon graduation, those students often find that they don't have access to the mathematics that they need. The chairman of a university department of mathematics helped to frame this curriculum disjuncture in terms of a fundamental difference in instructional emphasis.*

- *Should instructional emphasis in mathematics courses be on developing “**mathematical apprentices**” who are prepared to use specific mathematical techniques?*
- *Should instructional emphasis in mathematics courses be on developing “**mathematical practitioners**” who are able to select and apply a wide array of mathematical tools in order to solve unfamiliar problems?*

*An obvious question, then, is “What mathematics should be taught?” One not-so-obvious response is “That's the wrong question.” **What should be asked is “How can we help students develop ‘habits of mind’ that will help them to think like mathematicians think and to use real mathematical methods?”***

Essentially, what this means is that generally speaking, students study mathematics, but often their learning of the subject has little to do with the “way mathematics is created and applied” outside of school. “One reason for this has been a view of curriculum in which mathematics courses are seen as mechanisms for communicating established results and methods for preparing students for life after school by giving them a bag of facts.”

“Organizing the mathematics curriculum around *Habits of Mind* gives students the tools they will need to use, understand, and even ‘make’ mathematics that doesn't yet exist. Such a curriculum lets students “in” on the process of creating, inventing, conjecturing, and experimenting. It is a curriculum that encourages false starts, calculations, experiments, and special cases. A *Habits of Mind* curriculum is devoted to giving students a genuine research experience and values how a particular piece of mathematics typifies an important research technique as much as it values the importance of the result itself.”

**IV. Mathematics Curriculum Review: Year 3**

In the information provided herein and in a presentation that I will be making before you on Tuesday, June 2nd, I will summarize and highlight the accomplishments of the Mathematics Curriculum Review Committee for **Year Three**.

The **Goals for Year 3**, as outlined in a document previously shared with the School Committee during the P.E./Wellness presentation of May 19<sup>th</sup> regarding **all** programmatic reviews, include the following:

- Implementation of new curriculum.
- Collect data using benchmark outcomes/assessments around new curriculum.
- Share and discuss data based on outcomes.
- Determine student academic growth using data analysis.
- Based on data analysis results, make projections for any necessary updates and additional supports
- Continue to identify professional development needs to successfully implement new curriculum and train all faculty appropriately.

**V. Accomplishments of Year 3:**

It should be noted that upon entering Year 3 of the review, the committee worked on following through on the recommendations made at the end of the 2<sup>nd</sup> year. Please refer to the chart below to review the recommendations made last year and the responses made this year to those recommendations:

RECOMMENDATIONS of Year 2	OUTCOMES/RESULTS
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.	<ul style="list-style-type: none"> <li>• K-5 Curriculum Document completed</li> <li>• 6-8 Curriculum document to be completed in summer/fall of 2009</li> <li>• 9-12 Curriculum document to be completed in summer/fall of 2009</li> </ul>
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.	<ul style="list-style-type: none"> <li>• 5<sup>th</sup> to 6<sup>th</sup> grade meeting held on October 21, 2008 to ensure that 5<sup>th</sup> grade student outcomes matched in-coming 6<sup>th</sup> grade skill expectations. These agreements and clarifications assist in making appropriate course recommendations as students transition from 5<sup>th</sup> to 6<sup>th</sup> grade</li> <li>• Revisions were made to the mathematics section of the Middle School Program of Studies for 2009-2010 to include the above clarifications on course selections</li> <li>• 8<sup>th</sup> to 9<sup>th</sup> grade meeting held on November 1, 2008</li> <li>• Transitional issues from the middle school to the high school require some additional work in the summer and fall of 2009</li> </ul>

RECOMMENDATIONS of Year 2	OUTCOMES/RESULTS
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.	<ul style="list-style-type: none"> <li>The two middle school mathematics intervention specialists continue working together in an effort to further refine interventions and appropriate curriculum</li> </ul>
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.	<ul style="list-style-type: none"> <li>See individual sections of this report for specific professional development</li> <li>Creation of common assessments at all levels K-12</li> <li>Creation of summative assessments for each grade level K-5 (See binder)</li> </ul>
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. Strong requests for more common meeting/sharing time in order to insure consistency and equity across the district have been urged.	<ul style="list-style-type: none"> <li>Creation of a district-wide professional development committee to address increasing needs and synthesize multiple initiatives</li> </ul>
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.	<ul style="list-style-type: none"> <li>On-going, but should become a more regular practice for all teachers</li> </ul>
Continued and more extensive review of various textbook publications and material resources for possible implementation at the 6-12 level.	<ul style="list-style-type: none"> <li>Grades 6-8 teachers agree that the current Glencoe and McDougal Littell program best suits the district's middle mathematics needs with the addition of ancillary and support materials purchased this year</li> <li>Grades 9-12 teachers of mathematics have piloted selected units from the Core Plus series with varied points of view depending on the particular course. This series is organized in an integrated fashion combining all content standards in a non-course specific manner. A summary review of this "field test" is included in Appendix E</li> <li>In academic year, 2009-10, grades 9-12 are scheduled to review a newly published series developed by the Center for Mathematics Education (CME) at the Education Development Center that is organized by course-specific name with an integrated approach. Unfortunately, the CME publishing timeline was "out of</li> </ul>

	sync” with the committee’s work and was not available to be field tested this past year. It will, however, be closely examined in the coming year, as it appears to be most closely aligned with Lexington’s 9-12 curricular standards
<b>RECOMMENDATIONS of Year 2</b>	<b>OUTCOMES/RESULTS</b>
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 ineffective. 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.	<ul style="list-style-type: none"> <li>• The collective response at all levels of the committee (K-12) is that the availability and reliability of technology is imperative in fulfilling the current and future demands of a successful and effective mathematics program for all students</li> <li>• The district has purchased TI-nSpire calculators for teacher use and training. This calculator is the next step up from the TI graphing calculator and offers more sophisticated and advanced mathematical applications. Viewscreens that are compatible with the TI-nSpire have also been purchased for classroom use</li> <li>• The district has hired a consultant to survey teachers and administrators regarding the status of technology in our schools. This individual will present his findings and recommendations to the Superintendent, the Administrative Council, and the School Committee on June 2, 2009</li> </ul>
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.	<ul style="list-style-type: none"> <li>• See Executive Summary for Year 3</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Special educators in the district’s ILP and DLP classrooms are using these materials with students, in some cases, as supplemental materials and in one case as a total program</li> </ul>
Purchase print materials and manipulatives to supplement the geometry strand of the Everyday Mathematics Program EDM.	<ul style="list-style-type: none"> <li>• Done</li> </ul>
Purchase pilot software “FASTT Math”- “ <b>F</b> luency and <b>A</b> utomaticity through <b>S</b> ystemic <b>T</b> eaching with <b>T</b> 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.	<ul style="list-style-type: none"> <li>• The district researched the possibility of purchasing this highly successful software package, however due to limited funding and the need for a dedicated server to run the software, we are “on hold.”</li> </ul>

**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 and the resultant *Action Plan for Equity and Excellence* 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:**

- Curriculum:
  - Creation of a K-5 Curriculum Document aligning the Massachusetts State Frameworks with the Lexington's standards; identification of the units of study in the Everyday Mathematics Program that correlate to the benchmarks and the essential vocabulary/concepts that support these standards. The ELL coordinator played a role in working with the mathematics task force in ensuring that these essential vocabulary items were shared and used by our ELL teachers in instructing our ESL students. (Refer to K-12 curriculum binder)
  - Development of a Kindergarten Scope and Sequence for the district's newly established full-day kindergarten program. (Refer to K-12 curriculum binder)
  - Exploration and research on ancillary materials to support learning; purchase of commercial math games for each school to be used in classrooms to extend and enrich the program.
  - Based on the newly established standards, End-of-Year Summative Assessments were constructed for each grade level K-5 to ensure and evaluate essential learning. Although the End-of-Year assessment is summative when given at the conclusion of the school year, teachers may use the resulting data to inform instruction in the final weeks of school. The summative data is used to track student growth over time, provide exit data, to assess the effectiveness of instruction and/or intervention, and provide the teacher with a snapshot of his/her students before they move on to the next grade. Receiving teachers will find the information helpful to have at the beginning of the year and may choose to re-administer the assessment to determine how much information was retained over the summer.
  - Revision of the district's "homegrown" compilation of Differentiated Binders for teachers of each grade level offering extensive ideas and tools on extending and enhancing instruction for diverse student needs. Final versions of each of these grade level documents will be completed by June 2009 and duplicated for distribution in August 2009. (See Grade 1 FINAL version in K-12 curriculum binder)
- Professional Development:
  - Sharing the above-cited curriculum document with all classroom teachers with an emphasis on grade-level and cross-grade discussions to bridge the overall understanding of the continuum of mathematics learning between grade levels.
  - Focus on the integration of materials (newly acquired ancillary materials, as well as existing resources) to meet the wide range of learners. Teachers worked in building based teams to collaboratively plan units based on Richard DuFour's

four essential questions: **1.** What do we want all students to know? **2.** How will we know if they have learned it? **3.** How will we respond when they don't learn? **4.** How will we respond when they have learned it?

- *Mathematics and Mathematics Methods* taught by elementary Mathematics Specialist, Edie Lipinski and *Assessment Driven Instruction in Mathematics K-2* taught by Mathematics K-5 department head, Karen Tripoli, were two courses offered by the Lexington Public Schools Academy (LPSA) and sponsored by the Lexington Education Foundation (LEF).
- An additional LEF grant entitled: *Exploring Foundational Concepts and Teaching them Through Learning Stations* was funded for fifteen teachers. The participants took part in a content institute during the summer of 2008 and, as a result, throughout the school year, explored the use of learning stations to supplement instruction.
- Formation of a K-5 Mathematics Leadership Committee comprised of mathematics specialists, special educators, K-5 mathematics department head, principal, and assistant superintendent. This committee was created as a result of attendance at a 2008 summer workshop sponsored by the Educational Development Center (EDC) entitled: “*Leading for Success: Building Capacity to Improve Mathematics Learning for Students with Special Needs.*” The focus of this group has been on designing, investigating, and piloting instructional intervention programs and progress monitoring tools that specifically target “at risk” students, but which ultimately benefit **all** students. The group meets on a monthly basis and has developed an Action Plan for Equity and Excellence.
- Completion of data collection entitled “Student Support System Continuum for Mathematics” by all classroom teachers. This assessment gauge was developed by Richard DuFour, Thomas Many, and Robert Eaker in an effort to help school districts measure the level of support they provide students. (Appendix B) The analysis of this data (to be done in the summer and fall of 2009) will help the district to evaluate, monitor, and determine necessary professional development/training, as well as any curricular adjustments that need to be made as we strive for the “sustaining” level of achievement on the assessment tool.
- The approval of an additional 1.3 FTE K-5 Mathematics Specialists in the FY09 budget has increased the capacity of our mathematics specialists to consult with classroom teachers, to offer direct instruction to students, and provide content and instructional leadership in mathematics education at the building level.
- Publication by Karen Tripoli, K-5 Department Head, of a communication document entitled “**MATH MATTERS,**” which includes vital and recent information and updates on elementary mathematics issues. Four publications have been disseminated to classroom teachers since January 2009. (Appendix C)

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

- The two middle school Math Intervention specialists, recommended and hired in 2007 are now in the second year of providing “double-dosing” opportunities for struggling mathematics students. All students who scored “needs improvement” (NI) or “warning” (W) on MCAS are 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. These specialists have had a significant impact on students’ MCAS scores. The 2009 MCAS scores will not be available until late in the summer or early-fall, however, in 2008, Diamond Middle

School's MCAS scores indicated that 42% of students increased their scores from W to NI. Thirty-three percent (33%) increased their scores from NI to "proficient" (P). Two students actually increased from W to P and two students increased from NI to "advanced" (A). Similarly, Clarke Middle School's 2008 MCAS demonstrated that 56% of students in the W category increased to NI and 24% of the students in the NI category increased to P.

- The "Executive Functioning" class now in its second year in both middle schools, continues to successfully address intervention strategies related to students' capacities to organize, manage, and perform more efficiently in all programmatic areas.
- Continued writing for grades 6-8 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."
- A "Scope and Sequence" document for each of the three middle school grades and all courses is in the process of being developed with a completion date set for this summer. This document will identify the units of study that comprise each course to ensure consistency and coherency throughout the district.
- A collection of resource materials (specific lessons, worksheets, suggested activities, etc.) will be gathered and placed in binders to support the scope and sequence of each individual course. Each middle school mathematics teacher will receive a copy of the binder and be encouraged to share new ideas with colleagues. This work will be completed in the summer of 2009.
- Content meeting time has been provided for teachers to create common grade level assignments and resultant assessments to better inform individual instruction, as well as to evaluate curricular effectiveness.
- Regular and special education co-teaching model classes continue to provide more collaboration between regular and special education teachers on a daily basis.

### High School, 9-12:

- An essential common core curriculum for each course and level of instruction has been created. The program is aligned to the *NCTM Standards* and *Massachusetts Frameworks*. Each curriculum/course team reviewed their NEASC documents to determine if the scope of content coverage was realistic for the course and level. Once the curriculum team agreed that the document was an accurate representation of the course, all teachers explicitly agreed to ensure their students would receive instruction in all identified topics, thereby establish strong horizontal articulation.
- As part of the professional learning community (PLC) work this year, each course team developed at least one common assessment that was administered during the year to evaluate whether students could demonstrate their understandings and to compare learning across sections of the same course. The resulting discussions about teaching and learning, assessment, and standards-based instruction were substantive and fostered a mutual accountability. The next phase of this work that has just begun is a focus on vertical articulation to ensure continuity of instruction throughout the four-year high school program at each level of instruction. The department will determine if there are any gaps or unnecessary redundancies in instruction. The

goal is to have a consistent course of study at each level that develops a coherent mathematical storyline inclusive of all strands in the *Frameworks*. (Appendix D)

- As a result of expressed interest by the high school mathematics department in the potential of several “reform-based” programs that emphasize procedural and conceptual understanding and embed instruction in a context that helps students make connections both within mathematics and across other disciplines, a team of six high school mathematics teachers and the department head, convened a summer workshop in 2008 to review several high school reform-based mathematics programs. (These programs have the added value of incorporating a strong statistics strand, discrete mathematics, and technology.) This team, referred to as the “9-12 Field-Test Steering Committee,” was charged with reviewing exemplary programs and choosing representative units from one or two of these programs to field-test across all sections of the existing introductory courses (Algebra 1, Geometry, and Algebra 2). Details of this work and resulting commentary are provided in the accompanying Appendix E. As you will see in the details of that report, the “field test” came in with somewhat mixed reviews. As mentioned earlier in this report a newly published series by CME will be examined closely in the new academic year as it appears to be most closely aligned with both the philosophical and standards-based outcomes of the high school’s curriculum.
- It should be noted that the 9-10 grade span learning standards constitute the essential curriculum for preparation for the MCAS mathematics examination which is administered in May of the sophomore year for all students. In the Spring 2008 examination, 81% of LHS students achieved the *Advanced* performance level, 13% achieved the *Proficient* performance level, 6% performed at the *Needs Improvement* level, and there were no students who did not pass the examination. Although we are striving for all students to perform at or above the *Proficient* level by 2012 as required by NCLB, these results are extremely encouraging and are a strong indicator that the curriculum is not only aligned with the Frameworks, but a significant percentage of students are able to demonstrate deep understanding on this high-stakes examination.

## VI. Research and Literature:

It should be noted that the “backdrop” of the district’s work in any domain must be and should continue 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. Even where there exist differing points of view, research from multiple studies consistently agree and underscore the importance of the following essential ingredients in an effective mathematics curriculum:

- Increased collaboration and networking among teaching professionals at all levels and researchers (local PLCs) increases student achievement.
- 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. Consequently, continuous professional development and training for teachers is imperative.
- 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 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. In other words, curriculum MUST simultaneously develop conceptual understanding, computational fluency, and problem-solving skills. These capabilities should be taught as 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.**

#### **VII. Scheduled Work: Summer 2009 and Beyond**

- All new grades 1-5 classroom teachers will enroll in the Everyday Mathematics Training course offered by EDCO.
- Mathematics Specialist, Edie Lipinski, will assemble a collection of websites that can be used as supportive resources for specific units of study for both the teacher and the student.
- See attached approved 2009 Summer Workshop proposals. (Appendix F)

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

<b>District-Wide, K-12:</b>
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- Complete the work outlined in the Summer Workshop proposals so as to bring closure to the K-12 Mathematics Curriculum document and all accompanying work.
- Continue to work towards improving the quality of instruction to meet the learning needs of students who require specific curricular and/or instructional accommodations at all grade levels in all courses through programs like Response to Intervention (RTI), other tiered models of intervention, targeted PLC work, and more collaborative work with the Special Education department.
- Increase the accessibility and dependability of the hardware and software technology required to keep pace with changing needs, specifically as these relate to the mathematics program
- Provide on-going professional development and teacher training for use of this technology.
- Provide regular opportunities/meeting times for departmental members to sustain conversations about the effectiveness of the program at both horizontal and vertical levels.
- Provide professional development to learn new content, pedagogy, assessment practices, technology integration, and ways of implementing new mathematics curriculum.
- Continue to work on addressing the needs of our ELL students, special education students, students on the autism spectrum, and those who are disenfranchised.
- Increase communication with and education of parents with regard to the district’s mathematics program in more regular and consistent ways in order to promote a clearer understanding of the curriculum, course recommendations, and other related instructional information. Some suggestions include expansion of the LPS website (FAQs), school newsletters, PTA newsletters, PTA meeting presentations, “Our Schools” article, parent meetings, curriculum nights, Literacy/Numeracy nights, Family Math Nights, and more.

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

- Finalize the grades 6-8 segment of the K-12 curriculum document.
- Identify the units of study, essential student skills/benchmarks and vocabulary for each course and level.
- Continue to work on resolving the issue of “Algebra for all” or “Algebra for most” at the middle school in an academically and developmentally appropriate way for this age level.
- Continue to work on resolving some conflicting middle to high school programmatic issues as these relate to textbook selection, course offerings, and seamless curricular transitions, particularly at the 8<sup>th</sup> to 9<sup>th</sup> grade levels.

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

- Work towards striking a balance and distribution of core topics across courses to establish the “connective tissue” of mathematics so as to diminish the impact on students who often feel a disconnect across the various branches of mathematics due to an “artificial” separation by subject-specific courses (i.e. Algebra I, Geometry, Algebra II, Advanced Mathematics); Integrate statistics across the high school mathematics program and include vector geometry and discrete mathematics topics whenever appropriate.
- Integrate statistics across the curriculum and include vector geometry and discrete mathematics topics where appropriate in the core curriculum. Currently, the following standards are not being adequately addressed for all students: [10.G.11] Use vertex-edge graphs to model and solve problems; [12.G.3] Use the notion of vectors to solve problems. Describe addition of vectors and multiplication of a vector by a scalar, both symbolically and geometrically. Use vector methods to obtain geometric results; [12.D.1] Design surveys and apply random sampling techniques to avoid bias in the data collection.
- Modify the existing curriculum in order to shift the current sequence so that students take Geometry after Algebra 1 in academic year 2010-2011.
- Research the *CME* program as a possible alternative to our current texts.
- Continue to work on resolving some conflicting middle to high school programmatic issues as these relate to textbook selection, course offerings, and seamless curricular transitions, particularly at the 8<sup>th</sup> to 9<sup>th</sup> grade levels.

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

- Revise the K-5 report card (summer 2009) so as to reflect the standards-based curriculum developed at this level.
- Compile and analyze the data collected from the “Student Support System Continuum for Mathematics” assessment completed by all K-5 classroom teachers. The analysis of this data will help the district to evaluate, monitor, and determine necessary professional development/training, as well as any curricular adjustments that need to be made in our elementary program as we strive for the “sustaining” level of achievement on this assessment grid.
- Review and assess the newly developed end-of-year assessments administered at the end of this academic year (2008-2009) to determine if revisions need to be made.

## **IX. Concluding Remarks:**

I believe I speak on behalf of the entire group when I say that the review process has been an exhilarating experience for all of us. We have learned much from our collective work and from each other. Just as the field of mathematics (traditional, reformed, integrated, etc.) can be quite controversial and invoke many differing opinions as to the most effective instructional approaches, even at the national level, our discussions often reflected many of these same differences at the local level. There was, however, one principle that never wavered and that was the group's commitment to do what was in the best interest of the students and their success and constant growth in field of mathematics. Since curriculum is ever-evolving and instructional interventions for the wide range of diverse needs must be continuously assessed to respond to changing needs, the committee has resolved that the district should commit to offering continuing opportunities to maintain these important discussions on a regular basis and never again let a decade pass in between "formal" review cycles. The work of improving and modifying curriculum and the accompanying instruction must remain on-going in order to be the most current, the most powerful, and the most effective, for these are the standards of excellence to which the Lexington Public Schools has always aspired.

In summary, these three years have yielded valuable discussions among members of the Task Force, school staff, grade-level teams, and cross-grade groups. These discussions have helped to clarify grade-level expectations, helped to inform instruction, and have led to more consistency of mathematics instruction across grades and across schools at all levels. End-of-year assessments have been established, common Informative assessments have been created at all grade levels as a result of focused PLC work, emphatic attention has been placed on instructional interventions designed to improve learning in all programs, and our MCAS have demonstrated that student performance/achievement has improved, as a result. Our work has taught us that the "work" is never truly over; instead it has emphasized the need to consistently and regularly review what we teach, how we teach, and what to do to continuously improve.

Our collective hope is that you will find this report helpful in understanding the status of the work accomplished by the committee in its three years. I look forward, along with other members of the review committee, to answer any questions you might have when we meet on June 2nd.

# Executive Summary:

*Update on Year Three of the  
Mathematics Curriculum Review*

*Lexington Public Schools*

*June 2, 2009*

*Carol A. Pilarski*

*Assistant Superintendent for Curriculum,  
Instruction, and Professional Development*



# *In Recognition and Appreciation*

- Mathematics Task Force
- All K-5 Classroom teachers
- All Secondary Mathematics Teachers
- Special thanks to the leadership
  - Karen Tripoli, K-5
  - Josh Frost, 6-8, Clarke MS
  - John DeMarco, 6-8 Diamond MS
  - Gary Simon, 9-12



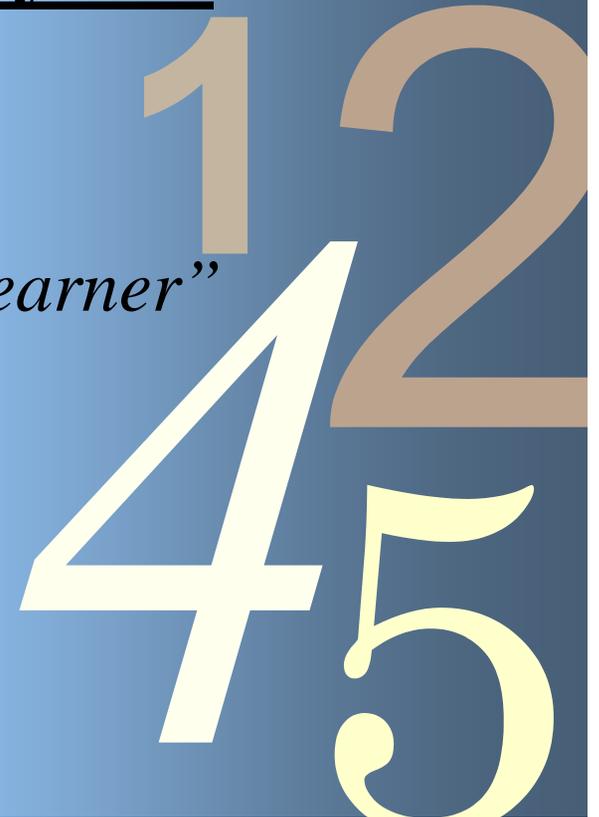
# “The Mission”

*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.*

# Mission

## *Our Philosophical Framework*

- Focus in Year 3: to support our findings and the district's focus on Equity and Excellence for ALL
  - “enable every student to achieve full potential as a mathematics learner”
  - “everyone can succeed”
  - “habits of mind”



# NCTM Standards

- CONTENT

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

- PROCESS

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



# The CHALLENGE

- Mathematics Instruction **cannot** be effective if it is based on either extreme . . .

*Content or Process*

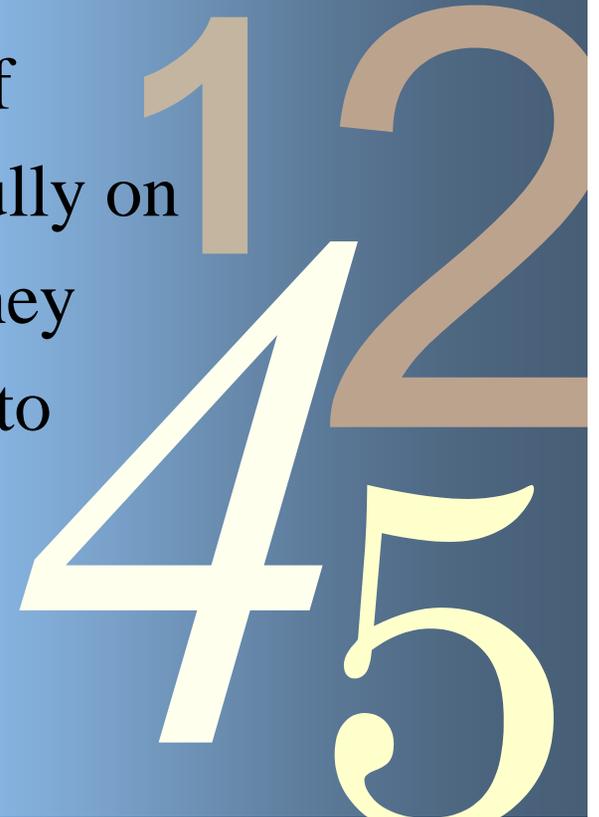
- *“Students become more proficient when they understand the underlying concepts of math and they understand the underlying concepts more easily if they are skilled at computational procedures.”*



*“Students entering Kindergarten in 2009 will graduate from HS in 2022. Educators can only guess at the problems those graduates will face and the corresponding mathematical competencies they will need. Still, educators must define and implement a K-12 Mathematics curriculum that will prepare students for the uncertain demands of 2022.”*



“Despite these varied efforts, the resulting K-12 (current) curriculum has been characterized as being eight years of 11<sup>th</sup> century arithmetic, followed by two years of 16<sup>th</sup> century algebra and a year of 3<sup>rd</sup> century BCE geometry. Students perceive this as nothing more than a smorgasbord of facts and procedures acquired one-by-one, applied to certain types of problems, and demonstrated successfully on a variety of tests. Upon graduation, they often find that they don’t have access to the mathematics they need.”



# The Questions . . . NSF paper published by the Educational Development Center

- “Should instructional emphasis in mathematics be on developing *mathematical apprentices* who are prepared to use specific mathematical techniques?”
- “Should instructional emphasis be on developing *mathematical practitioners* who are able to select and apply a wide array of mathematical tools in order to solve unfamiliar problems?”



# In other words . . .

What Mathematics should be taught?

- Response: *That's the wrong question!*
- What should be asked: *“How can we help students develop “habits of mind” that will help them think like mathematicians think and use real mathematical methods?”*



# *What is a “Habits of Mind” Curriculum?*

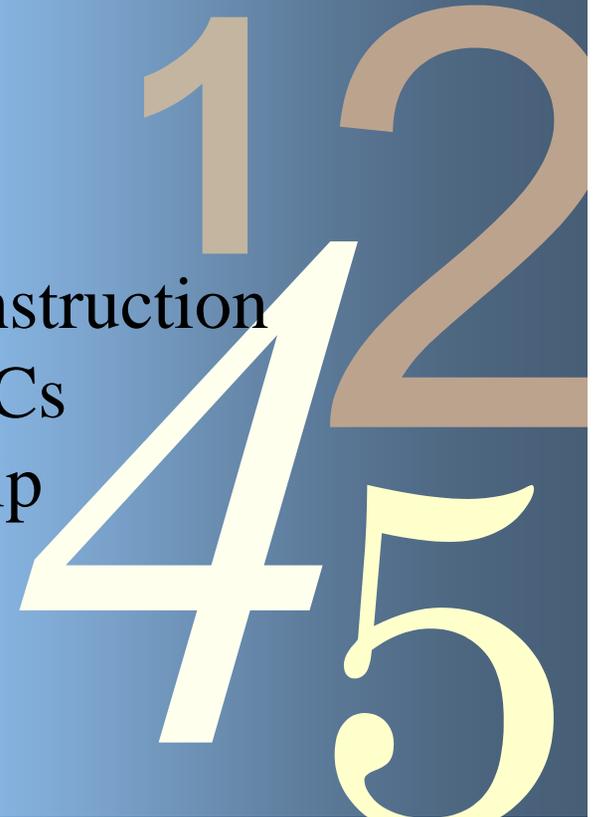
- Gives students the tools they need to use and understand what they have learned and not yet learned.
- Lets students “in” on the process of creating, inventing, conjecturing, and experimenting.



# Accomplishments of Year 3. . .

## *Elementary, K-5*

- Curriculum Document completed
- Kindergarten Scope & Sequence
- Purchase of ancillary materials
- End of Year summative assessments
- Revision of Differentiated Binders at each grade level to enhance and extend instruction
- Extensive professional development: PLCs
- Formation of K-5 Mathematics Leadership Committee (MLC)



## K-5 Accomplishments. . *continued*

- Completion of Assessment Tool - “*Student Support System Continuum for Mathematics*”
- Increase of 1.3 FTE Mathematics Specialists
- Publication of “*Math Matters*”
- **LEF** funded courses:
  - *Mathematics and Mathematics Methods*
  - *Assessment Driven Instruction K-2*
  - *Exploring Foundational Concepts and Teaching Them Through Learning Stations*



# Accomplishments of Year 3

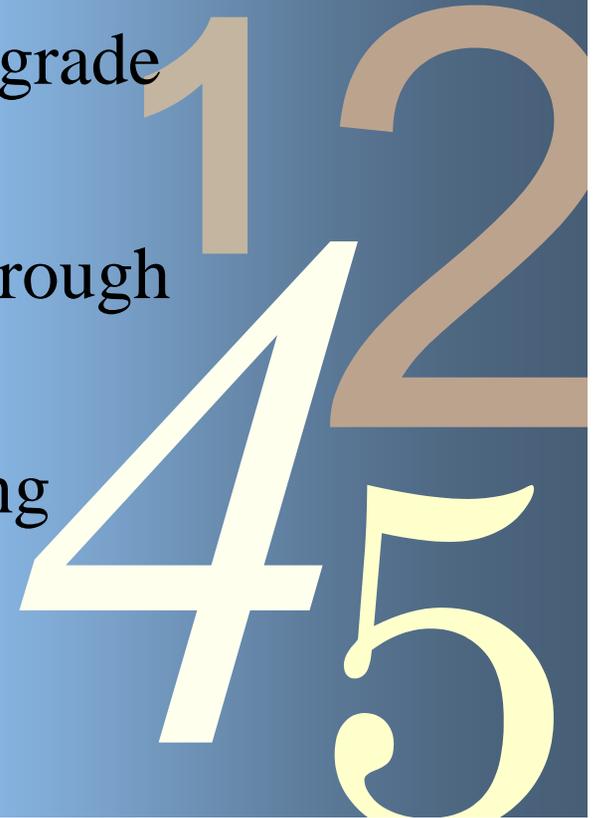
## Middle School, 6-8

- Continuing Work of Mathematics Intervention Specialists hired in 2007
- Improved 2008 MCAS scores
  - Clarke:
    - 56% of students increased from **W** to **NI**
    - 24% of the students increased from **NI** to **P**
  - Diamond:
    - 42% of students increased from **W** to **NI**
    - 33% of students increased from **NI** to **P**
    - 2 students increased from **NI** to **A**



## 6-8 Accomplishments. . *continued*

- “Executive Functioning” class in 2<sup>nd</sup> year
- Continued Writing of 6-8 Curriculum document
- Development of a *Scope & Sequence* document for each MS grade and course
- Collection of resource materials for each grade and course
- Development of *Common Assessments* through PLC work
- Regular and Special Education co-teaching model to ensure collaboration



# Accomplishments of Year 3. . .

## *LHS, 9-12*

- Creation of CORE curriculum for each course and level of instruction
- Development of *Common Assessments* for each course – PLC work
- *Core-Plus* – “field test” – mixed reviews
- Mutual Accountability – *Appendix D*
- Vertical articulation to ensure continuity of instruction and to determine any gaps or unnecessary redundancies



# Research & Literature

Research & Literature should consistently and continuously remain the “backdrop” for any programmatic decisions

- Collaboration and networking increases student achievement
- Effort, **NOT** just inherent talent, counts in achievement
- Children’s goals and beliefs about learning are related to their academic performance



# Research & Literature . . . *continued*

- **Informative assessment improves student learning**
- Research on the relationship between teachers' mathematical knowledge and students' achievement confirms importance of teachers' content knowledge



# Accomplishments

## Overall: Mutually Beneficial Goals

- Improved Student Learning
- Curriculum Review Process
- Professional Learning Community
- Committee for Equity and Excellence
- Full-Day Kindergarten



# “Next Steps & Recommendations”

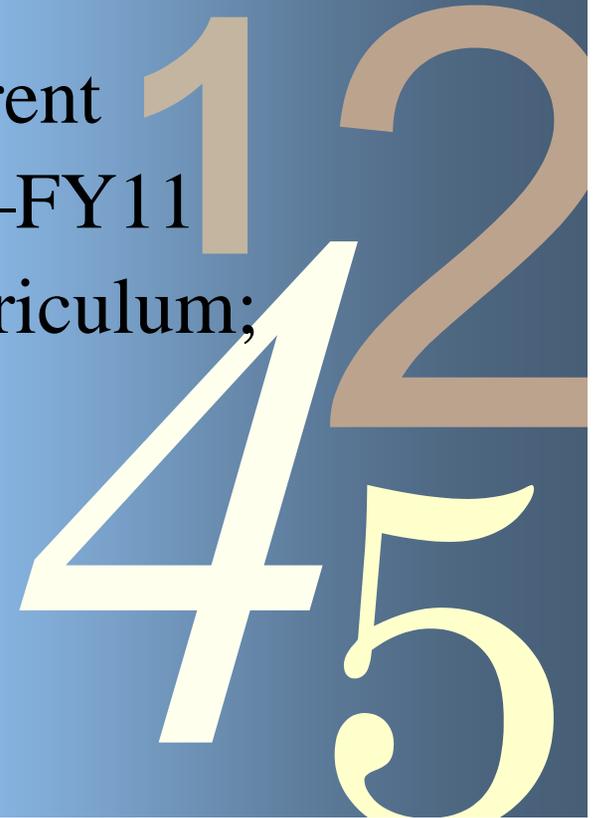
## District-wide

- Complete the goals of the 9 summer workshops as outlined in Appendix F
- Continued work on finalizing the creation of a well-articulated K-12 curriculum document
- Work towards improving the quality of instruction through programs like Response to Intervention and other models of tiered intervention
- Increase accessibility and dependability of hardware and software technology to keep pace with changing times
- Continued efforts to support professional development and training in technology integration, pedagogy, assessment practices
- Need to schedule classroom visitations to encourage collaborative sharing and learning
- Increase communication and education of parents with regard to the district's mathematics program



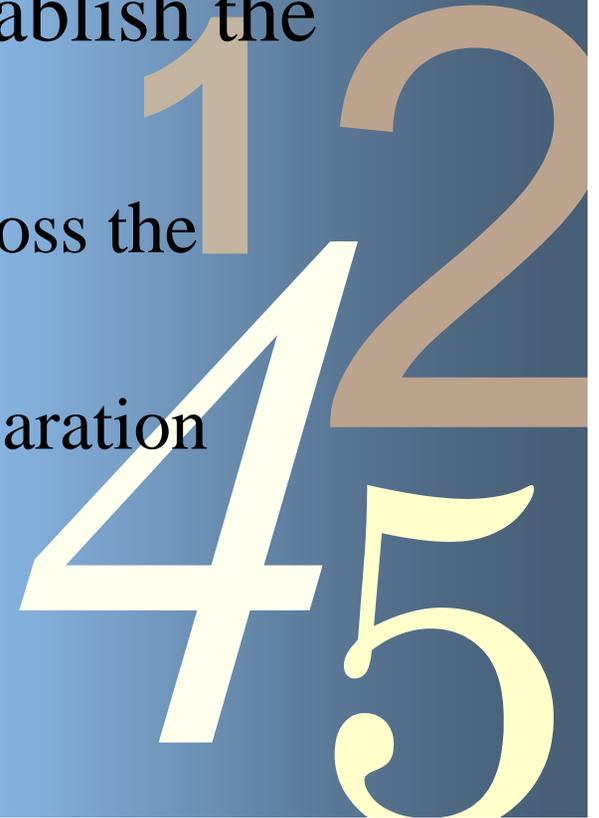
# “Recommendations” . . . *LHS*

- Work on resolving some conflicting middle to high school programmatic issues as these relate to textbook selection, course offerings, and seamless curricular transitions, particularly at the 8<sup>th</sup> to 9<sup>th</sup> grade levels
- Modify the curriculum to shift the current sequence – Geometry after Algebra I –FY11
- Integrate statistics more across the curriculum; include vector geometry and discrete mathematics where appropriate



# Recommendations - LHS

- Research the CME program as a possible alternative to current texts
- Continue to work on a balance and distribution of core topics to establish the “connective tissue”
  - To diminish the disconnect across the various branches
  - To diminish the “artificial” separation by subject –specific courses



# Recommendations – *Elementary K-5*

- Revise the K-5 report card to reflect a standards based approach
- Compile and analyze data from the “*Student Support System Continuum for Mathematics*” assessment
- Review and assess the newly developed EOY assessments administered at the end of this academic year.



# *Recommendations – MS, 6-8*

- Finalize grades 6-8 segment of the K-12 curriculum document
- Identify the units of study, essential skills/benchmarks, and vocabulary for each course
- Work on resolving some conflicting middle to high school programmatic issues as these relate to textbook selection, course offerings, and seamless curricular transitions, particularly at the 8<sup>th</sup> to 9<sup>th</sup> grade levels



# Most Importantly!

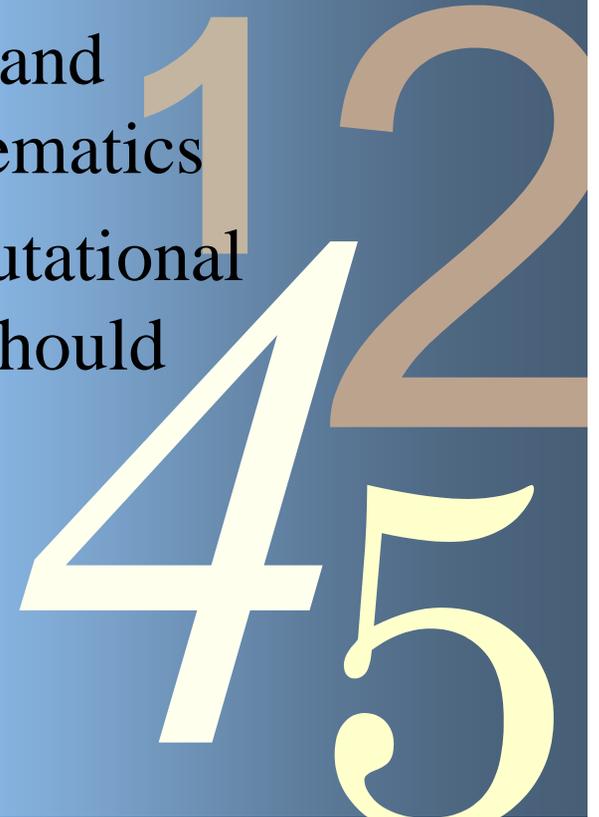
When children **BELIEVE** that their efforts to learn make them “smarter,” they show greater persistence and desire to learn.”



# Most Importantly #2

Both CONTENT and PROCESS standards:

- evoke the essential elements of a highly effective program
- include mastery of skills and concepts
- emphasize mathematical communication and thinking, positive attitudes towards mathematics
- develop conceptual understanding, computational fluency, and problem-solving skills that should be taught as mutually supportive, each facilitating the learning of the others



QUESTIONS ?

1 2  
4 5



## For more information

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