

PREFACE FOR ARCHDIOCESE OF DENVER CATHOLIC SCHOOLS 2010 Math Curriculum Guidelines

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In March 2008 the U.S. Department of Education issued the *Foundations for Success: Final Report of the National Mathematics Advisory Panel*. Nineteen experts were members of this panel, along with 5 ex-officio members and 4 members of the U.S. Department of Education Staff. The panel worked for two years and during that time consulted many of the finest researchers, mathematicians, and teachers in the field. The Panel was convened in response to concerns at the national level that

1. the students in the United States are falling behind their peers in other countries on international tests of math and science skills,
2. the level of remediation in Math required for students entering college is increasing at an alarming rate,
3. and the interest in careers related to science, technology, engineering, and mathematics (STEM) is decreasing among United States students.

The Panel agreed broadly that “...the system that translates mathematical knowledge into value and ability for the next generation—is broken and must be fixed” (p. xiii). They listed six elements that would help U.S. schools “put first things first” to fix this problem.

1. The mathematics curriculum in Grades PreK-8 should be streamlined and should emphasize a well-defined set of the most critical topics in the early grades.
2. Use should be made of what we clearly know: children need a strong start; there are mutually reinforcing benefits to conceptual understanding, procedural fluency and automatic recall of facts; and that effort—not just inherent talent—counts in mathematical achievement.
3. Teachers have a central role in mathematics education and therefore, schools should work to attract, appropriately prepare, evaluate, and retain effective teachers in this area.
4. Research does not support either that instruction should be entirely “student-centered” or “teacher-directed”, but that elements of both must be used under specific conditions.
5. The National Assessment of Educational Progress (NAEP) and state assessments should be improved in quality (*or, my comment is that they need to be better aligned with the TIMMS and PISA if we intend to hold these measures as the goal. SEY*)
6. The nation needs to build capacity for research that can inform policy and practice more effectively.

To support these broad elements, the panel developed 45 main findings and recommendations. The Archdiocese of Denver Catholic Schools Math Curriculum Revision Committee was very specific about attending to several of these as they wrote the 2010 Edition of the Math Curriculum Guidelines.

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CURRICULAR CONTENT

There are 7 findings in this area. The most significant to our committee follow.

1. “A focused, coherent progression of mathematics learning, with an emphasis on proficiency with key topics, should become the norm in elementary and middle school curricula. *Any approach that continually revisits topics year after year without closure is to be avoided...* (Italics added.) Students should understand key concepts, achieve automaticity as appropriate, ...develop flexible, accurate, and automatic execution of standard algorithms, and use these competencies to solve problems” (p. xvi).

The objectives of this curriculum guideline reflect the committee’s desire to respond to this recommendation. The words “fluency and automaticity” are frequently used in the student objectives. The Panel understands the meaning of proficiency in line with the 5 attributes associated with proficiency from *Adding It Up*, a report by the National Research Council in 2001: “1) conceptual understanding, ...2) procedural fluency, ...3) strategic competence, ... 4) adaptive reasoning, ...and 5) productive disposition.” It is clear in the Scope and Sequence of the Math Curriculum Guidelines that topics are intended to be taught only once, but taught in depth and very well at that grade. The committee deleted any repetition of instruction in the student performance objectives. We intend that skills be practiced and used after they have been learned, but we have not included relearning in the objectives.

The Curriculum Committee read an article by one 4th Grade Math teacher who lamented the fact that she had to spend the first quarter of the school year reviewing what had been taught the previous year before she could even begin to teach the new material for her grade. That can result in boredom for students. It does not take advantage of the “beginning of the year” excitement that could provide a spring board for learning and growth. Good teachers understand that they must assess the current knowledge of students and start at that point to move on to new material. That assessment includes an analysis of critical skills that need to be reinforced, reviewed or even retaught in the context of teaching new content, but whole lessons ought not to be dedicated to an intentional retreatment of content for which the previous grade is accountable.

Teachers should be very familiar with the new curriculum guide. It is the intention of the curriculum committee that teachers be held accountable for the objectives in this guideline and not necessarily for the contents of an entire textbook. For example, teachers are encouraged to skip pages, sections of chapters, and perhaps whole chapters of textbooks if they do not address the grade specific objectives. The National Council of Teachers of Mathematics published *Curriculum Focal Points for Prekindergarten Through Grade 8 Mathematics (2006)* in which they discuss the challenge faced by textbook publishers who try to address all the standards of all the states who will consider purchasing their textbook. “[...]n a study of the mathematics curriculum standards of ten states... the total number of grade-level expectations in mathematics for Grade 4 ranged from 26 to 89 (see Table 1)” (p.3). When publishers cover 89 standards so that Florida will select their textbook, people in Georgia or Virginia (or Colorado) get too much information. The challenge, then, is to understand what the Archdiocese of Denver Catholic Schools considers important and teach those concepts well regardless of the content of the textbook. The recommendations of the committee in the Appendix of the Archdiocese of Denver Catholic Schools Mathematics Curriculum Guideline point to series that support the objectives well, but there is no one series that does so perfectly.

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Table 1:

Number of Fourth-Grade Learning Expectations (LEs) per State by Content Strand (from Rey, et al. 2006, p. 20)

	Number & Operations	Geometry	Measurement	Algebra	Data Analysis, Prob & Stat	Total Number of LEs
California	16	11	4	7	5	43
Texas	15	7	3	4	3	32
New York	27	8	10	5	6	56
Florida	31	11	17	10	20	89
Ohio	15	8	6	6	13	48
Michigan	37	5	11	0	3	56
New Jersey	21	10	8	6	11	56
North Carolina	14	3	2	3	4	26
Georgia	23	10	5	3	4	45
Virginia	17	8	11	2	3	41

Source: Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics (2006, p. 4)

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2. “A major goal for K-8 mathematics education should be proficiency with fractions (including decimals, percents, and negative fractions), for such proficiency is foundational for algebra and at the present time seems to be severely underdeveloped. Proficiency with whole numbers is a necessary precursor for the study of fractions as are aspects of measurement and geometry. These three areas—whole numbers, fractions, and particular aspects of geometry and measurements are the Critical Foundations of Algebra” (p. xvii).

Table 2: Benchmarks for Critical Foundations

Fluency With Whole Numbers

1. By the end of Grade 3, students should be proficient with the addition and subtraction of whole numbers.
2. By the end of Grade 5, students should be proficient with multiplication and division of whole numbers.

Fluency With Fractions

1. By the end of Grade 4, students should be able to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals.
2. By the end of Grade 5, students should be proficient with comparing fractions and decimals and common percents, and with the addition and subtraction of fractions and decimals.
3. By the end of Grade 6, students should be proficient with multiplication and division of fractions and decimals.
4. By the end of Grade 6, students should be proficient with all operations involving positive and negative integers.
5. By the end of Grade 7, students should be proficient with all operations involving positive and negative fractions.
6. By the end of Grade 7, students should be able to solve problems involving percent, ratio, and rate and extend this work to proportionality.

Geometry and Measurement

1. By the end of Grade 5, students should be able to solve problems involving perimeter and area of triangles and all quadrilaterals having at least one pair of parallel sides (i.e., trapezoids).
2. By the end of Grade 6, students should be able to analyze the properties of two-dimensional shapes and solve problems involving perimeter and area, and analyze the properties of three-dimensional shapes and solve problems involving surface area and volume.
3. By the end of Grade 7, students should be familiar with the relationship between similar triangles and the concept of the slope of a line.

Source: National Mathematics Advisory Panel, 2008 (p. 20)

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3. “All school districts should ensure that all *prepared students* have access to an authentic algebra course—and should prepare more students than at present to enroll in such a course by Grade 8” (p. xviii) (Italics added).

In 2004 when the previous edition of the Math Curriculum Guidelines was published, a policy on Algebra was included that prohibited the teaching of Algebra in the 8th Grade except in tightly controlled circumstances. The committee has made a significant change in this policy based on the research cited in *Foundations for Success*. The recommendation of the committee is that the teaching of Algebra in 8th Grade become the norm. These Curriculum Guidelines are written with that goal in mind.

The Benchmarks for Critical Foundations of Algebra should be a guide for preparation and readiness of students to take Algebra. The Panel suggests that 1) by the end of 3rd Grade, all students should be proficient with the addition, subtraction of whole numbers and by the end of 5th Grade students should be proficient with multiplication and division of whole numbers. 2) By the end of 7th grade all students be fluent in fractions including decimals and percents; and 3) that by the end of 7th grade all students should be proficient in certain areas of geometry and measurement. (see Table 2)

A major understanding in the past that led educators to be very selective about when Algebra should be taught was our understanding of child development. Teachers and developers of instructional materials sometimes assume that students need to be a certain age to learn certain mathematical ideas. However, a major finding, documented in a National Research Council synthesis of studies about science learning and reaffirmed in the review of learning studies in mathematics conducted by the Task Group on Learning Processes is, “What is developmentally appropriate is not a simple function of age or grade, but rather is largely contingent on prior opportunities to learn” (Duschl et al., 2007, p2). Claims based on Piaget’s highly influential theory, and related theories of “developmental appropriateness” that children of particular ages cannot learn certain content because they are “too young,” “not in the appropriate stage,” or “not ready” have consistently been shown to be wrong. Nor are claims justified that children cannot learn particular ideas because their brains are insufficiently developed, even if they possess the prerequisite knowledge for learning the ideas (*Foundations for Success*, p. 30).

There has been significant debate about a move such as this since the report was published. One of the Panel members, Tom Loveless wrote an article (2008) that documented how ill advised educators would be to adopt this recommendation. He provides data supporting a clear case for the failure of students placed in Algebra without the proper preparation. Seventh graders who are weak students placed in Algebra in the 8th grade score lower on standardized tests than their peers who are placed in a pre-Algebra class. Others (Viadero, 2010) have repeated this caveat. The emphasis in these reports is that these students were not prepared. The new goal of the Archdiocese of Denver Catholic Schools is that students are prepared for this step by 8th Grade.

There was strong resistance to this policy change among members of the Math Curriculum Revision Committee. One member, a veteran master teacher of mathematics at the secondary level, was very vocal about her views and addressed this very concern. She asked that we not make this policy change, and allow only those student who can demonstrate success with pre-requisite skills to take Algebra – at what ever grade level that should happen. She brought research support and opinions of others in the educational community to bolster her point of view. She also expressed concern for middle school math teachers, especially in smaller schools, who will not be able to juggle so many levels of math readiness in one classroom. With respect to that concern, many of our schools are already offering Algebra in 8th Grade. Many of them have found that our students are put at a disadvantage when they move to high school and have not had Algebra in 8th Grade like their public school peers. Teachers in small schools have been dealing with diverse abilities and a variety of levels of readiness to learn among students for many years.

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LEARNING PROCESSES

The second area of findings and recommendations concerns itself with the process of learning. The findings again address “...conceptual understanding of mathematical operations, fluent execution of procedures, and fast access to number combinations jointly support effective and efficient problem solving” (p. xix).

Students need to experience some responsibility for their own learning. The Panel notes,

“[e]xperimental 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. ... Teachers and other educational leaders should consistently help students and parents to understand that an increased emphasis on the importance of effort is related to improved mathematics performance. ...[M]uch of the public’s evident resignation about mathematics education...seems rooted in the erroneous idea that success is largely a matter of inherent talent or ability, not effort” (Foundations for Success, p. xx).

These Curriculum Guidelines have some significant changes. Some schools may need—and should take some transition time to come into line with them. Others may have students that will not ever be ready for Algebra as 8th Graders. We always provide adaptations and interventions for these students. We ask that you challenge students to greater effort and provide support and guidance for that effort. Effort counts!

TEACHERS AND TEACHER EDUCATION

There may also be teachers who experience a high degree of discomfort with these changes. Change is always hard, and this one is no exception. Our goal is a challenging one. The Panel has 7 recommendations in this area. “Research on the relationship between teachers’ mathematical knowledge and students’ achievement confirms the importance of teachers’ content knowledge” (Foundations for Success, p. xxi). Teachers who are insecure in teaching Math because of their own experience as students will want to rely heavily on a textbook for content delivery, especially a series like Saxon Math that is quite prescriptive. This is understandable. However, it is our schools’ responsibility to students and families that we provide the best possible instructional environment. Therefore, it is highly recommended that schools provide professional development in the area of teaching Math. The publishers whose series have been recommended by the committee provide various levels of staff development opportunities—many online resources and additional print resource materials. Many schools have excellent elementary teachers who could coach or mentor insecure teachers in neighboring schools or clusters of schools. A “Math specialist” may be an option for some schools, or sharing instruction responsibilities among teachers—the 2nd Grade teacher would teach both 2nd and 3rd Grade Math and the 3rd Grade teacher would teach both 2nd and 3rd Grade Social Studies.

For this change to have the success we envision, support and professional development opportunities must be provided for teachers of Math at every level so that they have the skills they need and can assist their students to meet these challenging goals.

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INSTRUCTIONAL MATERIALS, ASSESSMENT, and RESEARCH POLICIES are the last three areas considered by the Panel. In the Assessment area, the Panel discusses formative assessment and says that classroom teachers frequently checking with students to ensure understanding is critical for student success.

One of the Assessments used by the Archdiocese of Denver Catholic Schools for the area of Math is the Iowa Test of Basic Skills. ITBS tests three areas of Math: Concepts/Estimating, Problem Solving, and Computation. On average, students in the Archdiocese of Denver score above grade level in all areas and increase their scores more than one year each year in each area. By 8th Grade, the average of our students shows scores 1.5 years above grade level in Computation. About 5% of students (fewer than 50 individuals) score at the Below Basic proficiency range on the Math Total in grades 2 – 8. About 25% of students score in the Basic Range – which is at the low end of grade level achievement. Forty to 47% of students score in the Proficient Range, and between 18% and 30% score in the Advanced Range. Passing is defined as Proficient plus Advanced. Overall, 2/3 to 3/4 of Archdiocese of Denver Catholic Schools students achieve a Passing Proficiency on the Math total score. A guess would be that students in the Passing range can easily achieve success in Algebra at the 8th Grade. Those in the Basic range will need additional support, but are also good candidates for success in this goal.

Many thanks to the members of the Math Curriculum Revision Committee. They have worked for two years assimilating the input from their peers, the current research and emerging data to provide the following document. They considered far more than just what teachers should teach at each grade level. They took seriously the challenge to create a document that will reshape our instruction for greater success among our students. Their discussions and networking have helped make them stronger classroom teachers themselves.

The members of the committee are:

Amber Carpenter	St. Mary's School – Littleton
Lynn Celano	All Souls School
Tammy de la Cuesta	St. Thomas More School
Barbara Flesher.....	Nativity of Our Lord School
Molly Gentine	St. Mary's School – Littleton
Sally Gillett.....	St. John the Baptist School
Brent (Tom) Goerke.....	St. Thomas More School
Laura Brummer Konrade.....	Our Lady of Fatima
Thomas Matejka	Christ the King School
Susan Miller.....	Nativity of Our Lord School
Elizabeth Moore	Presentation of Our Lady School
Joe Peters	All Souls School
Sr. Elizabeth Youngs	Office of Catholic Schools

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