



# News from the Administration

December 2011

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## Understanding “Going Deeper in Mathematics”

Recently, there have been some questions about the change in the content and pace of the MCPS math curriculum for grades K-2. With this month’s newsletter, our intent is to answer your questions with a detailed description of how the content and pace of our math curriculum is beneficial to our K-2 students now, and in the future our 3-5 students. First, we want to acknowledge that “going deeper” is a shift in the way we’ve all (in the U.S.) been taught to think about math instruction. The concept of going deeper is a complex topic, and as a result, may take some time to fully understand the different aspects that contribute to what going deeper means for our children’s learning about math.

Let us start with The Common Core State Standards (CCSS). The CCSS identify eight practices of mathematically proficient students. Just as we have good reading practices for reading literacy, we have good math practices for math literacy. The state of Maryland’s eight practices for mathematically proficient students are identified as

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Students that demonstrate these practices as habits are demonstrating their mastery of the math content. What MCPS is finding is that although many of our children certainly can show their use of these 8 practices with prompting and review, most do not demonstrate these practices as a means to an end. This is what we are after. Just as our good readers know intuitively how to use, for example, their phonics skills to sound out a word or to cover part of the word to find the root to understand the meaning or to use picture clues as a way of strengthening their comprehension of given reading passage, we want our good math students to naturally and intuitively to use the 8 good practices to complete math problems. In other words a child with a deeper understanding may say, “I understand not only how and when to use an algorithm; I know why the algorithm is the most efficient way to solve a problem and I can explain why.”

## IMPORTANT DATES

### December 6

Picture Make-Up Day

PTA Meeting 6:30 p.m. at St. Andrews School, Potomac

### December 7

Dr. Starr’s public presentation of the fiscal year 2013 operating budget at 7:30 p.m. in the auditorium of Richard Montgomery High School, Rockville

### December 26 – January 3

Winter Break – School is closed

### January 16

Martin Luther King Day, School is closed



The chart below shows how these eight practices relate to the strands of mathematical proficiency or UCARE (Understanding, Computing, Applying, Reasoning, Engaging). Grasping the skills represented in the strands of UCARE support a deeper understanding of the content and balance between procedural skill and understanding. Students who are math proficient use these math practices to develop deep understandings. Deep understandings are a portion of the skills and concepts a student must know and be able to do at each grade level. They are the building blocks for all future math understandings.

UCARE	Math Practices	Deep Understandings
Understanding	<ol style="list-style-type: none"> <li>1. Make sense of problems and persevere in solving them.</li> <li>2. Reason abstractly and quantitatively.</li> <li>3. Construct viable arguments and critique the reasoning of others.</li> <li>4. Model with mathematics.</li> <li>5. Use appropriate tools strategically.</li> <li>6. Attend to precision.</li> <li>7. Look for and make use of structure.</li> <li>8. Look for and express regularity in repeated reasoning.</li> </ol>	<p><b>Kindergarten</b></p> <ul style="list-style-type: none"> <li>• Understand the relationship between numbers and quantities.</li> <li>• Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from</li> </ul> <p><b>Grade 1</b></p> <ul style="list-style-type: none"> <li>• Understand and apply properties of operations and the relationship between addition and subtraction.</li> <li>• Understand place value.</li> <li>• Use place value understanding and properties of operations to add and subtract.</li> </ul>
Computing	<ol style="list-style-type: none"> <li>1. Make sense of problems and persevere in solving them.</li> <li>4. Model with mathematics.</li> <li>5. Use appropriate tools strategically.</li> <li>6. Attend to precision.</li> </ol>	<p><b>Grade 2</b></p> <ul style="list-style-type: none"> <li>• Understand place value.</li> <li>• Use place value understanding and properties of operations to add and subtract.</li> </ul> <p><b>Grade 3</b></p> <ul style="list-style-type: none"> <li>• Understand properties of multiplication and the relationship between multiplication and division.</li> <li>• Use place value understanding and properties of operations to perform multi-digit arithmetic.</li> <li>• Develop understanding of fractions as numbers.</li> <li>• Geometric measurement: understand concepts of area and relate area to multiplication and to addition.</li> </ul>
Applying	<ol style="list-style-type: none"> <li>1. Make sense of problems and persevere in solving them.</li> <li>4. Model with mathematics.</li> <li>5. Use appropriate tools strategically.</li> <li>7. Look for and make use of structure.</li> </ol>	<p><b>Grade 3</b></p> <ul style="list-style-type: none"> <li>• Understand properties of multiplication and the relationship between multiplication and division.</li> <li>• Use place value understanding and properties of operations to perform multi-digit arithmetic.</li> <li>• Develop understanding of fractions as numbers.</li> <li>• Geometric measurement: understand concepts of area and relate area to multiplication and to addition.</li> </ul>
Reasoning	<ol style="list-style-type: none"> <li>2. Reason abstractly and quantitatively.</li> <li>3. Construct viable arguments and critique the reasoning of others.</li> <li>8. Look for and express regularity in repeated reasoning.</li> </ol>	<p><b>Grade 4</b></p> <ul style="list-style-type: none"> <li>• Generalize place value understanding for multi-digit whole numbers.</li> <li>• Use place value understanding and properties of operations to perform multi-digit arithmetic.</li> <li>• Extend understanding of fraction equivalence and ordering.</li> </ul>
Engaging	<ol style="list-style-type: none"> <li>1. Make sense of problems and persevere in solving them.</li> <li>2. Reason abstractly and quantitatively.</li> <li>3. Construct viable arguments and critique the reasoning of others.</li> <li>4. Model with mathematics.</li> <li>5. Use appropriate tools strategically.</li> <li>6. Attend to precision.</li> <li>7. Look for and make use of structure.</li> <li>8. Look for and express regularity in repeated reasoning.</li> </ol>	<ul style="list-style-type: none"> <li>• Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.</li> <li>• Understand decimal notation for fractions, and compare decimal fractions.</li> <li>• Geometric measurement: understand concepts of angle and measure angles.</li> </ul> <p><b>Grade 5</b></p> <ul style="list-style-type: none"> <li>• Understand the place value system.</li> <li>• Apply and extend previous understandings of multiplication and division to multiply and divide fractions.</li> <li>• Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.</li> </ul>

One critical component of “**understanding**” is a student’s ability to justify “why a particular mathematical statement is true or from where an applied mathematics rule comes.” When students understand the mathematics behind a problem and can explain where it comes from, students have a better chance to succeed at a less familiar task. Comparatively, this is very similar to using phonics to pronounce and unknown word. In this regard, mathematical understanding and procedural skill are equally important and are critical components of long-term success.

Students who lack understanding of a topic may rely on procedures too heavily and may be less likely to consider similar problems, represent problems coherently, justify conclusions, apply the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, **a lack of understanding effectively prevents a student from engaging in the mathematical practices.**

One example of this is in place value which receives great emphasis in Grade 1 (2-digit numbers) and Grade 2 (3-digit numbers) for development of understanding. After this point place value understanding is an expectation, there is no more cycling back, as people experienced in a spiral curriculum, to review and reteach prior “learnings”. With an expectation of deep and lasting understanding, place value understanding is then applied and extended from that point onward.

Other examples are in operations, specifically **division**:

- Addition and subtraction begin informally in K, goes into depth in Grades 1-2, with fluency expected for different ranges of numbers in K (+/- within 5) to Grade 4 (+/- within 1 million)
- Multiplication and Division begin in Grade 3 and continue through MS with increasingly complex numbers.

As you can see, students are challenged to approach math concepts using more complete and thorough processes, ultimately building a stronger base of deeper understanding. Our state core standards include rigorous content on par with nations proven to higher math achievement. In each grade level these new and internationally driven standards prepare our students for a future we may not recognize. Building a deeper and wider knowledge of mathematics is necessary to provide skills and understanding necessary to succeed in our rapidly changing global world.

As many of you are aware and have visited the entire curriculum framework is available on the MCPS Curriculum 2.0 web page: <http://www.montgomeryschoolsmd.org/curriculum/2.0/> and is also a link from the Beverly Farms home page. As we move forward with the change of implementing our new state-standards based curriculum, we will certainly share any new information so that our students receive the maximum benefits from our collaborative efforts. In the words of Ian Jukes (teacher, administrator, writer, consultant, university instructor), “We need to prepare students for their future, not our past.”

