Math4Minors Presents:

EDUCATORS GUIDE:
On My Way to Grandma's House

Lynda Brennan

A comprehensive educational resource aimed at demystifying Common Core Standards and promoting in-depth understanding of key math concepts for educators, parents and kids.

Math MileMarkers®
Calm, Command and Conquer the Curriculum

Math MileMarkers Educational Guide/Children's Book Series
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On My Way to Grandma's House
Educators Guide

Math4Minors is pleased to present *On My Way to Grandma's House*, a Math Mile-Markers® original story that addresses curriculum standards related to rounding and estimation. As with all books in the series, the goal is to streamline current information related to math standards, helping parents and teachers get to the core of what children need to know and understand in order to be successful in today's mathematical world.

Recently published teacher resources such as *Cowboys Count, Monkeys Measure* and *Princesses Problem Solve and Number Stories: Using Children's Literature to Teach Young Children Number Sense*, highlight the value of incorporating story-telling into math instruction as a means of engaging students in mathematical thinking. Teachers who work with children will confirm that creating relatable images and stories helps foster rich math inquiry and can launch meaningful discussions in the classroom. Math MileMarkers make the link to content easy for teachers and parents and enjoyable for kids.

At first glance, this Math MileMarkers original story seems to focus prima-rily on the concept of rounding numbers, a standard identified in the Number and Base Ten Content Standards found in grades 3, 4 and 5. However, rather than looking at rounding as an isolated skill, Math MileMarkers uses this oppor-tunity to encourage teachers and children to explore using the number line as a tool for rounding numbers in places they may never have been before. Think about it: how often do children have the opportunity to "play" on a number line that stretches to the nearest ten thousand or to the nearest thousandth?

The story of Lily and her adventures on Cypress Road can be equally enjoy-able for children in grades kindergarten, 1 and 2. Primary students will recognize the numeracy connections as they work to gain a solid understanding of number names and proper sequencing of numbers, as well as perspective on the distance between numbers in relation to one another on the number line. This simple story goes far beyond rounding; its message for children, teachers and parents reaches far beyond Lily's trip to Grandma's and another happy ending.

Math4Minors invites you to sit back and enjoy the latest adventure on this mathematical journey as children uncover the infinite possibilities of numbers and the ultimate power tool for problem solving: the number line.

MileMarker Math Talk and Storyboard activities are available
on our website www.mathmilemarkers.com.

What Does the Research Say?

An abundance of research supports the use of the number line as a tool for problem-solving. If you are in the trenches working with children, a few key pieces of research do an excellent job of packaging and promoting the development of number knowledge and the use of the number line.

According to the U.S. Department of Education, using visual models such as the number line provides a concrete understanding of numbers and their magnitude and movement within the number system. Using this common underlying structure can significantly increase a student's achievement in math by helping them to create mental images of the number line that they will forever be able to reference for problem solving activities.[1]

Hans Freudenthal, a mathematician from the Netherlands, presented some interesting research in the area of math that continues to be built on today. According to his Realistic Mathematics Education theory (RME), educators should be encouraging children to develop their own mathematical tools and understanding rather than merely using ready-made math tools. The models and structures that emerge from students working through math in this way will support them at all academic levels and will ultimately lead to improved critical thinking skills and a more successful approach to problem solving.[2]

The number line is an example of a model that students can use in this way to gain meaning when solving problems. The key idea is that math does not exist within an instructional model but rather in the way a student makes meaning of math concepts using that model. In other words, it's not enough for us to simply give a child a number line and say, "Here's your tool." In fact, learning to jump up and down a number line can be meaningless if a child is not connecting that activity to a larger understanding of numbers that includes where numbers live in relation to one another. When we look at the big picture, what we are really trying to do is to help children realize that every number, every quantity has its place. Ultimately, it's the distance between these numbers or units that really matters.

All too often, teachers jump into the concept of rounding by using procedure-driven methods. Everyone has heard the series of little rhymes that have been published to provide guidance to children on the subject. The main message is, "5 and above you simply round up." Of course these are all helpful reinforcements for kids, and provide an interesting way to infuse meaningful

reminders, but do they provide enough context to support true understanding of the concept of rounding, and to build or reinforce the essential concepts of the number system?

The research tells us that we educators must allow time for children to experience the number line and develop their own understanding of just how powerful it can be as a mathematical tool. The concept of rounding numbers fits nicely into supporting that greater goal.

Mathematical Practice Standards

The Standards for Mathematical Practice (MP) outline specific expertise that students at all levels should seek to obtain in order to become proficient at math and successful lifelong learners. These standards promote true understanding versus a series of procedures.[3]

In the case of rounding numbers, the related MP Standards remind us of the importance of focusing on the entire journey and not just an individual piece. The concept of "rounding" in itself can barely be considered a Math Mile-Marker. Instead, rounding numbers should be seen as a concept that can be woven into a much bigger idea. This big idea incorporates true understanding of numbers and their placement on the number line. Our goal as educators must be to encourage children to become good thinkers and problem solvers. Combining content standards (skills) with MP (expertise) will allow us to emphasize key proficiencies while fostering the complex problem solving skills necessary for children to find success in today's math curriculum.

Mathematical Practice Standards	
MP.1 Make sense of problems and persevere in solving them	Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
MP.4 Model with mathematics	Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
MP.5 Use appropriate tools strategically	Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

Common Core Standards for Mathematical Practice

Using the Number Line Effectively in the Classroom

Children grow up with numbers all around them. Games like hopscotch and simple board games allow young children to jump forward and back with ease, encountering numbers up to 100 on a regular basis. Counting out objects like cookies, pencils or math-manipulatives is commonplace in and out of the classroom, but dealing with larger numbers can be tedious and is often avoided. What happens when the numbers grow beyond what exists in a child's everyday visual world?

To explain my point I'll share a Math MileMarker classroom encounter that highlights this very point. I asked some students in grades 3-5 to place the number 137 on a number line that stretched from 0 to 200. The variations and rationales expressed were quite enlightening. Some children immediately placed the number 137 closer to 200 stating that it ended with a 7 and therefore must belong closer to 200. Others placed it to the left of their designated mid-point saying the 3 in the number would clearly dictate its actual position closer to 0. After these misunderstandings surfaced, things really got interesting. The most common misconception that came to light as a result of this activity happened when children were asked to find the midpoint between 0 and 200. The leading response that was given was 150. After all, 150 does have a 5 in it, so this must be true; 5 is the designated midpoint no matter what. Children were defying logic by applying rules that they had heard rather than reasoning and visualizing what made sense.

In order to help these students prove their theory correct or incorrect, I asked them to outline a number chart by boxing in numbers 0 to 200. I next asked them to shade with a color pencil all numbers that landed above what they identified as their mid-point. With a simple fold on their mid-point, students immediately identified the correct answer and solidified an understanding that they needed to have to move forward. Without the ability to find an accurate midpoint between two numbers, including decimals, rounding would never become a mastered skill.

The second thing that seemed to present difficulty for children surfaced mostly when the students were asked to round to a large number, such as rounding to the nearest ten thousand. Many students could underline that place value and look at the number to the right and identify a correct answer. Some even drew an arrow and correctly rounded up or kept the number the same. Regardless of their ability to apply that process, many still struggled with what that really meant in terms of the number line. They simply could not justify their answer.

It's easy to assess where children are with this skill. Simply ask a child to round 147,302 to the nearest ten thousand. Notice how they approach the problem in terms of the number line. Does the student understand where that number actually lives?

Do they really understand that when rounding on the ten thousands number line they need to skip count by ten thousand to identify the two end points?

120,000   130,000   140,000   150,000   160,000   170,000
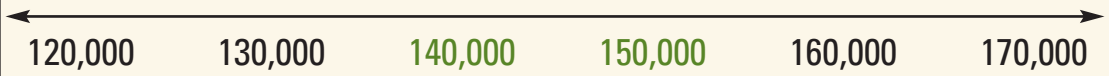
Can the student identify the mid-point?

150,000

147,302

145,000

140,000

135,000

Does that information inform their decision to round up to 150,000?

Can they identify where 147,302 is in relation to that mid-point?

135,000   140,000   145,000   150,000   155,000   160,000

147,302
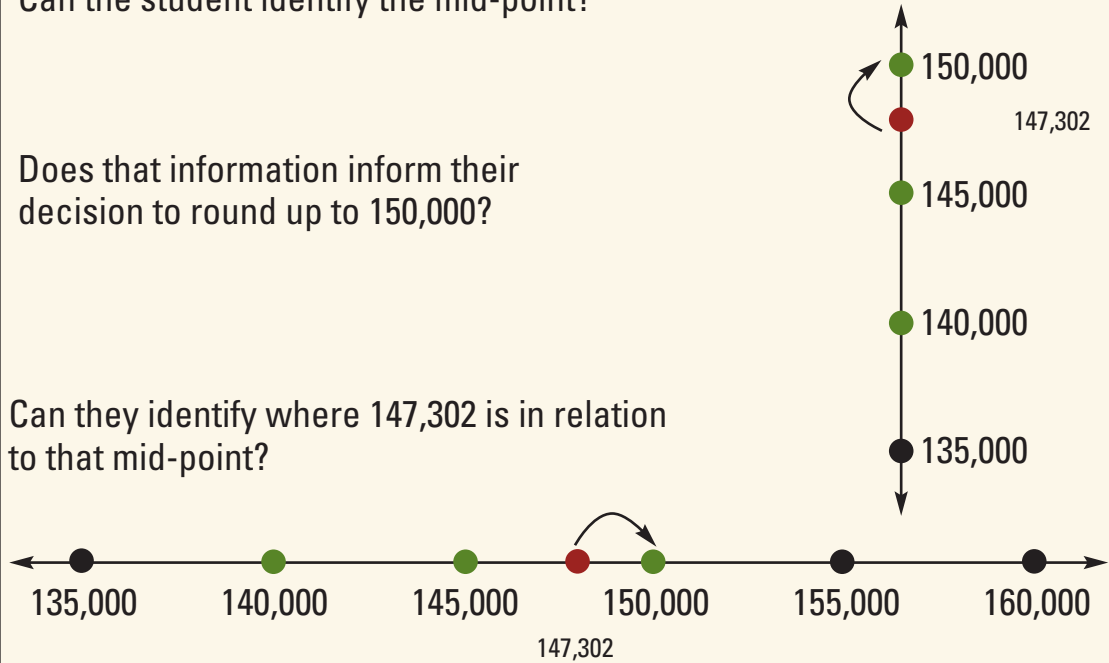
This Math MileMarkers moment reminds us of how important it is to stop periodically to acknowledge and assess the multitude of skills that so often come together within an individual lesson. As educators we must be careful not to assume that a process-driven rounding procedure contains all the answers; instead we must continually challenge students by asking them to justify or prove their response.

In Math MileMarkers, *On My Way to Grandma's House* has become a story that surfaces each year when students approach the topic of rounding. The numbers get larger and decimals eventually become part of the discussion, but Lily's house and Grandma's house remain the designated endpoints and the anchors for understanding. The discussion immediately focuses on the appropriate midpoint of two numbers. With these important elements in place, students can easily identify the placement of a given number in relation to the other numbers. More importantly, armed with this important visual, children can justify their answer, an essential skill identified in the Mathematical Practice Standards.

Lily's story was first told to my 2nd and 3rd graders as they learned to get to the next ten and round to the nearest ten or hundred. It became relevant again in grade 4 when the same students began rounding with larger numbers like 10,000

and 100,000 and it continued to live on in grade 5, as standards dictated that they round to the nearest tenth or hundredth. It was only after the story was published that I introduced Lily and Grandma's adventures to kindergarten and 1st grade students who immediately connected to Lily based on the prerequisite skills that were part of their curriculum. These younger students followed the "house number" number line that runs throughout the book and began to recognize the rote and sequential counting skills that were part of Lily's travels. What I found even more interesting was their natural instinct to figure out how many more houses Lily had to pass before getting to her final destination, Grandma's house. The story provided a great entry into solving a missing piece problem and targeting the next ten.

Students at every level connect with Lily's adventure because it's real, it's believable, and it's within their scope of understanding. This familiarity creates a safe place to build knowledge. They are disappointed when Lily has to return home, and cheer when she ultimately arrives at Grandma's house.

When working with students who are struggling with the concept of rounding, I often ask children to walk with me along the teacher-made number line that I draw on the white board that extends across the front of my classroom with drawings of a simplistic house at either end. By doing this children can physically experience rounding on a number line using Lily's experience and a variety of numbers appropriate to their age as their base for understanding. The house numbers may change to reflect grade level standards but the structure (number line), the imagery of that block, the location of the endpoints and midpoint remains constant.

To further support this concept, Math MileMarkers created an accompanying placemat activity that allows for additional practice with this skill. This activity is available on the website, www.mathmilemarkers.com.

As you can see, the "Math Talk" and learning opportunities that evolve from *On My Way to Grandma's House* are powerful. Lily's story becomes universal and can resurface year after year, providing a common structure that highlights and addresses basic numeracy skills, supports the progression of number knowledge written within the standards, and establishes the importance of endpoints and midpoints. More importantly, it allows students to visualize the number line in a way that helps them to gain perspective on the relationship that all numbers have to one another on the number line.

Math MileMarkers®:
Structures for Learning

The section that follows provides teachers and parents with an easy-to-read outline that highlights the most important aspects of the learning standards addressed within the story. The Math MileMarkers charts break things down into three components: the actual *Learning Standards*, which present the Common Core Learning Standard addressed and the related standard and grade level; *True Meanings*, which offers readers an inside look into what the standard is really about, what students should know and be able to do, and various structures that can be used to help them find meaning; and *Math MileMarkers*, which offers sample questions and age-appropriate tasks related to each of the standards addressed. In other words, how might the students encounter this content in a class or testing situation?
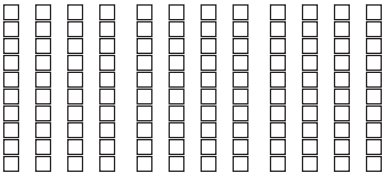
The Common Core Learning standards have raised the bar in terms of what students are expected to be able to know and do at each grade level. The good news is that in doing so, the writers of Common Core have provided much needed clarity and greater definition of the curriculum for teachers and students. And, they have established a clear, progressive path that allows learners to move backwards to specific prerequisite skills when needed, and forward when enrichment opportunities are appropriate.

Please join the Math MileMarkers Professional Learning Community by registering with us at www.mathmilemarkers.com. As a member you will receive periodic updates regarding new products, resources and services that will help *Calm, Command, and Conquer the Curriculum!*

Common Core Learning Standards
Pre-requisite Skill

1.NBT.1

Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral.
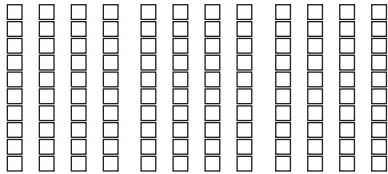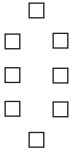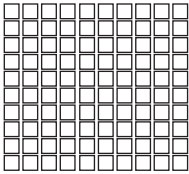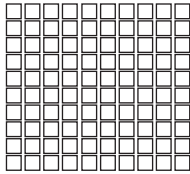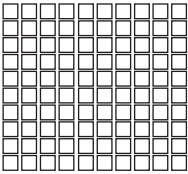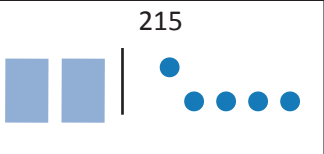
True Meanings	Math MileMarkers®

Grade 1
Number and Base
Standard #1

In first grade students will become more proficient at rote counting.

According to CCLS standards they should be able to begin at any given number and count forward to 120.

First graders work to solidify their understanding of number names and work to make sense of numerical order. Through number play, they gain a greater understanding of the numbers on the number line, the quantity each represents and can visualize that each number represents one more than the number before it on the number line.

This may initially require concrete materials as students gain in-depth understanding of numbers.

1. Fill in the missing numbers.

	91				95				
		102						108	
			114			117			

2. Number Line March

Start at the first number on each line and count up.

43, ___, ____, ____, ____, ____, ____, ____, ____,

Start at:

109, ___, ____, ____, ____, ____, ____, ____, ____,

3. Color the Base Ten Blocks that you would use to make the number 54 green.

Common Core Learning Standards
Pre-requisite Skill

2.NBT.1

Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; for example, 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases: See 2.NBT.1a & b.

True Meanings	Math MileMarkers®

True Meanings

Grade 2
Number and Base Ten
Standard #1

Students in grade 2 will understand that each digit in a three-digit number represents a specific number of hundreds, tens and ones.

Students will also be able to represent numbers in multiple ways. For example they will see 215 as being equivalent to 2 hundreds, 1 ten, 5 ones.

More importantly they will learn that 215 has the same value when represented as 1 hundred, 11 tens and 5 ones.

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Build That Number

1. Using base ten blocks, models or drawings, to build the number_____ two different ways.

215	215
426	426
506	506

2. Look at the base ten blocks below. What number is represented by these base ten blocks? _____

Complete the chart telling how many hundreds, tens and ones are represented in this number.

_____ hundreds   _____ tens   _____ ones

3. Write the number that has 6 tens, 1 hundred and 8 ones in standard form.

_____

Common Core Learning Standards
Pre-requisite Skill

3.NBT.1
Use place value understanding to round whole numbers to the nearest 10 or 100.

True Meanings	Math MileMarkers®
Grade 3 **Number and Base Ten** **Standard #1** According to standard 3.NBT.1, students are expected to display in-depth understanding of number sense and place value when rounding numbers to the nearest 10 or 100. This can only be achieved when students are given multiple opportunities to round numbers using tools such as the number line, or hundreds chart to support and justify their answer. Memorized procedures and rounding rhymes will not provide the in-depth understanding, math vocabulary or justifications necessary to support true understanding.	1. The carnival committee was trying to increase attendance at this year's fall festival. They mailed 126 coupons to students in the elementary school and 293 coupons to students in the middle school. Estimate to the nearest hundred how many students will attend the fall festival if all the coupons are used.

2. Several new movies were released at the JTB Cinema in December. The chart below outlines how many children and adults purchased tickets during the busiest weekend of the holiday season.

Day	Childrens Tickets	Adult Tickets
Thursday	657	546
Friday	882	832
Saturday	893	871
Sunday	901	849

On what day was the number of children tickets purchased about the same as the number of adult tickets purchased?

3. Place the number 1372 on the following number line.

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<------------------------------------------------->
1000                                          2000
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Common Core Learning Standards
Pre-requisite Skill

4.NBT.3

Use place value understanding to round multi-digit whole numbers to any place

True Meanings	Math MileMarkers®
Grade 4 **Number and Base Ten** **Standard #3** As in grade three, place value understanding and knowledge of the number system is at the forefront of this standard which involves rounding of larger whole numbers. The use of the number line, identification of end points and mid points all provide visual models that support a child's understanding of this concept. Keep in mind; children in grade 4 have limited opportunities to play on the number line and experience counting activities in the ten thousand or other large numbers. Rounding numbers allows children to explore, running up and down the number line in places that they may have never been before.	1. Mr. Casey told his class that today's mystery number could be rounded to 2,300. Give three examples of what the mystery number could be. Explain using words, drawings or models why these numbers could accurately be rounded to 2,300. 2. Justin's new car was accurately rounded to 4,000 pounds. What is the smallest weight possible for the car to weigh if it was rounded to 4,000? 3. The Fox family drove 4,798 miles during their summer road trip. The Lopez family drove 2,978 during their summer road trip. What is the best estimate of how many more miles the Fox family drove than the Lopez family? 4. The Pilot Convention Center held three concerts last weekend. The following chart contains the number of people who purchased tickets at each of the three shows.

Concert	Number of tickets sold
Friday	34,198
Saturday	29,772
Sunday	54,012

To the nearest thousand, how many total people purchased tickets for the three shows?

Common Core Learning Standards
Pre-requisite Skill

5.NBT.4
Use place value understanding to round decimals to any place.

True Meanings	Math MileMarkers®
Grade 5 Number and Base Ten Standard #4 In grade 5 students are expected to be able to display an in-depth understanding of the concept of rounding decimal numbers to the nearest thousandth. Being able to identify endpoints and midpoint on a number line as they relate to the given number can ensure that students have the number sense necessary to justify their answer. The number line is an important visual model for students to work with. The second question shows how standard 5.NBT.4 is often intertwined and used to assess multiple standards.	1. Name three numbers that when rounded to the nearest hundredth place will round to 6.23. _____, _____, _____ Using the number line below, show the placement of these numbers as proof that they would in fact round to 6.23. ⟵─────────────────────⟶ Explain in writing why you answered as you did. Use appropriate math vocabulary to justify your answer. _____ _____ 2. Sean's baseball team traveled to towns throughout the northeast. Last week they had three away games. The following chart contains the total miles traveled from his home field to the away games and back. Rounded to the nearest tenth of a mile, how many miles did Sean's team travel last week?

Game Day	Total Miles Traveled
Monday	35.27 miles
Wednesday	26.123 miles
Saturday	72.96 miles

3. Round 56.43 to the nearest tenth. _____

Notes

1. D. Frye, A.J. Baroody, M. Burchinal, S.M. Carver, N.C. Jordan, & J. McDowell, (2013). *Teaching Math to Young Children: A Practice Guide* (NCEE 2014-4005). Washington, DC: National Center for Education Evaluation and Regional Assistance (NCEE), Institute of Education Sciences, US Department of Education. Retrieved from the NCEE website: http://whatworks.ed.gov.

2. For an overview of Hans Freudenthal's work, see Catherine Twomey Fosnot and Colleagues from Mathematics In The City and the Freudenthal Institute, Contexts for Learning Mathematics, http://www.contextsforlearning.com/series Overview.asp

3. Common Core State Standards for Mathematics. Washington, D.C.: National Governors Association Center for Best Practices (NGA Center), 2010. Accessed at http://www.corestandards.org/Math/.

Additional Resources

Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools. http://ies.ed.gov/ncee/wwc/pdf/practice_guides/rti_math_pg_042109.pdf.

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Educational Research Letters and Newsletters. http://www.ernweb.com/educational-research-articles/8-recommendations-for-doing-math-rti-from-expert-panel/.

"EngageNY." New York State Education Department. www.engageny.org; especially: file:///C:/Users/Owner/Downloads/a-story-of-units-a-curriculum-over view-and-map-for-grades-p-5%20(1).pdf.

First Grade Mathematics: Unpacked Content. North Carolina Department of Public Instruction. Instructional Support Tools for Achieving New Standards. Accessed at http://www.ncpublicschools.org/docs/acre/standards/common-core-tools/unpacking/math/1st.pdf

Howard County Public School System: PARCC Resources. https://grade4commoncore-math.wikispaces.hcpss.org/PARCC+Resources.

Illustrative Mathematics. https://www.illustrativemathematics.org/.

Institute of Education Sciences. What Works Clearinghouse. http://ies.ed.gov /ncee/wwc/

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Kilpatrick, Jeremy, Jane Swafford, and Bradford Findell. Adding It Up: Helping Children Learn Mathematics. Washington, DC: National Academy, 2001.

Kindergarten Common Core Math [a wikispace]. https://gradekcommoncoremath.wiki spaces.hcpss.org/K.NBT.1

Math Worksheets Land: Math Worksheets for All Ages. http://www.mathworksheets land.com/k/cardinal/.

"Mathematics Standards." Home. Common Core State Standards Initiative, n.d. http://www.p12.nysed.gov/ciai/common_core_standards/pdfdocs/nysp12cclsmath.pdf.

New York State Learning Standards for Mathematics. Accessed at http://www.p12.nysed.gov/ciai/common_core_standards/pdfdocs/nysp12cclsmath.pdf.

Strong, Elizabeth, Janes, Rita. Numbers and Stories: Using children's literature to teach young children number sense (April 2014).

Quinn, Pat. Ultimate RTI: Expanded 2nd Edition Paperback. Ideas Unlimited Seminars, 2010.

Richardson, Kathy. How Children Learn Number Concepts: A Guide to the Critical Learning Phases. Bellingham, WA: Math Perspectives, 2012. Print.

Van den Heuvel-Panhuizen, Marja. Freudenthal's Work Continues. Accessed at http://www.icme12.org/upload/submission/2048_f.pdf.

The Author

Lynda Brennan has been in the educational arena for over twenty-three years. After many years as an elementary classroom teacher, she now serves as a math specialist in a K-5, title I, New York State public school. In addition to curriculum and assessment responsibilities; she works closely with teachers providing ongoing professional development, and with students working to build strong foundational skills and in-depth understanding of common core and state standards.

Lynda Brennan is an educational speaker and the creator of the Math Mile-Markers® game and book series. She has been featured at national teacher conferences and her message on how to *Calm, Command and Conquer the Curriculum*® has been well received. With degrees in both Marketing and Education, she has found a way to join her experiences and bring her love of learning to life for children and the adults who support them.

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