Teacher Training on the Revised Math Standards

Grades 9-12

TN Department of **Education**

Welcome & Introductions

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Agenda: Day 1

Time	Content
8–11:15 (includes break)	Part 1: The Standards • M1: Standards Review Process • M2: TN Academic Standards • M3: Summary of Revisions
11:15–12:30	Lunch (on your own)
12:30–4 (includes break)	Part 2: Diving into the Standards • M4: Know-Do-Understand Part 3: Instructional Shifts • M5: Revisiting SMP's and Instructional Shifts • M6: Literacy Skills for Mathematical Proficiency

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Agenda: Day 2

Time	Content
8–11:15 (includes break)	Part 4: Assessment • M7: Connecting Standards and Assessment
11:15–12:30	Lunch (on your own)
12:30–4 (includes break)	• M8: Evaluating Instructional Materials Part 5: Putting it All Together • M9: Instructional Planning

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Today's Goals

- Review the standards revision process

- Highlight changes/revisions to standards

- Use a KUD exercise to deepen our understanding of the expectations of the standards

- Discuss the instructional shifts and their relationship to the Standards for Mathematical Practice (SMPs)

- Explore the Literacy Skills for Mathematical Proficiency

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Norms

- Keep students at the center.

- Be present and engaged.

- Be reflective and solutions oriented.

- Challenge ideas with respect.

- Monitor airtime.

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Introductions

- Make a name tent
  - Top left corner: # of ★ = how many years you have taught

  - Top right corner: where you're from

  - Bottom left corner: your favorite hobby

  - Bottom right corner: the name of a student who inspires you to learn and improve

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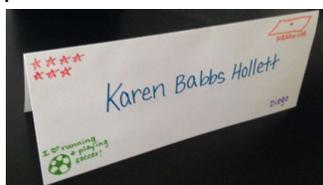
Appointments with Peers

- Create an appointment with four fellow participants by having them sign your manual.

- Participant partners will meet together during the training to discuss content.
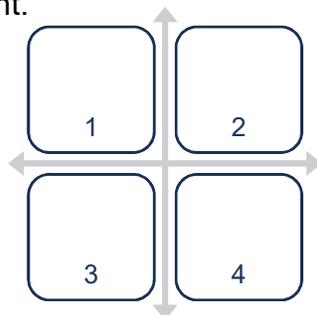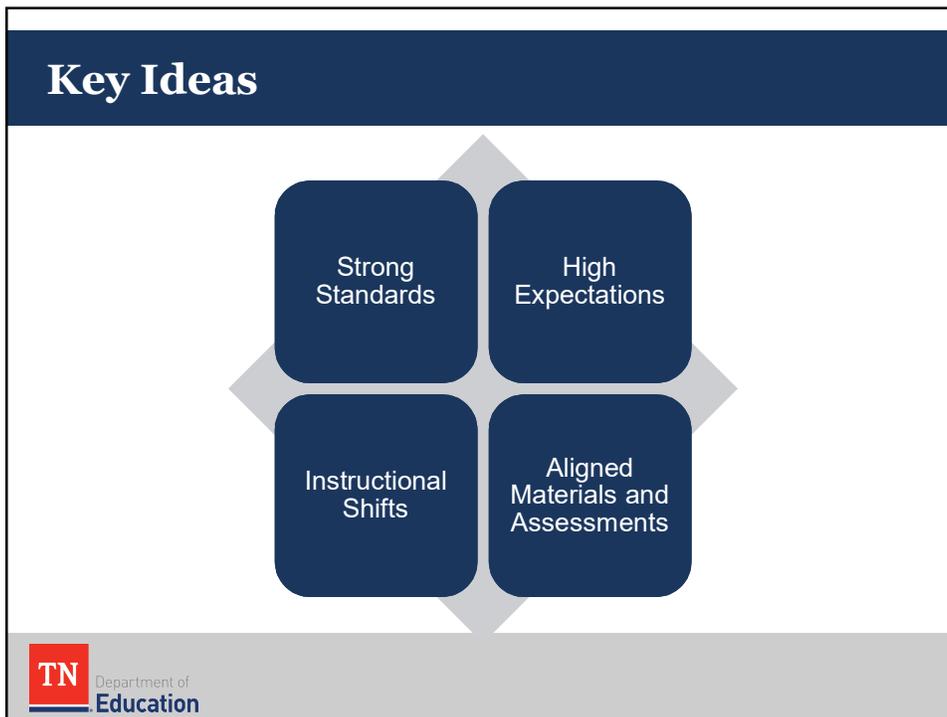
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Key Ideas

Strong Standards	High Expectations
Instructional Shifts	Aligned Materials and Assessments

Key Ideas

Strong Standards

Standards are the bricks that should be masterfully laid through quality instruction to ensure that all students reach the expectation of the standards.

High Expectations

We have a continued goal to prepare students to be college and career ready.

6/19/2017

Key Ideas

Instructional Shifts

The instructional shifts are an essential component of the standards and provide guidance for how the standards should be taught and implemented.

Aligned Materials and Assessments

Educators play a key role in ensuring that our standards, classroom instructional materials and assessments are aligned.

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Part 1: The Standards

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Key Ideas

Strong Standards	High Expectations
Instructional Shifts	Aligned Materials and Assessments

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Module 1: Standards Review Process

Standards Review Process

Public Comment Period – November 2014

Educator Advisory Teams Review – April 2015

Standards Review and Development Committee – Fall 2015

Revised Standards Released for Public Comment – October 2015

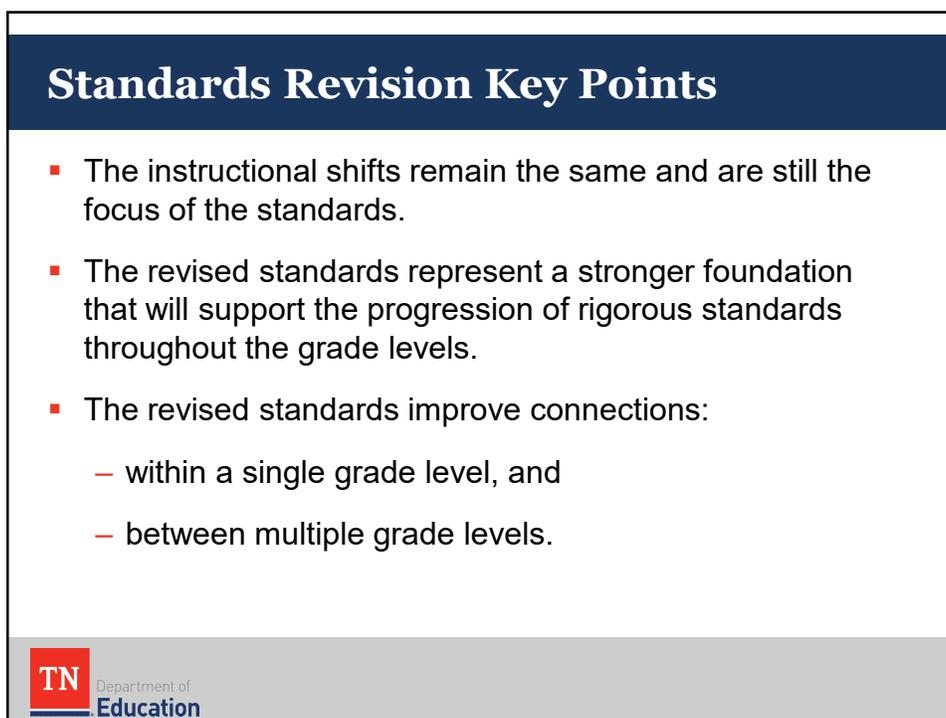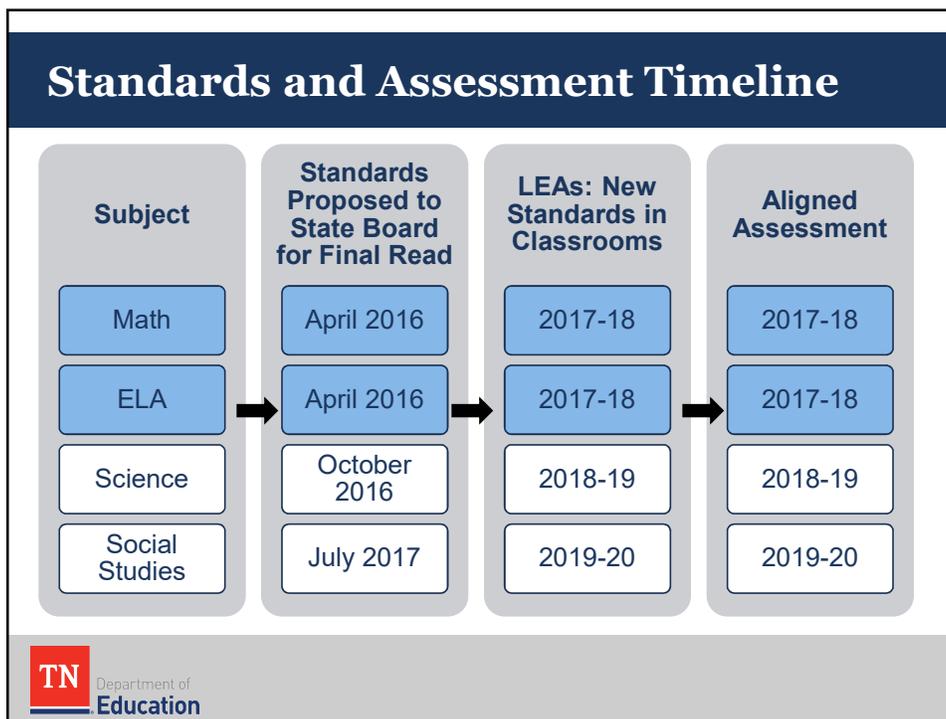Standards Recommendation Committee – January 2016

State Board of Education Approval – April 2016

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Educator Advisory Team Members

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Standards and Assessment Timeline

Subject	Standards Proposed to State Board for Final Read	LEAs: New Standards in Classrooms	Aligned Assessment
Math	April 2016	2017-18	2017-18
ELA	April 2016	2017-18	2017-18
Science	October 2016	2018-19	2018-19
Social Studies	July 2017	2019-20	2019-20

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Standards Revision Key Points

- The instructional shifts remain the same and are still the focus of the standards.

- The revised standards represent a stronger foundation that will support the progression of rigorous standards throughout the grade levels.

- The revised standards improve connections:

  – within a single grade level, and

  – between multiple grade levels.

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Module 2: Tennessee Academic Standards for Mathematics

TN

Goals

- Reinforce the continued expectations of the Tennessee Math Academic Standards.

- Revisit the three instructional expectations and their continued *and* connected role in the current standards.

- Review the overarching changes to the current Tennessee Math Academic Standards.

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Setting the Stage

- Read and annotate the General Introduction to the TN Math Standards (page 1–2).

- After reading and annotating the two parts, write the sentence or phrase you felt was the most important in your participant manual on page.

- Be prepared to share with your colleagues.

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What Has <u>NOT</u> Changed

Overview of Similarities

- Students **prepared** for college and career

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Overview of Similarities

- Students **prepared** for college and career

- K–12 **learning progressions**

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The Learning Progressions

K	1	2	3	4	5	6	7	8	HS
Counting & Cardinality									

Number and Operations in Base Ten — Ratios and Proportional Relationships — Number & Quantity

Number and Operations – Fractions — The Number System

Expressions and Equations — Algebra

Operations and Algebraic Thinking

Functions — Functions

Geometry — Geometry

Measurement and Data — Statistics and Probability — Statistics & Probability

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Overview of Similarities

- Students **prepared** for college and career

- K–12 **Learning Progressions**

- Traditional and integrated **pathways** (for high school)

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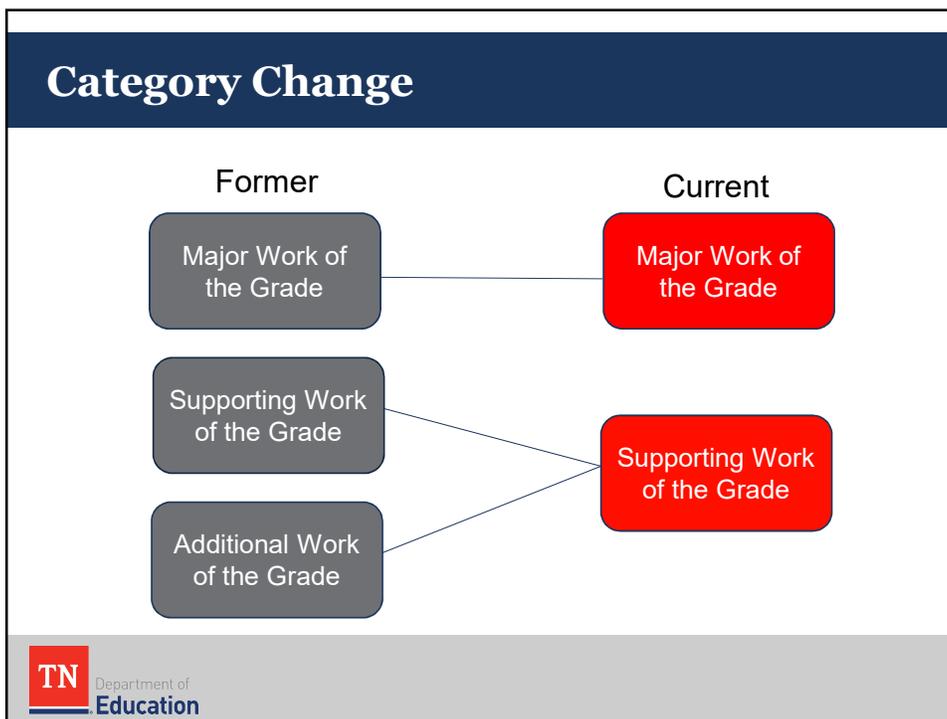
Overview of Similarities

- Students **prepared** for college and career

- K–12 **Learning Progressions**

- Traditional and Integrated **pathways**

- Standards for **Mathematical Practice**

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Standards for Mathematical Practice

Standards for Mathematical Practice

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.

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Overview of Similarities

- Students **prepared** for college and career

- K–12 **Learning Progressions**

- Traditional and Integrated **pathway**

- Standards for **Mathematical Practices**

- **Instructional shifts**

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Instructional Shifts

- **Focus**
  - The standards are focused on fewer topics so that students can dig deeper within the mathematics.
- **Coherence**
  - Topics within a grade are connected to support focus. Additionally, standards are linked across grades to ensure vertical coherence.
- **Rigor**
  - The standards set expectations for a balanced approach to pursuing conceptual understanding, procedural fluency, application, and modeling.

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What <u>Has</u> Changed

Overarching Revisions K–12

K–12

- Revised structure
- Literacy Skills for Mathematical Proficiency

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Category Change

Former

Current

Major Work of the Grade

Major Work of the Grade

Supporting Work of the Grade

Supporting Work of the Grade

Additional Work of the Grade

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Revised Structure

Operations and Algebraic Thinking (OA)

Domain	Cluster	Cluster Headings	Content Standards
Operations and Algebraic Thinking	Use the four operations with whole numbers to solve problems.	A. Use the four operations with whole numbers to solve problems. (See Table 1 - Addition and Subtraction Situations and Table 2 - Multiplication and Division Situations)	**4.OA.A.1** Interpret a multiplication equation as a comparison (e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5). Represent verbal statements of multiplicative comparisons as multiplication equations.
	Gain familiarity with factors and multiples.		**4.OA.A.2** Multiply or divide to solve contextual problems involving multiplicative comparison, and distinguish multiplicative comparison from additive comparison. For example, school A has 300 students and school B has 600 students: to say that school B has two times as many students is an example of multiplicative comparison; to say that school B has 300 more students is an example of additive comparison.
	Generate and analyze patterns.		**4.OA.A.3** Solve multi-step contextual problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
		B. Gain familiarity with factors and multiples.	**4.OA.B.4** Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite.
		C. Generate and analyze patterns.	**4.OA.C.5** Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.

Major Content   Supporting Content

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High School: Scope & Clarification

Cluster Headings	Content Standards	Scope & Clarifications
B. Solve equations and inequalities in one variable.	**A1.A.REI.B.3** Solve quadratic equations and inequalities in one variable. a. Use the method of completing the square to rewrite any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, knowing and applying the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions	*For A1.A.REI.B.3b:* *Tasks do not require students to write solutions for quadratic equations that have roots with nonzero imaginary parts. However, tasks can require the student to recognize cases in which a quadratic equation has no real solutions.* *Note: solving a quadratic equation by factoring relies on the connection between zeros and factors of polynomials. This is formally assessed in Algebra II.*
C. Solve systems of equations.	**A1.A.REI.C.4** Write and solve a system of linear equations in context.	*Solve systems both algebraically and graphically.* *Systems are limited to at most two equations in two variables.*

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Nomenclature and Coding
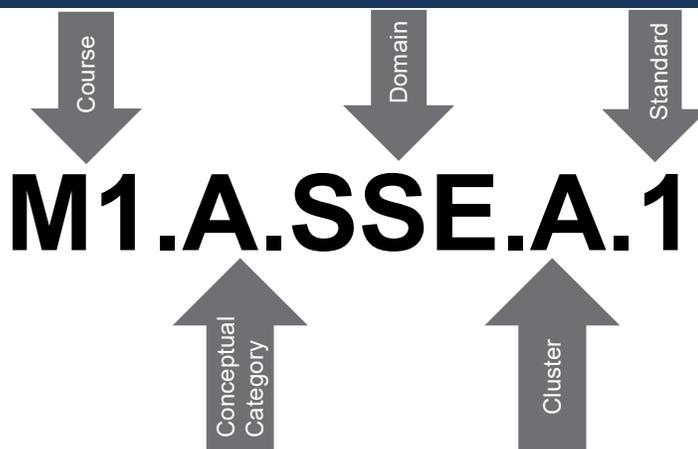
Course → Domain → Standard

M1.A.SSE.A.1

Conceptual Category ↑   Cluster ↑

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Literacy Skills for Mathematical Proficiency

Communication in mathematics requires literacy skills in reading, vocabulary, speaking, listening, and writing.

Literacy Skills for Mathematical Proficiency

1. Use multiple reading strategies.
2. Understand and use correct mathematical vocabulary.
3. Discuss and articulate mathematical ideas.
4. Write mathematical arguments.

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Module 2 Review

- Reinforce the continued expectations of the Tennessee Math Standards.

- Revisit the three instructional shifts and their continued *and* connected role in the revised standards.

- Review the overarching changes to the revised Tennessee Math Standards.

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10-Minute Break

Module 3: Summary of Revisions by Grade Band

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Goal

- Review a summary of the revisions to the math standards by grade band.

- Emphasize changes in courses beyond Algebra II or Integrate Math III

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Turn & Talk

"To assess student achievement accurately, teachers and administrators must know and understand the content standards that their students are to master. Again, we cannot teach or assess achievement that we have not defined."

—S. Chappuis, Stiggins, Arter & J. Chappuis (2006)

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Revisions to Math Standards

Specific to K–5

- Refined for clarity
- Increased fluency expectations
- Revised examples

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K–5: Overarching Revisions

- **Supporting and additional work of the grade is combined as supporting work of the grade**

- Increased fluency expectations

- Added/shifted a small number of standards to strengthen coherence across grade levels

- Revised language to provide clarity and continuity

- Highlighted chart for grade-level mastery expectations for addition, subtraction, multiplication, and division

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K–5: Overarching Revisions

- Supporting and additional work of the grade is combined as supporting work of the grade

- **Increased fluency expectations**

- Added/shifted a small number of standards to strengthen coherence across grade levels

- Revised language to provide clarity and continuity

- Highlighted chart for grade-level mastery expectations for addition, subtraction, multiplication, and division

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Sample Revision: K–2

	Increased Fluency Expectations	
	Former Standard	Current Standard
Kindergarten	K. OA.5 Fluently add and subtract within 5.	K.OA.A.5 Fluently add and subtract within 10 using mental strategies.
First Grade	1.OA.6. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10.	1.OA.C.6 Fluently add and subtract within 20 using mental strategies. By the end of Grade 1, know from memory all sums up to 10.
Second Grade	2.OA.2 Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.	2.OA.B.2 Fluently add and subtract within 30 using mental strategies. By the end of Grade 2, know from memory all sums of two one-digit numbers and related subtraction facts.

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K–5: Overarching Revisions

- Supporting and additional work of the grade is combined as supporting work of the grade

- Increased fluency expectations

- **Added/shifted a small number of standards to strengthen coherence across grade levels**

- Revised language to provide clarity and continuity

- Highlighted chart for grade-level mastery expectations for addition, subtraction, multiplication, and division

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Sample Revision: K–2

	Former Standard	Current Standard
Kindergarten	No Past Standard	K.MD.B.3 Identify the penny, nickel, dime, and quarter and recognize the value of each.
First Grade	No Past Standard	1.MD.B.4 Count the value of a set of like coins less than one dollar using the ¢ symbol only.
Second Grade	2.MD.8 Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately.	2.MD.C.8 Solve contextual problems involving dollar bills, quarters, dimes, nickels, and pennies using ¢ and $ symbols appropriately.

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Sample Revision: 3–5

	Former Standard	Current Standard
Fourth Grade	4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, <u>express measurements in a larger unit in terms of a smaller unit.</u> Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36),…	4.MD.A.1 Measure and estimate to determine relative sizes of measurement units within a single system of measurement involving length, liquid volume, and mass/weight of objects using customary and metric units.
Fifth Grade	5.MD.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.	5.MD.A.1 Convert customary and metric measurement units within a single system by <u>expressing measurements of a larger unit in terms of a smaller unit.</u> Use these conversions to solve multi-step real world problems involving distances, intervals of time, liquid volumes, masses of objects, and money (including problems involving simple fractions or decimals). For example, 3.6 liters and 4.1 liters can be combined as 7.7 liters or 7700 milliliters.

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K–5: Overarching Revisions

- Supporting and additional work of the grade is combined as supporting work of the grade

- Increased fluency expectations

- Added/shifted a small number of standards to strengthen coherence across grade levels

- **Revised language to provide clarity and continuity**

- Highlighted chart for grade-level mastery expectations for addition, subtraction, multiplication, and division

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Sample Revision: K–2

Former Standard

2.NBT.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.

Current Standard

2.NBT.A.3 Read and write numbers to 1000 using **standard form**, **word form**, and expanded form.

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Sample Revision: 3–5

Former Standard

4.NBT.A.3 Use place value understanding to round multi-digit whole numbers to any place.

Current Standard

4.NBT.A.3 Round multi-digit whole numbers to any place **(up to and including the hundred-thousand place)** using understanding of place value.

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K–5: Overarching Revisions

- Supporting and additional work of the grade is combined as supporting work of the grade

- Increased fluency expectations

- Added/shifted a small number of standards to strengthen coherence across grade levels

- Revised language to provide clarity and continuity

- **Highlighted chart for grade-level mastery expectations for addition, subtraction, multiplication, and division**

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Addition and Subtraction Chart

Table 1 Common addition and subtraction situations

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? $2 + 3 = ?$ (K)	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? $2 + ? = 5$ (1st)	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? $? + 3 = 5$ (2nd) One-Step Problem
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? $5 - 2 = ?$ (K)	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? $5 - ? = 3$ (1st)	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? $? - 2 = 3$ (2nd) One-Step Problem

	Total Unknown	Addend Unknown	Both Addends Unknown²
Put Together/ Take Apart³	Three red apples and two green apples are on the table. How many apples are on the table? $3 + 2 = ?$ (K)	Five apples are on the table. Three are red and the rest are green. How many apples are green? $3 + ? = 5, 5 - 3 = ?$ (K)	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? $5 = 0 + 5, 5 = 5 + 0$ $5 = 1 + 4, 5 = 4 + 1$ $5 = 2 + 3, 5 = 3 + 2$ (1st)

	Difference Unknown	Bigger Unknown	Smaller Unknown
Compare⁴	("How many more?" version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? (1st)	(Version with "more"): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (1st) One-Step Problem	(Version with "more"): Julie has 3 more apples than Lucy. Julie has five apples. How many apples does Lucy have? $5 - 3 = ?$ $? + 3 = 5$ (2nd) One-Step Problem
	("How many fewer?" version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? $2 + ? = 5, 5 - 2 = ?$ (1st)	(Version with "fewer"): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? $2 + 3 = ?, 3 + 2 = ?$ (2nd) One-Step Problem	(Version with "fewer"): Lucy has three fewer apples than Julie. Julie has five apples. How many apples does Lucy have? (1st) One-Step Problem

K: Problem types to be mastered by the end of the Kindergarten year.
1st: Problem types to be mastered by the end of the First Grade year, including problem types from the previous year. However, First Grade students should have experiences with all 12 problem types.
2nd: Problem types to be mastered by the end of the Second Grade year, including problem types from the previous years.

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Multiplication and Division Chart

Table 2 Common multiplication and division situations[1]

	Unknown Product	Group Size Unknown ("How many in each group?" Division)	Number of Groups Unknown ("How many groups?" Division)
	$3 \times 6 = ?$	$3 \times ? = 18$, and $18 \div 3 = ?$	$? \times 6 = 18$, and $18 \div 6 = ?$
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example.* You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example.* You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example.* You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays,[2] Area[3]	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example.* What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example.* A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? *Area example.* A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example.* A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example.* A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example.* A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	$a \times b = ?$	$a \times ? = p$, and $p \div a = ?$	$? \times b = p$, and $p \div b = ?$

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Revisions to Math Standards

Specific to 6–8

- Refined major work of the grade
- Revised supporting work of the grade, especially in statistics and probability

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Grades 6−8: Overarching Revisions

- **Slight revisions made to geometry in grade 8**
- Supporting and additional work of the grade is combined as supporting work of the grade
- Revised language to provide clarity and continuity
- Revised a small number of standards to strengthen coherence by condensing, expanding, and removing standards
- Revised a small number of statistics and probability standards

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Grades 6−8: Overarching Revisions

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Grades 6−8: Sample Revision

Former Standard

6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

Current Standard

6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center **(mean, median, mode)**, spread **(range)**, and overall shape.

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Grades 6−8: Overarching Revisions

- Slight revisions made to geometry in grade 8
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- **Revised a small number of standards to strengthen coherence by condensing, expanding, and removing standards**
- Revised a small number of statistics and probability standards

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Grades 6−8: Sample Revision

Former Standard

6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another. *For example, Susan is putting money in her savings account by depositing a set amount each week (50). Represent her savings account balance with respect to the number of weekly deposits (*s = 50w*, illustrating the relationship between balance amount* s *and number of weeks* w*).* Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

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Grades 6−8: Sample Revision

Current Standard

6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another. *For example, Susan is putting money in her savings account by depositing a set amount each week (50). Represent her savings account balance with respect to the number of weekly deposits (*s = 50w*, illustrating the relationship between balance amount* s *and number of weeks* w*).*

a. Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable.

b. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

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Grades 6−8: Sample Revision

Former Standard

7.G.A.3 Describe the two-dimensional figures that result from slicing three dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids

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Grades 6−8: Overarching Revisions

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- **Revised a small number of statistics and probability standards**

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Grades 6−8: Sample Revision

Former Standard

6.SP.B.5c Summarize numerical data sets in relation to their context, such as by: c. Giving quantitative measures of center (median and/or mean) and variability **(interquartile range and/or mean absolute deviation)**, as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

Current Standard

6.SP.B.5c Summarize numerical data sets in relation to their context, such as by: c. Giving quantitative measures of center (median and/or mean) and variability **(range)**, as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

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Revisions to Math Standards

Specific to 9–12

- Revised scope and clarifications
- Revisions for Algebra II and Integrated III
- Restructured additional Mathematics courses to reflect college and career readiness

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Grades 9–12: Overarching Revisions

- **Supporting and additional work of the grade is combined as supporting work of the grade**
- Removed or shifted a small number of standards to the major work of the grade to streamline vertical progression
- Revised language and examples to provide clarity and continuity
- Shifted a small number of supporting work of the grade standards to the additional mathematics courses
- Restructured additional courses to reflect college and career readiness

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Grades 9–12: Overarching Revisions

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Grades 9–12: Overarching Revisions

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- Restructured additional courses to reflect college and career readiness

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Grades 9–12: Sample Revisions

Former Standard

G.SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Current Standard

G.SRT.C.8 *Know and* use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

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Grades 9–12: Overarching Revisions

- Supporting and additional work of the grade is combined as supporting work of the grade
- Removed or shifted a small number of standards to the major work of the grade to streamline vertical progression
- Revised language and examples to provide clarity and continuity
- **Shifted a small number of supporting work of the grade standards to the additional mathematics courses**
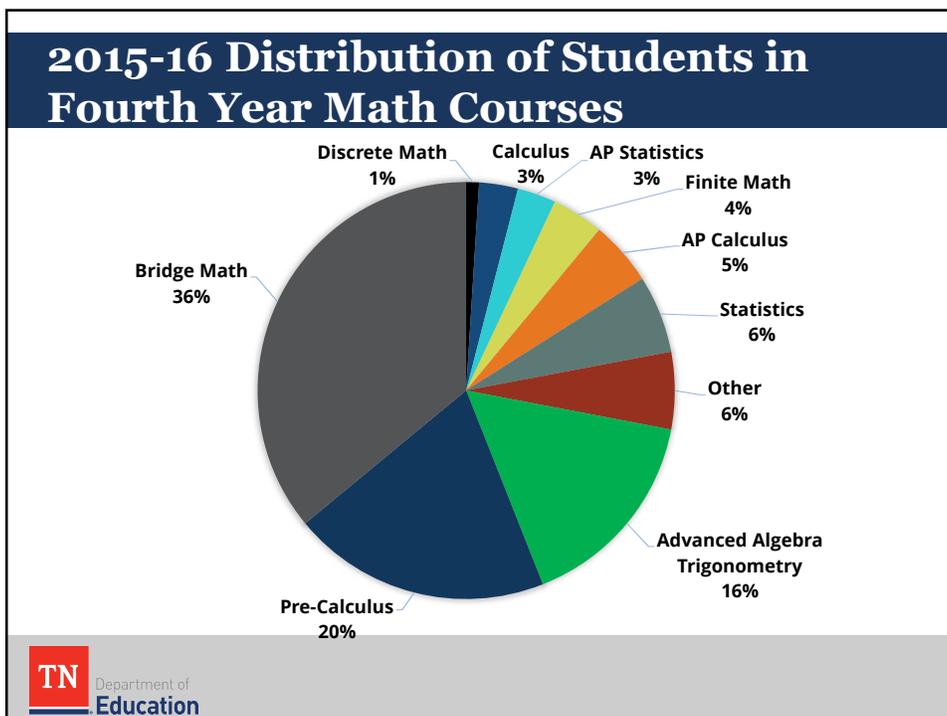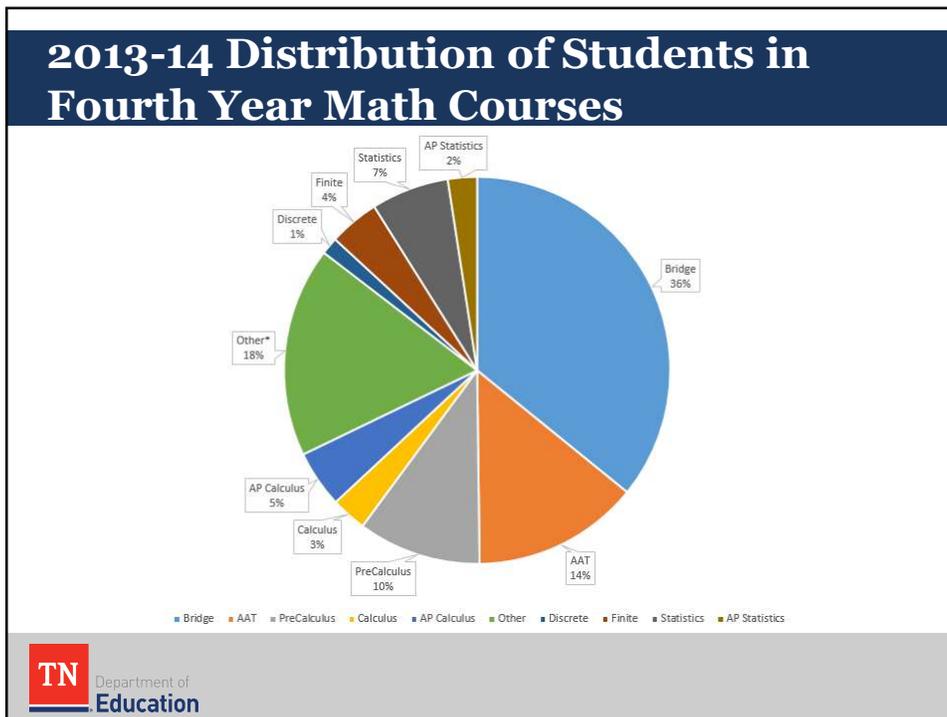- Restructured additional courses to reflect college and career readiness

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Grades 9−12: Sample Revisions

Moved Standard

A2/M3.F.TF.5 to P.F.TF.A.4 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

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Grades 9−12: Overarching Revisions

- Supporting and additional work of the grade is combined as supporting work of the grade

- Removed or shifted a small number of standards to the major work of the grade to streamline vertical progression

- Revised language and examples to provide clarity and continuity

- Shifted a small number of supporting work of the grade standards to the additional mathematics courses

- **Restructured additional courses to reflect college and career readiness**

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2013-14 Distribution of Students in Fourth Year Math Courses

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2015-16 Distribution of Students in Fourth Year Math Courses

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Additional Mathematics Courses Rationale

- **High expectations**

- Retention of **rigorous standards**

- Clearly **defined** and **coherent** pathways

- **Equity** and **opportunity**

- Aligned with **student interest** in postsecondary fields

- Shift to a **discipline- and career-based pathway**

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Additional Mathematics Courses

- **Advanced Algebra and Trigonometry**

- **Discrete Math**

- **Finite Math**

- Bridge Math

- Pre-Calculus

- Statistics

- Calculus

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Additional Mathematics Courses

- **Applied Mathematical Concepts (New Course)**

- Bridge Math

- Pre-Calculus

- Statistics

- Calculus

NEW Applied Mathematical Concepts Course

- For students interested in careers that use applied mathematics such as banking, industry, or human resources

- Rich problem solving experience

- Combines standards from Senior Finite Math and Discrete Mathematics

- Designed with industry needs in mind

- Alignment with first three math courses and ACT college and career readiness

- Possible dual credit exam

Problems in Applied Mathematical Concepts

- Standard AM.G.L.A.3 Solve a variety of logic puzzles.

  What's the easiest way to heat a pan of water for 9 minutes when you have only a 6-minute hour-glass timer and a 21-minute hour-glass timer?

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Problems in Applied Mathematical Concepts

- Standard AM.D.ID.A.2 Use a variety of counting methods to organize information, determine probabilities, and solve problems.

  Given a group of students: G = {Allen, Brenda, Chad, Dorothy, Eric} list and count the different ways of choosing the following officers or representatives for student congress. Assume that no one can hold more than one office.

  A president, a secretary, and a treasurer, if the president must be a woman and the other two must be men.

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Problems in Applied Mathematical Concepts

- Standard AM.N.NQ.B.6 Solve contextual problems involving financial decision-making.

  The cash price of a fitness system is $659.99. The customer paid $115 as a down payment. The remainder will be paid in 36 monthly installments of $19.16 each. Find the amount of the finance charge.

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Standards Comparison Activity

- Compare the 2016-17 standards to the revised standards for your assigned grade or course.

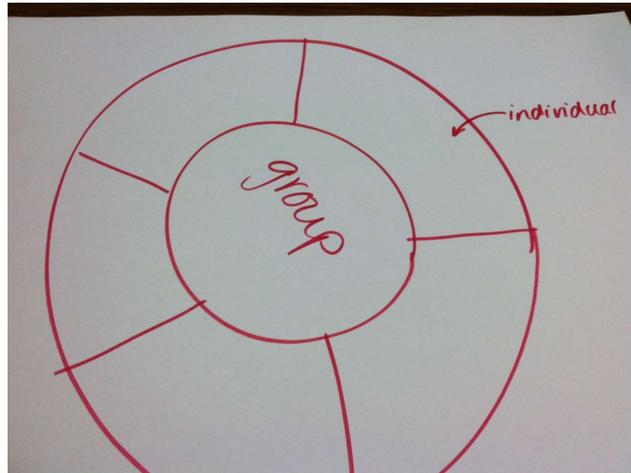- Highlight any changes in the 2017-18 column.

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Standards Comparison Activity

- If a standard is in the 2016-17 document, but not in the 2017-18 document, place a check in the "Dropped from Course" column.
- If a standard was not in the 2016-17 document, but is now in the 2017-18 document, place a check in the "Added to Course" column.
- If a standard was revised in any way (recoded, changes to the standard itself, moving examples from the standard to "Scope and Clarifications," etc.), place a check in the "Revised Or Refined" column.
- If a standard was not revised in any way, place a check in the "No Change" column.

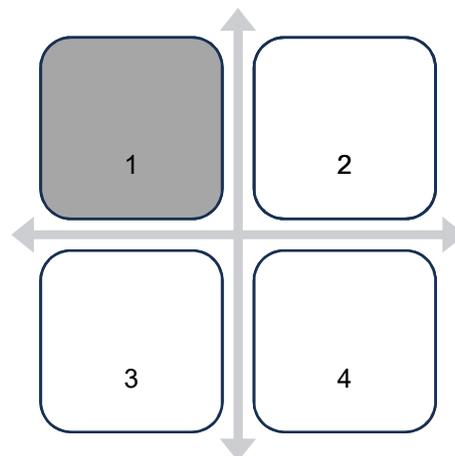**TN** Department of **Education**

Standards Comparison Activity

- If you had to summarize the revisions to these selected standards in twenty words or less, what would you say?

- Write your response to the question in the participant manual.

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Consensus Circle

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Appointments with Peers

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Module 3 Review

- The instructional shifts remain the same and are still the focus of the standards.

- The revised standards represent a stronger foundation that will support the progression of rigorous standards throughout the grade levels.

- The revised standards improve connections:

  - within a single grade level, and

  - between multiple grade levels.

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Part One

Strong Standards

Standards are the bricks that should be masterfully laid through quality instruction to ensure that all students reach the expectation of the standards.

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Lunch Break: 1 hour 15 minutes

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Please Sign In!

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Part 2:
Diving into the Standards

Key Ideas

Strong Standards

High Expectations

Instructional Shifts

Aligned Materials and Assessments

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Module 4:
A Deeper Dive into Grades 6–8 Math Standards

Goals

- Concisely describe a course based on its introduction

- Develop a means for deconstructing standards to determine the mathematical emphasis of the standard—its intent and purpose.

- Use the KUD approach to guide planning, instruction, and assessment.

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Closer Look

Take a few minutes to read the Overview page for your grade level (the outline only) and think about how this relates to the overarching revisions we have just seen.

Algebra I: p. 85   **Integrated Math I: p. 120**

Geometry: p. 97   **Integrated Math II: p. 133**

Algebra II: p. 106   **Integrated Math III: p. 146**

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What would you Tweet?

You have to summarize your course in 140 characters. Write a tweet that will inform others regarding what is included in your course.

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Intent and Purpose

Intent and Purpose

"With my ears to the ground, listening to my students, my eyes are focused on the mathematical horizon."

—Ball (1993)

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Analyzing Standards

A1.F.IF.C.7   (Note Also: A2.F.IF.B.4 and M2.F.IF.B.5)

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

   a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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Highlight Verbs: Expectations of the Student

A1.F.IF.C.7   (Note Also: A2.F.IF.B.4 and M2.F.IF.B.5)

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

   a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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Verbs and Connected Nouns

A1.F.IF.C.7   (Note Also: A2.F.IF.B.4 and M2.F.IF.B.5)

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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Dangers of Isolation: Individual Words

What does "properties" mean in this standard?

A1.F.IF.C.7   (Note Also: A2.F.IF.B.4 and M2.F.IF.B.5)

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

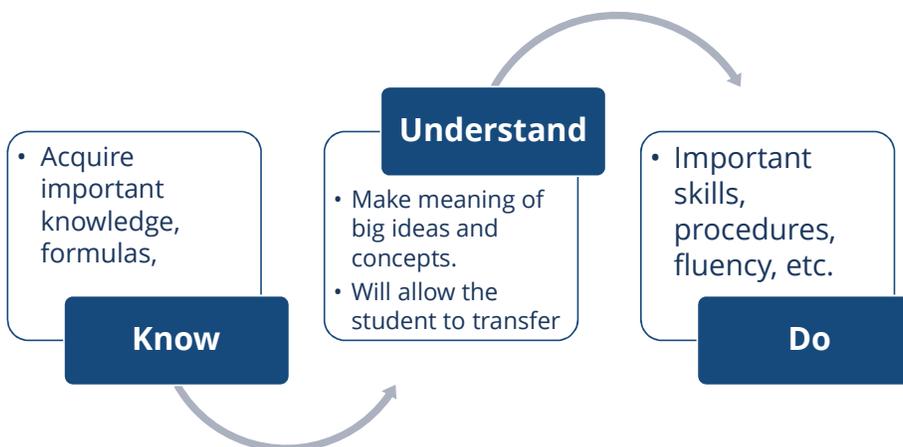a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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Dangers of Isolation: Parts of Standard

- Isolated: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

- Context: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

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From Standard to Instruction: KUD

Know, Understand, and Do

- What is it that the standard wants the student to know, understand, and do?

- KUD – helps to maintain focus in differentiated instruction

  – **Know**: facts, vocabulary, properties, procedures, etc.

  – **Understand**: concepts, ideas, etc

  – **Do**: tasks, approaches, assessment problems, etc.

- The two go together: What is the intent and purpose of the standard and how do I put this into instructional form?

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KUD

Understand

- Make meaning of big ideas and concepts.
- Will allow the student to transfer

- Acquire important knowledge, formulas,

Know

- Important skills, procedures, fluency, etc.

Do

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Summary of the Intent and Purpose of the Standard

- Write a brief description of each part of KUD with respect to this standard.

- What does the math look like? What vocabulary stands out? Any symbolism to be understood or other literacy skills needed?

- Can you now write an I Can statement and/or an Essential Question based on our understanding of the standard and the focus that KUD gives us?

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What does the math look like?

The quadratic $-n^2 + 4n$ (see its graph below) represents the speed of a mouse running through a short maze to get to food.

Ft/sec

Seconds
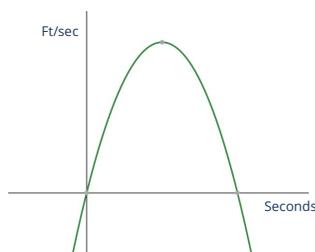
Determine how long it took the mouse to get to the food and at what time was the mouse running its fastest to get there.

Use equivalent forms of the quadratic to determine and show exact answers.

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Do these work?

I CAN
explain the properties of a function by writing it in different equivalent forms.

A1.F.IF.C.7 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

ESSENTIAL QUESTION
How can writing a function in different equivalent forms help us with problems and in understanding the properties of the function?

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Analyzing Your Standard

Grade-level Examples

- Please get into small groups based on the grade level you teach.

- You will be given a standard for your grade level.

Analyzing Your Standard

- First, highlight verbs that speak to what the student will do

- Second, highlight the nouns (noun phrases) connected to the verbs.

- Third, KUD, jot down what the students are to know, understand, and do (brief descriptions will do).

- Fourth, determine what the math will look like and touch on vocabulary and literacy skills needed.

- Now, write an I CAN statement and Essential Question that will be used in determining student mastery.

Your Turn: Grade-level examples

A1.F.IF.C.8 (or M1.F.IF.C.7 – same standard)

G.CO.B.8 (or M1.G.CO.B.8 – same standard)

A2.N.RN.A.1 (or M2.N.RN.A.1 – same standard)

A2.F.TF.A.1 (or M3.F.TF.A.1 – same standard)

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Gallery Walk

Please provide any comments or questions on Post-Its and put them on the chart paper.

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Gallery Walk Debrief

- Small Group Discussion

  – Review the feedback you were given.

  – What are your key takeaways?

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Module 4 Review

- Concisely describe a course based on it's introduction.

- Develop a means for deconstructing standards to determine the mathematical emphasis of the standard – it's intent and purpose.

- Use the KUD approach to guide planning, instruction, and assessment.

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Part Two

High Expectations

We have a continued goal to prepare students to be college and career ready.

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10-Minute Break

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Part 3: Instructional Shifts

Key Ideas

- Strong Standards
- High Expectations
- Instructional Shifts
- Aligned Materials and Assessments

Module 5: Revisiting the Shifts & Standards for Mathematical Practice

Goals

- Revisit the concepts of focus, coherence, and rigor and how they play out in instruction.

- Discuss the purpose and place of the content and practice standards.

- Focus on two areas of mindset: praise and mistakes.

- Share instructional strategies related to the Standards for Mathematical Practice.

- Discuss research on the influence of mindsets in the math classroom.

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Practice Standards
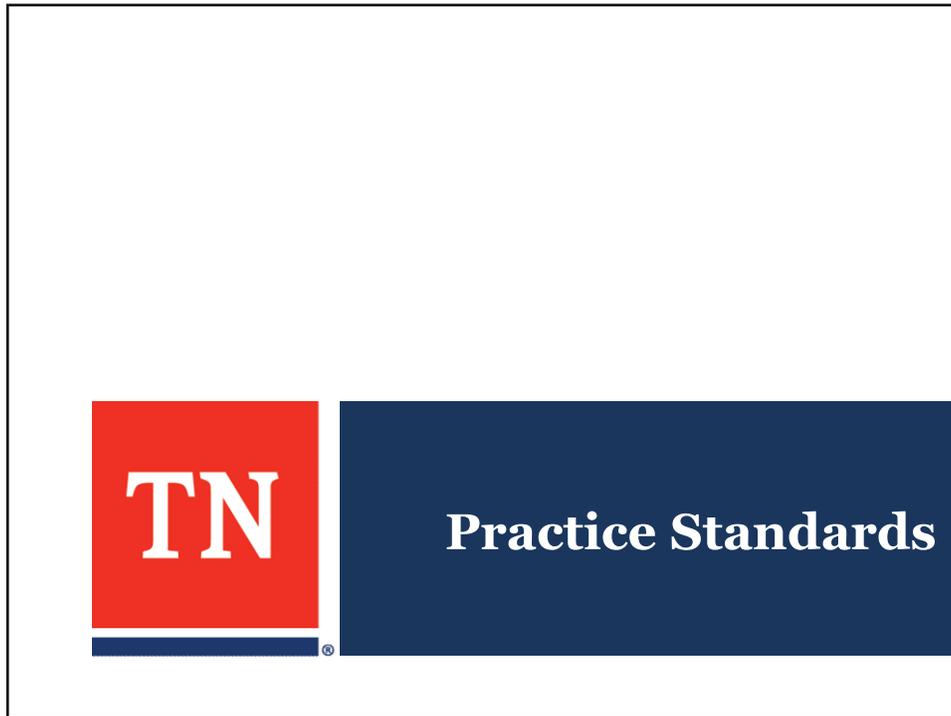
The Standards for Mathematical Practice

- **Why do we have the standards?**

- Tell us what students should know and be able to do

- So, what should students know and do?

  - Content Standards

  - Mathematics Practice Standards

  - Literacy Skills

- **Knowing that these are WHAT students need to learn, teachers determine HOW to teach these.**

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Standards for Mathematical Practice

Standards for Mathematical Practice

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.

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SMPs and Culture

What Are We Asking of Students?

"If there's a threat of being wrong every time I raise my hand, and being wrong is a bad thing, then very quickly I decide math isn't for me, I don't like this, I'm not a smart person."

—Noah Heller, Harvard Graduate
School of Education

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What Are We Asking of Students?

- The SMPs will require students to engage "publicly" in our classrooms and collaboratively work with others.

- What are some of the main issues we face in a math classroom with respect to carrying out the SMPs.

- Can we be successful with this and not take into consideration the culture and mindsets in our classrooms?

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Mindset

- The TN Academic Standards for Mathematics may seem challenging for students whose mindset has been fixed by their past experiences in mathematics classrooms.

- As teachers, we are best positioned to influence students' mathematical mindsets through our actions/practices in the mathematics classroom.

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Fixed Mindset vs. Growth Mindset

- **Fixed mindset**

  Intelligence is a fixed trait. You cannot change it.

- **Growth mindset**

  You can grow your intelligence through effort.

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Study of Praise and Mindsets

TrainUgly.com

Fixed vs. Growth Mindset

Why Address Mindsets?

"If there's a threat of being wrong every time I raise my hand, and being wrong is a bad thing, then very quickly I decide math isn't for me, I don't like this, I'm not a smart person".

—Noah Heller, Harvard Graduate School of Education

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Setting Up Positive Norms in the Math Classroom

Everyone can learn math to the highest levels

Mistakes are valuable

Questions are important

Math is about creativity and making sense

Math is about connections and communicating

Math class is about learning not preforming

Depth is more important than speed

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Instructional Shifts: Focus, Coherence, & Rigor

The Nature of the Standards

- Focus
  - The standards are focused on fewer topics so that students can dig deeper within the mathematics.
- Coherence
  - Topics within a grade are connected to support focus. Additionally, standards are linked across grades to ensure vertical coherence.
- Rigor
  - The standards set expectations for a balanced approach to pursuing conceptual understanding, procedural fluency, and application.

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Instructional Shifts

- **Focus**
  - The standards are focused on fewer topics so that students can dig deeper within the mathematics.
- **Coherence**
  - Topics within a grade are connected to support focus. Additionally, standards are linked across grades to ensure vertical coherence.
- **Rigor**
  - The standards set expectations for a balanced approach to pursuing conceptual understanding, procedural fluency, and application.

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Expectation One: Focus

- In your grade-level groups, discuss ways you could respond if someone asks you the following question, "Why focus? There's so much math that students could be learning. Why limit them?"

- Review the table in the participant manual and answer the question, "Which 2 of the following represent areas of major focus for the indicated grade?"

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Shift One: Focus

6	Understand ratio concepts and use ratio reasoning to solve problems	~~Identify and utilize rules of divisibility~~ Students are not required by the Standards to know the divisibility rules.	Apply and extend previous understandings of arithmetic to algebraic expressions
7	Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers	Use properties of operations to generate equivalent expressions	~~Generate the prime factorization of numbers to solve problems~~ Students are not required by the Standards to generate the prime factorization of a number.
8	~~Standard form of a linear equation~~ Though linear equations are a major focus of 8th grade, students are not required to use a "standard form."	Define, evaluate, and compare functions	Understand and apply the Pythagorean Theorem
Alg.1	~~Zeros of polynomials~~ Supporting Alg 1 - Major Alg 2	Linear and quadratic functions	Creating equations to model situations
Alg.2	Exponential and logarithmic functions	~~Polar coordinates~~ Polar coordinates are not required by the Standards for Alg. 2	Using functions to model situations

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Shift Two: Coherence

Read through all of the standards under the domain of seeing structure in expressions (SSE) in both Algebra I and Algebra II. Note how coherence is evident in these standards. How might the Geometry standards in the domain Expressing Geometric Properties with Equations (GPE) be related to this algebra domain?

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Shift Three: Rigor

- *Make a true statement: Rigor =_____+_____+ ____*

- What are key words in the standards that indicate each of the components of rigor?

- In your groups, discuss ways to respond to one of the following comments: "These standards are expecting too much of our students." Or "I have too much to cover to be able to dig deeper. My students have too many gaps for me to teach conceptually or spend a lot of time in application."

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Turn & Talk

- What do these instructional shifts look like in the classroom?

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Module 5 Review

- We connected the instructional shifts to the standards and our classroom practices.

- We explored students' mathematical mindsets.

- We shared instructional strategies related to the Standards for Mathematical Practice.

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Module 6: Literacy Skills for Mathematical Proficiency

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Goal

- Develop a better understanding of the Literacy Skills for Mathematical Proficiency

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Literacy in your Math Classroom

Reflect on ways literacy skills are already present in your mathematics classroom.

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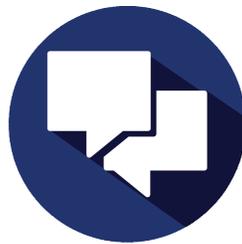
Literacy Skills for Math Proficiency

Communication in mathematics requires literacy skills in reading, vocabulary, speaking, listening, and writing.

Literacy Skills for Mathematical Proficiency

1. Use multiple reading strategies.
2. Understand and use correct mathematical vocabulary.
3. Discuss and articulate mathematical ideas.
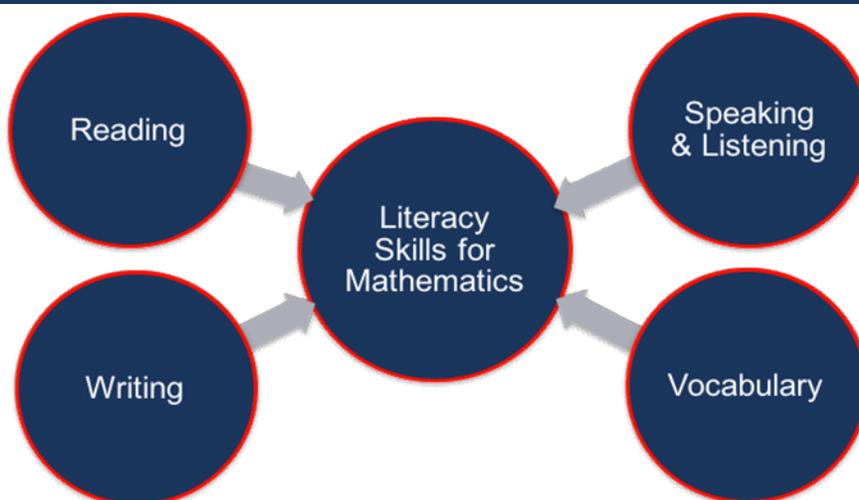4. Write mathematical arguments.

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Literacy Skills in the Math Classroom

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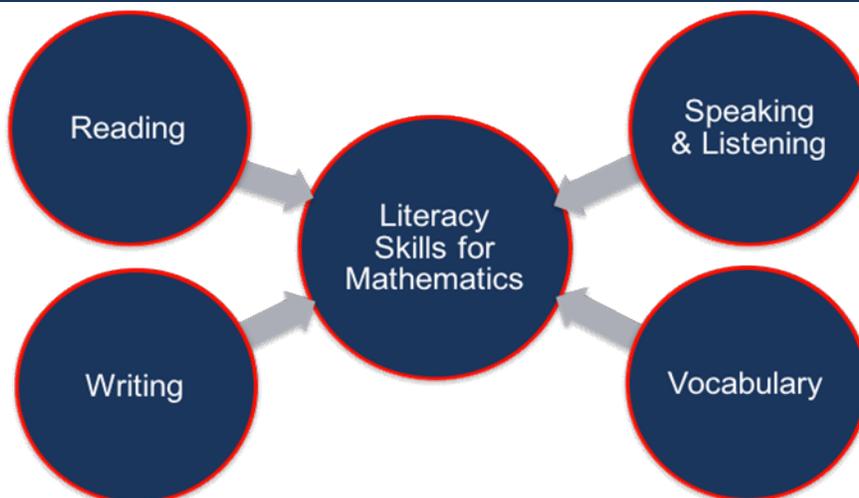
Group Activity

- Divide into groups.

- Each group will be assigned one literacy topic.

- Each group will read and annotate the paragraph on that topic in the Math Standards Document (pg. 13–14).

- Use chart paper to create a supporting document to share the ideas from your topic with the group.

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Literacy Skills in the Math Classroom

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Strategies for Incorporating Literacy Skills in Mathematics

Research-based Strategies to Teach Math Literacy

- Text Features

    – Highlight key symbols

    – Color code steps or circle action steps

    – Place a box around key terms in vocabulary

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Let's Try a Problem

Brandon and Allison participate in an annual community 5K. Brandon can run at a rate of 3 miles in 24 minutes. Allison can run at a rate of 1 mile in 9 minutes. Who has the faster rate? Who finished the race first?

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Let's Try a Problem

~~Brandon and Allison participate in an annual community 5K~~. Brandon can run at a **rate** of **3 miles in 24 minutes**. Allison can run at a **rate** of **1 mile in 9 minutes**. **Who** has the **faster rate**? **Who finished the race first?**

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Graphic Organizers

- Graphs
- Tables
- Four Corner's and a Diamond
- Frayer's Model
- Four Square Graphic Organizer
- Semantic Grid Analysis
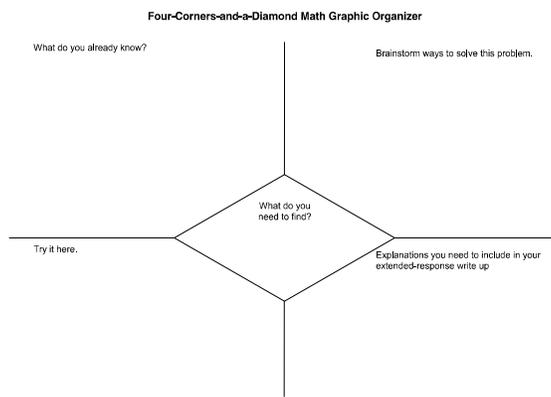
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Four Corners Graphic Organizer

Four-Corners-and-a-Diamond Math Graphic Organizer

What do you already know?

Brainstorm ways to solve this problem.

What do you
need to find?

Try it here.

Explanations you need to include in your
extended-response write up

Originally from *Teaching Children Mathematics*, © November 2009, Mathematical graphic organizers, p. 222.
May be adapted for personal use with students.

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Four Corners Graphic Organizer

Four-Corners-and-a-Diamond Math Graphic Organizer

What do you already know?

Brandon's rate = 3 miles in 24 minutes
Allison's rate = 1 mi in 9 minutes

Brainstorm ways to solve this problem.

- Calculate rate per person
- Calculate unit rate
- Divide miles per minute

What do you
need to find?
**Fastest Runner and
Who finished first**

Try it here.

Brandon's rate =3mi in 24 min
= **1mi in 8 min**
Allison's rate = **1 mi in 9 min**

Explanations you need to include in your
extended-response write up

First, I calculated the unit rate of Brandon and Allison. Since Brandon can run a mile in less time than Allison, then Brandon finished the race first. Brandon is the faster runner.

Originally from *Teaching Children Mathematics*, © November 2009, Mathematical graphic organizers, p. 222.
May be adapted for personal use with students.

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Vocabulary

"Students must be taught that the language we read and speak in mathematics class is actually a technical jargon, even though it may look and sound like regular English."
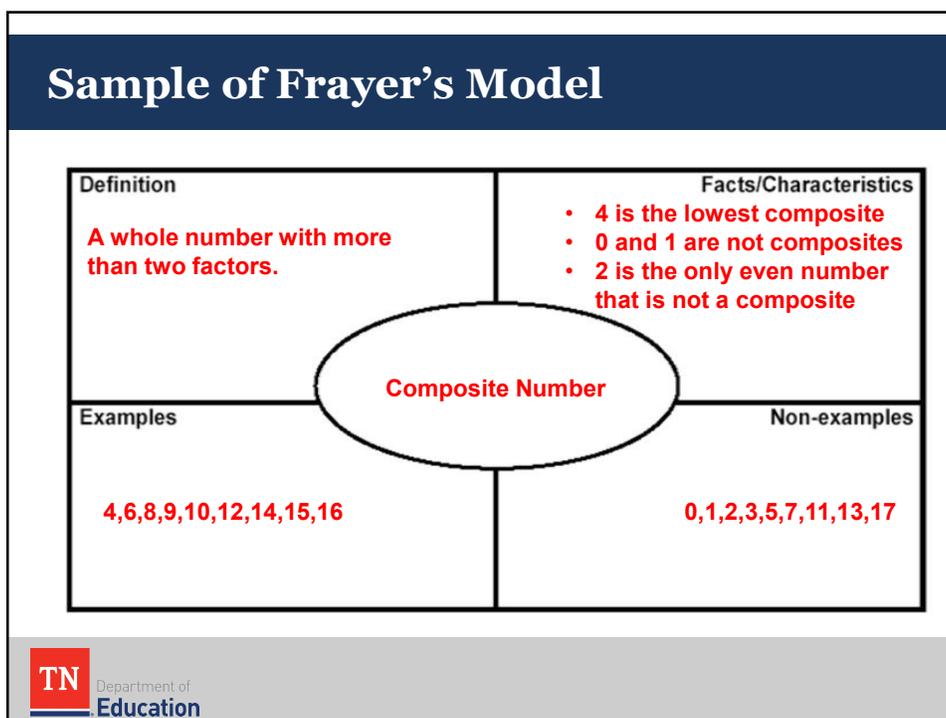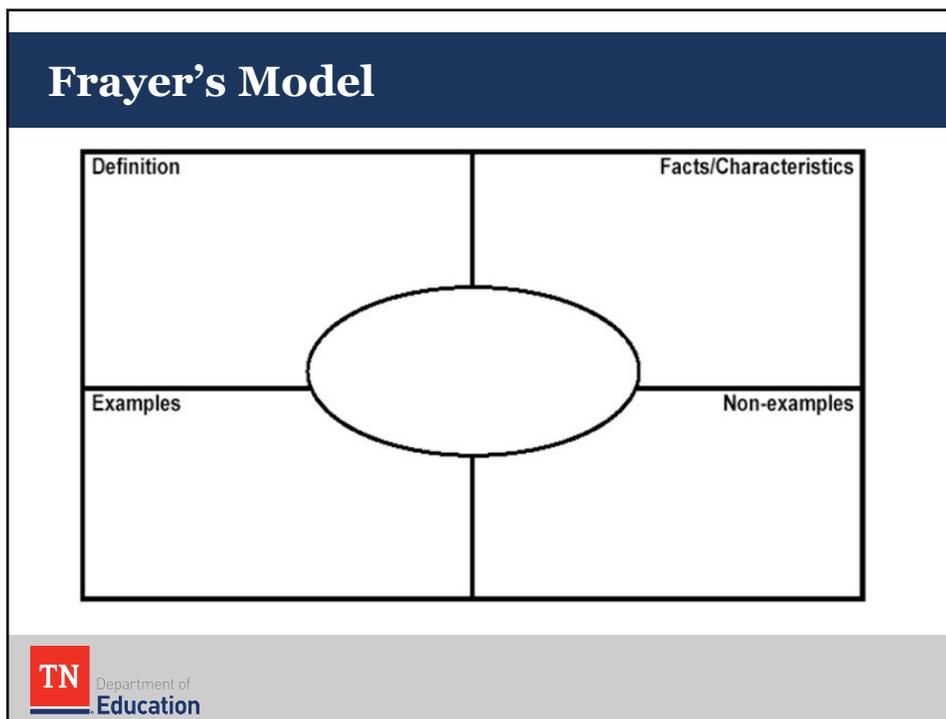
—Hersh, 1997

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Four Stages of Word Knowledge

1. Students have never encountered the word before.

2. Students have seen/heard the word but do not know the definition.

3. Students know the word but rely on context to define it.

4. Students know the word and can use it comfortably.

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Mathematics Vocabulary

- Student achievement is dependent upon students' reading comprehension and content area learning.

- Math vocabulary is decontextualized because they are not in everyday conversations.

- Mathematical terms can have specific meanings (i.e., average, reflection).

- Students need to develop a conceptual meaning in order to read and use the words accurately.

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Frayer's Model

Definition	Facts/Characteristics
Examples	Non-examples

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Sample of Frayer's Model

Definition	Facts/Characteristics
A whole number with more than two factors.	• 4 is the lowest composite • 0 and 1 are not composites • 2 is the only even number that is not a composite

Composite Number

Examples	Non-examples
4,6,8,9,10,12,14,15,16	0,1,2,3,5,7,11,13,17

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Vocabulary

- Symbols are used as language.

- Many mathematical terms have different meanings in everyday use.

- Can you think of any examples?
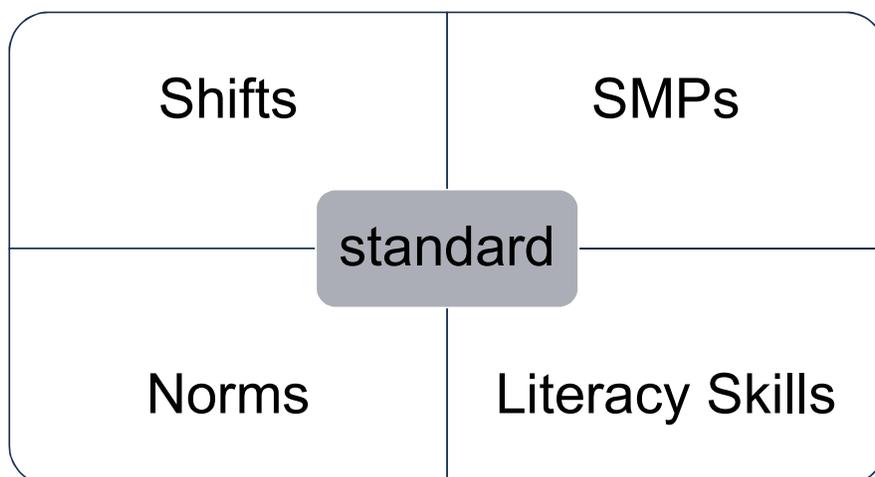
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What is literacy?

"…the ability to identify, understand, interpret, create, communicate, compute, and use printed and written materials associated with varying contexts. Literacy involves a continuum of learning to enable an individual to achieve his or her goals, to develop his or her knowledge and potential, and to participate fully in society as a whole."

—www.literacymidsouth.org/resources/

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Module 6 Review

- Literacy skills in the math classroom will support students' understanding of the content standards.

- When students can read, write, and speak about math ideas, connections are made between concepts.

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Making Connections

Shifts	SMPs
Norms	Literacy Skills

standard

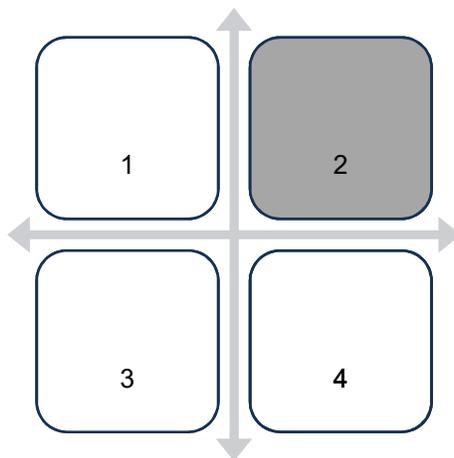**TN** Department of
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Part Three

Instructional Shifts

The instructional shifts are an essential component of the standards and provide guidance for how the standards should be taught and implemented.

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Appointments with Peers

1	2
3	4

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What to Expect: Day 2

- Dig more deeply into assessments and question development.

- Explore what it means to assure alignment of curriculum to standards.

- Explore how to begin to develop instructional planning.

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Districts and schools in Tennessee will exemplify excellence and equity such that all students are equipped with the knowledge and skills to successfully embark on their chosen path in life.

Excellence | Optimism | Judgment | Courage | Teamwork