MAFS: Mathematics Standards

GRADE: K

Domain: COUNTING AND CARDINALITY	
Cluster 1: Know number names and the count sequence.	
STANDARD CODE	**STANDARD**
MAFS.K.CC.1.1	Count to 100 by ones and by tens. *Cognitive Complexity:* Level 1: Recall
MAFS.K.CC.1.2	Count forward beginning from a given number within the known sequence (instead of having to begin at 1). *Cognitive Complexity:* Level 1: Recall
MAFS.K.CC.1.3	**Read and write numerals from 0 to 20. Represent a number of objects with a written numeral 0–20 (with 0 representing a count of no objects).** *Cognitive Complexity:* Level 1: Recall

Cluster 2: Count to tell the number of objects.	
STANDARD CODE	**STANDARD**
MAFS.K.CC.2.4	Understand the relationship between numbers and quantities; connect counting to cardinality. a. When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. b. Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted. c. Understand that each successive number name refers to a quantity that is one larger. *Cognitive Complexity:* Level 1: Recall
MAFS.K.CC.2.5	Count to answer “how many?” questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1–20, count out that many objects. *Cognitive Complexity:* Level 1: Recall

Cluster 3: Compare numbers.	
STANDARD CODE	**STANDARD**
MAFS.K.CC.3.6	Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies.

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts
MAFS.K.CC.3.7	Compare two numbers between 1 and 10 presented as written numerals. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: OPERATIONS AND ALGEBRAIC THINKING

Cluster 1: Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.

STANDARD CODE	STANDARD
MAFS.K.OA.1.1	Represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.OA.1.2	**Solve addition and subtraction word problems[1], and add and subtract within 10, e.g., by using objects or drawings to represent the problem ([1]Students are not required to independently read the word problems.)** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.OA.1.3	Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawings, and record each decomposition by a drawing or equation (e.g., 5 = 2 + 3 and 5 = 4 + 1). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.OA.1.4	For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or drawings, and record the answer with a drawing or equation. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.OA.1.5	Fluently add and subtract within 5. *Cognitive Complexity:* Level 1: Recall
MAFS.K.OA.1.a	**Use addition and subtraction within 10 to solve word problems involving both addends unknown, e.g., by using objects, drawings, and equations with symbols for the unknown numbers to represent the problem. (Students are not required to independently read the word problems.)**

Domain: NUMBER AND OPERATIONS IN BASE TEN

Cluster 1: Work with numbers 11–19 to gain foundations for place value.

STANDARD CODE	STANDARD
MAFS.K.NBT.1.1	Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: MEASUREMENT AND DATA

Cluster 1: Describe and compare measurable attributes.

STANDARD CODE	STANDARD
MAFS.K.MD.1.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.MD.1.2	Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.MD.1.a	**Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.***

Cluster 2: Classify objects and count the number of objects in each category.

STANDARD CODE	STANDARD
MAFS.K.MD.2.3	Classify objects into given categories; count the numbers of objects in each category and sort the categories by count. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).

STANDARD CODE	STANDARD
MAFS.K.G.1.1	Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as *above, below, beside, in front of, behind, and next to.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.G.1.2	Correctly name shapes regardless of their orientations or overall size. *Cognitive Complexity:* Level 1: Recall
MAFS.K.G.1.3	Identify shapes as two-dimensional (lying in a plane, "flat") or three-dimensional ("solid"). *Cognitive Complexity:* Level 1: Recall

Cluster 2: Analyze, compare, create, and compose shapes.	
STANDARD CODE	**STANDARD**
MAFS.K.G.2.4	Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/"corners") and other attributes (e.g., having sides of equal length). *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.K.G.2.5	Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.K.G.2.6	Compose simple shapes to form larger shapes. *For example, "Can you join these two triangles with full sides touching to make a rectangle?"* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

GRADE: 1

Domain: OPERATIONS AND ALGEBRAIC THINKING

Cluster 1: Represent and solve problems involving addition and subtraction.

STANDARD CODE	STANDARD
MAFS.1.OA.1.1	**Use addition and subtraction within 20 to solve word problems[1] involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem ([1]Students are not required to independently read the word problems.)** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.OA.1.2	Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Understand and apply properties of operations and the relationship between addition and subtraction.

STANDARD CODE	STANDARD
MAFS.1.OA.2.3	Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.OA.2.4	Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Add and subtract within 20.

STANDARD CODE	STANDARD
MAFS.1.OA.3.5	Relate counting to addition and subtraction (e.g., by counting on 2 to add 2). *Cognitive Complexity:* Level 1: Recall
MAFS.1.OA.3.6	Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts

Cluster 4: Work with addition and subtraction equations.

STANDARD CODE	STANDARD
MAFS.1.OA.4.7	Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.OA.4.8	Determine the unknown whole number in an addition or subtraction equation relating to three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = [] – 3, 6 + 6 = [].* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER AND OPERATIONS IN BASE TEN

Cluster 1: Extend the counting sequence.

STANDARD CODE	STANDARD
MAFS.1.NBT.1.1	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. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Understand place value.

STANDARD CODE	STANDARD
MAFS.1.NBT.2.2	**Understand that the two digits of a two-digit number represent amounts of tens and ones.** **a. 10 can be thought of as a bundle of ten ones — called a "ten."** **b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.** **c. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones).** **d. Decompose two-digit numbers in multiple ways (e.g., 64 can be decomposed into 6 tens and 4 ones or into 5 tens and 14 ones).** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.NBT.2.3	Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Use place value understanding and properties of operations to add and subtract.

Additional Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.1.NBT.3.4	Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.NBT.3.5	Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.NBT.3.6	Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: MEASUREMENT AND DATA

Cluster 1: Measure lengths indirectly and by iterating length units.

STANDARD CODE	STANDARD
MAFS.1.MD.1.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.MD.1.2	Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.MD.1.a	**Understand how to use a ruler to measure length to the nearest inch.** **a. Recognize that the ruler is a tool that can be used to measure the attribute of length.** **b. Understand the importance of the zero point and end point and that the length measure is the span between two points.** **c. Recognize that the units marked on a ruler have equal length intervals and fit together with no gaps or overlaps. These equal interval distances can be counted to determine the overall length of an object.**

Cluster 2: Tell and write time.

STANDARD CODE	STANDARD
MAFS.1.MD.2.3	Tell and write time in hours and half-hours using analog and digital clocks. *Cognitive Complexity:* Level 1: Recall
MAFS.1.MD.2.a	**Identify and combine values of money in cents up to one dollar working with a single unit of currency[1].** **a. Identify the value of coins (pennies, nickels, dimes, quarters).** **b. Compute the value of combinations of coins (pennies and/or dimes).** **c. Relate the value of pennies, dimes, and quarters to the dollar (e.g., There are 100 pennies *or* ten dimes *or* four quarters in one dollar.) ([1]Students are not expected to understand the decimal notation for combinations of dollars and cents.)**

Cluster 3: Represent and interpret data.

Supporting Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.1.MD.3.4	Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: GEOMETRY

Cluster 1: Reason with shapes and their attributes.

Supporting Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.1.G.1.1	Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.G.1.2	Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape,

	and compose new shapes from the composite shape. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.1.G.1.3	Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters*, and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

GRADE: 2

Domain: OPERATIONS AND ALGEBRAIC THINKING

Cluster 1: Represent and solve problems involving addition and subtraction.

STANDARD CODE	STANDARD
MAFS.2.OA.1.1	Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.OA.1.a	**Determine the unknown whole number in an equation relating four or more whole numbers. For example, determine the unknown number that makes the equation true in the equations 37 + 10 + 10 = _____ + 18, ? – 6 = 13 – 4, and 15 – 9 = 6 + ☐.**

Cluster 2: Add and subtract within 20.

STANDARD CODE	STANDARD
MAFS.2.OA.2.2	Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers. *Cognitive Complexity:* Level 1: Recall

Cluster 3: Work with equal groups of objects to gain foundations for multiplication.

STANDARD CODE	STANDARD
MAFS.2.OA.3.3	Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.OA.3.4	Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends. *Cognitive Complexity:* Level 1: Recall

Domain: NUMBER AND OPERATIONS IN BASE TEN

Cluster 1: Understand place value.

STANDARD CODE	STANDARD
MAFS.2.NBT.1.1	Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases: a. 100 can be thought of as a bundle of ten tens — called a “hundred.” b. The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.NBT.1.2	Count within 1000; skip-count by 5s, 10s, and 100s. *Cognitive Complexity:* Level 1: Recall
MAFS.2.NBT.1.3	Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. *Cognitive Complexity:* Level 1: Recall
MAFS.2.NBT.1.4	Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Use place value understanding and properties of operations to add and subtract.

STANDARD CODE	STANDARD
MAFS.2.NBT.2.5	Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. *Cognitive Complexity:* Level 1: Recall
MAFS.2.NBT.2.6	Add up to four two-digit numbers using strategies based on place value and properties of operations. *Cognitive Complexity:* Level 1: Recall
MAFS.2.NBT.2.7	Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.NBT.2.8	Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900. *Cognitive Complexity:* Level 1: Recall
MAFS.2.NBT.2.9	Explain why addition and subtraction strategies work, using place value and the properties of operations. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: MEASUREMENT AND DATA

Cluster 1: Measure and estimate lengths in standard units.

STANDARD CODE	STANDARD
MAFS.2.MD.1.1	**Measure the length of an object to the nearest inch, foot, centimeter, or meter by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.MD.1.2	**Describe the inverse relationship between the size of a unit and number of units needed to measure a given object. *Example: Suppose the perimeter of a room is lined with one-foot rulers. Now, suppose we want to line it with yardsticks instead of rulers. Will we need more or fewer yardsticks than rulers to do the job? Explain your answer.*** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.MD.1.3	**Estimate lengths using units of inches, feet, yards, centimeters, and meters.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.MD.1.4	Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Relate addition and subtraction to length.

STANDARD CODE	STANDARD
MAFS.2.MD.2.5	Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.MD.2.6	Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Work with time and money.

STANDARD CODE	STANDARD
MAFS.2.MD.3.7	**Tell and write time from analog and digital clocks to the nearest five minutes.** *Cognitive Complexity:* Level 1: Recall
MAFS.2.MD.3.8	**Solve one- and two-step word problems involving dollar bills (singles, fives, tens, twenties, and hundreds) or coins (quarters, dimes, nickels, and pennies) using $**

	and ¢ symbols appropriately. Word problems may involve addition, subtraction, and equal groups situations[1]. *Example: The cash register shows that the total for your purchase is 59¢. You gave the cashier three quarters. How much change should you receive from the cashier?* **a. Identify the value of coins and paper currency.** **b. Compute the value of any combination of coins within one dollar.** **c. Compute the value of any combinations of dollars (e.g., If you have three ten-dollar bills, one five-dollar bill, and two one-dollar bills, how much money do you have?).** **d. Relate the value of pennies, nickels, dimes, and quarters to other coins and to the dollar (e.g., There are five nickels in one quarter. There are two nickels in one dime. There are two and a half dimes in one quarter. There are twenty nickels in one dollar).** **([1]See glossary Table 1)** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 4: Represent and interpret data.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.2.MD.4.10	Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.2.MD.4.9	Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Reason with shapes and their attributes.

Supporting Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.2.G.1.1	Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

	Cognitive Complexity: Level 1: Recall
MAFS.2.G.1.2	Partition a rectangle into rows and columns of same-size squares and count to find the total number of them. *Cognitive Complexity:* Level 1: Recall
MAFS.2.G.1.3	Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves, thirds, half of, a third of,* etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape. *Cognitive Complexity:* Level 1: Recall

GRADE: 3

Domain: OPERATIONS AND ALGEBRAIC THINKING

Cluster 1: Represent and solve problems involving multiplication and division.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.OA.1.1	Interpret products of whole numbers, e.g., interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5 × 7.* *Cognitive Complexity:* Level 1: Recall
MAFS.3.OA.1.2	Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8.* *Cognitive Complexity:* Level 1: Recall
MAFS.3.OA.1.3	Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.OA.1.4	Determine the unknown whole number in a multiplication or division equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations* 8 × ? = 48, 5 = [] ÷ 3, 6 × 6 = ?. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Understand properties of multiplication and the relationship between multiplication and division.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.OA.2.5	Apply properties of operations as strategies to multiply and divide. *Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.)*

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts
MAFS.3.OA.2.6	Understand division as an unknown-factor problem. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Multiply and divide within 100.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.OA.3.7	Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers. *Cognitive Complexity:* Level 1: Recall

Cluster 4: Solve problems involving the four operations, and identify and explain patterns in arithmetic.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.OA.4.8	Solve two-step word problems using the four operations. 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. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.OA.4.9	Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: NUMBER AND OPERATIONS IN BASE TEN

Cluster 1: Use place value understanding and properties of operations to perform multi-digit arithmetic.

Additional Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.NBT.1.1	Use place value understanding to round whole numbers to the nearest 10 or 100. *Cognitive Complexity:* Level 1: Recall
MAFS.3.NBT.1.2	Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. *Cognitive Complexity:* Level 1: Recall
MAFS.3.NBT.1.3	Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations. *Cognitive Complexity:* Level 1: Recall

Domain: NUMBER AND OPERATIONS - FRACTIONS

Cluster 1: Develop understanding of fractions as numbers.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.NF.1.1	Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size 1/b. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.NF.1.2	Understand a fraction as a number on the number line; represent fractions on a number line diagram. a. Represent a fraction 1/b on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each part has size 1/b and that the endpoint of the part based at 0 locates the number 1/b on the number line. b. Represent a fraction *a/b* on a number line diagram by marking off *a* lengths *1/b* from 0. Recognize that the resulting interval has size *a/b* and that its endpoint locates the number *a/b* on the number line. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.NF.1.3	Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size. a. Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line. b. Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3). Explain why the fractions are equivalent, e.g., by using a visual fraction model.

	c. Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.* d. Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: MEASUREMENT AND DATA

Cluster 1: Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.MD.1.1	Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.MD.1.2	**Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Represent and interpret data.

Supporting Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

Examples of Opportunities for In-Depth Focus

Continuous measurement quantities such as liquid volume, mass, and so on are an important context for fraction arithmetic (cf. 4.NF.2.4c, 5.NF.2.7c, 5.NF.2.3). In grade 3, students begin to get a feel for continuous measurement quantities and solve whole- number problems involving such quantities.

STANDARD CODE	STANDARD
MAFS.3.MD.2.3	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.MD.2.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Geometric measurement: understand concepts of area and relate area to multiplication and to addition.

Major Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.MD.3.5	Recognize area as an attribute of plane figures and understand concepts of area measurement. a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area. b. A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units. *Cognitive Complexity:* Level 1: Recall
MAFS.3.MD.3.6	Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). *Cognitive Complexity:* Level 1: Recall
MAFS.3.MD.3.7	Relate area to the operations of multiplication and addition. a. Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. b. Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. c. Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a × b and a × c. Use area models to represent the distributive property in mathematical reasoning. d. Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.

	Cognitive Complexity: Level 3: Strategic Thinking & Complex Reasoning

Cluster 4: Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Additional Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.MD.4.8	Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Reason with shapes and their attributes.

Supporting Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.3.G.1.1	Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.3.G.1.2	Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.* *Cognitive Complexity:* Level 1: Recall

GRADE: 4

Domain: OPERATIONS AND ALGEBRAIC THINKING	
Cluster 1: Use the four operations with whole numbers to solve problems. Major Cluster Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.	
STANDARD CODE	**STANDARD**
MAFS.4.OA.1.1	Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 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. *Cognitive Complexity:* Level 1: Recall
MAFS.4.OA.1.2	Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.OA.1.3	Solve multistep word 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. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.OA.1.a	**Determine whether an equation is true or false by using comparative relational thinking. *For example, without adding 60 and 24, determine whether the equation 60 + 24 = 57 + 27 is true or false.***
MAFS.4.OA.1.b	**Determine the unknown whole number in an equation relating four whole numbers using comparative relational thinking. *For example, solve 76 + 9 = n + 5 for n by arguing that nine is four more than five, so the unknown number must be four greater than 76.***

Cluster 2: Gain familiarity with factors and multiples. Supporting Cluster Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.	
STANDARD CODE	**STANDARD**
MAFS.4.OA.2.4	**Investigate factors and multiples.** **a. Find all factor pairs for a whole number in the range 1–100.** **b. 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.** **c. Determine whether a given whole number in the range 1–100 is prime or**

	composite. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Generate and analyze patterns.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.OA.3.5	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.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER AND OPERATIONS IN BASE TEN

Cluster 1: Generalize place value understanding for multi-digit whole numbers.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.NBT.1.1	Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.* *Cognitive Complexity:* Level 1: Recall
MAFS.4.NBT.1.2	Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.NBT.1.3	Use place value understanding to round multi-digit whole numbers to any place. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Use place value understanding and properties of operations to perform multi-digit arithmetic.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.NBT.2.4	Fluently add and subtract multi-digit whole numbers using the standard algorithm. *Cognitive Complexity:* Level 1: Recall
MAFS.4.NBT.2.5	Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.NBT.2.6	Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER AND OPERATIONS - FRACTIONS

Cluster 1: Extend understanding of fraction equivalence and ordering.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.NF.1.1	Explain why a fraction a/b is equivalent to a fraction (n × a)/(n × b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.4.NF.1.2	Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.NF.2.3	Understand a fraction a/b with a > 1 as a sum of fractions 1/b.

	a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole. b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples: 3/8 = 1/8 + 1/8 + 1/8 ; 3/8 = 1/8 + 2/8 ; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.* c. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction. d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.NF.2.4	Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. a. Understand a fraction a/b as a multiple of 1/b. *For example, use a visual fraction model to represent 5/4 as the product 5 × (1/4), recording the conclusion by the equation 5/4 = 5 × (1/4).* b. Understand a multiple of a/b as a multiple of 1/b, and use this understanding to multiply a fraction by a whole number. *For example, use a visual fraction model to express 3 × (2/5) as 6 × (1/5), recognizing this product as 6/5. (In general, n × (a/b) = (n × a)/b.)* c. Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. *For example, if each person at a party will eat 3/8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Understand decimal notation for fractions, and compare decimal fractions.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.NF.3.5	Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. *For example, express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.* *Cognitive Complexity:* Level 1: Recall
MAFS.4.NF.3.6	Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.*

	Cognitive Complexity: Level 1: Recall
MAFS.4.NF.3.7	Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: MEASUREMENT AND DATA

Cluster 1: Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.MD.1.1	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, express measurements in a larger unit in terms of a smaller unit. 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), ...* *Cognitive Complexity:* Level 1: Recall
MAFS.4.MD.1.2	**Use the four operations to solve word problems[1] involving distances, intervals of time, and money, including problems involving simple fractions or decimals[2]. Represent fractional quantities of distance and intervals of time using linear models. ([1]See glossary Table 1 and Table 2) ([2]Computational fluency with fractions and decimals is not the goal for students at this grade level.)** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.MD.1.3	Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Represent and interpret data.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.MD.2.4	Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4,

	1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Geometric measurement: understand concepts of angle and measure angles.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.4.MD.3.5	Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles. b. An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees. *Cognitive Complexity:* Level 1: Recall
MAFS.4.MD.3.6	Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.MD.3.7	Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD

MAFS.4.G.1.1	Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. *Cognitive Complexity:* Level 1: Recall
MAFS.4.G.1.2	Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.4.G.1.3	Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

GRADE: 5

Domain: OPERATIONS AND ALGEBRAIC THINKING

Cluster 1: Write and interpret numerical expressions.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.OA.1.1	Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. *Cognitive Complexity:* Level 1: Recall
MAFS.5.OA.1.2	Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.* *Cognitive Complexity:* Level 1: Recall

Cluster 2: Analyze patterns and relationships.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.OA.2.3	Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER AND OPERATIONS IN BASE TEN

Cluster 1: Understand the place value system.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.NBT.1.1	Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. *Cognitive Complexity:* Level 1: Recall
MAFS.5.NBT.1.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.NBT.1.3	Read, write, and compare decimals to thousandths. a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 × 100 + 4 × 10 + 7 × 1 + 3 × (1/10) + 9 × (1/100) + 2 × (1/1000). b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.NBT.1.4	Use place value understanding to round decimals to any place. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Perform operations with multi-digit whole numbers and with decimals to hundredths.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.NBT.2.5	Fluently multiply multi-digit whole numbers using the standard algorithm. *Cognitive Complexity:* Level 1: Recall
MAFS.5.NBT.2.6	Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts
MAFS.5.NBT.2.7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER AND OPERATIONS - FRACTIONS

Cluster 1: Use equivalent fractions as a strategy to add and subtract fractions.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.NF.1.1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.NF.1.2	Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.NF.2.3	Interpret a fraction as division of the numerator by the denominator (a/b = a ÷ b). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.NF.2.4	Apply and extend previous understandings of multiplication to multiply a fraction or

	whole number by a fraction. a. Interpret the product *(a/b) × q* as a parts of a partition of *q* into *b* equal parts; equivalently, as the result of a sequence of operations *a × q ÷ b*. *For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = ac/bd.)* b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.NF.2.5	Interpret multiplication as scaling (resizing), by: a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication. b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence *a/b = (n×a)/(n×b)* to the effect of multiplying *a/b* by 1. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.5.NF.2.6	Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.NF.2.7	Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. a. Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. *For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3.* b. Interpret division of a whole number by a unit fraction, and compute such quotients. *For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4.* c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: MEASUREMENT AND DATA

Cluster 1: Convert like measurement units within a given measurement system.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.MD.1.1	**Convert among different-sized standard measurement units (i.e., km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec) 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.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Represent and interpret data.

Supporting Cluster

• Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.MD.2.2	Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.

Major Cluster

Don't ...Sort clusters from Major to Supporting and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.MD.3.3	Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units.

	Cognitive Complexity: Level 1: Recall
MAFS.5.MD.3.4	Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. *Cognitive Complexity:* Level 1: Recall
MAFS.5.MD.3.5	**Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.** **a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.** **b. Apply the formulas V = l × w × h and V = B × h for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.** c. **Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Graph points on the coordinate plane to solve real-world and mathematical problems.

Additional Cluster

Don't ...Sort clusters from Major to Supporting and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.G.1.1	Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate). *Cognitive Complexity:* Level 1: Recall
MAFS.5.G.1.2	Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Classify two-dimensional figures into categories based on their properties.

Additional Cluster
Don't ...Sort clusters from Major to Supporting and then teach them in that order. To do so

would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.5.G.2.3	Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.5.G.2.4	**Classify and organize two-dimensional figures into Venn diagrams based on the attributes of the figures.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

GRADE: 6

Domain: RATIOS & PROPORTIONAL RELATIONSHIPS	
Cluster 1: Understand ratio concepts and use ratio reasoning to solve problems. Major Cluster Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.	
STANDARD CODE	**STANDARD**
MAFS.6.RP.1.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.RP.1.2	Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.RP.1.3	**Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.** **a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.** **b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*** **c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.** **d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.** **e. Understand the concept of Pi as the ratio of the circumference of a circle to its diameter.** **([1]See Table 2 Common Multiplication and Division Situations)** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: THE NUMBER SYSTEM
Cluster 1: Apply and extend previous understandings of multiplication and division to divide fractions by fractions. Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.NS.1.1	Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Compute fluently with multi-digit numbers and find common factors and multiples.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.NS.2.2	Fluently divide multi-digit numbers using the standard algorithm. *Cognitive Complexity:* Level 1: Recall
MAFS.6.NS.2.3	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. *Cognitive Complexity:* Level 1: Recall
MAFS.6.NS.2.4	Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4 (9 + 2).* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Apply and extend previous understandings of numbers to the system of rational numbers.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.NS.3.5	Understand that positive and negative numbers are used together to describe quantities

	having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.NS.3.6	Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite. b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes. c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.NS.3.7	Understand ordering and absolute value of rational numbers. a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.* b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –3 ºC > –7 ºC to express the fact that –3 ºC is warmer than –7 ºC.* c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.* d. Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.NS.3.8	Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: EXPRESSIONS & EQUATIONS

Cluster 1: Apply and extend previous understandings of arithmetic to algebraic expressions.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.EE.1.1	Write and evaluate numerical expressions involving whole-number exponents. *Cognitive Complexity:* Level 1: Recall
MAFS.6.EE.1.2	Write, read, and evaluate expressions in which letters stand for numbers. a. Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.* b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.* c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas $V = s^3$ and $A = 6 s^2$ to find the volume and surface area of a cube with sides of length s = 1/2.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.EE.1.3	Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.* *Cognitive Complexity:* Level 1: Recall
MAFS.6.EE.1.4	Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Reason about and solve one-variable equations and inequalities.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.EE.2.5	Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts
MAFS.6.EE.2.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.6.EE.2.7	Solve real-world and mathematical problems by writing and solving equations of the form x + p = q and px = q for cases in which p, q and x are all non-negative rational numbers. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.EE.2.8	Write an inequality of the form x > c or x < c to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form x > c or x < c have infinitely many solutions; represent solutions of such inequalities on number line diagrams. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Represent and analyze quantitative relationships between dependent and independent variables.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.EE.3.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; 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. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Solve real-world and mathematical problems involving area, surface area, and volume.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.G.1.1	Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts
MAFS.6.G.1.2	Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.G.1.3	Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.G.1.4	Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: STATISTICS & PROBABILITY

Cluster 1: Develop understanding of statistical variability.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.SP.1.1	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.* *Cognitive Complexity:* Level 1: Recall
MAFS.6.SP.1.2	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. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.SP.1.3	Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Summarize and describe distributions.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.6.SP.2.4	Display numerical data in plots on a number line, including dot plots, histograms, and

	box plots. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.6.SP.2.5	Summarize numerical data sets in relation to their context, such as by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. 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. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

GRADE: 7

Domain: RATIOS & PROPORTIONAL RELATIONSHIPS	
Cluster 1: Analyze proportional relationships and use them to solve real-world and mathematical problems. Major Cluster Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.	
STANDARD CODE	**STANDARD**
MAFS.7.RP.1.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.RP.1.2	Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.RP.1.3	Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: THE NUMBER SYSTEM	
Cluster 1: Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. Major Cluster Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.	
STANDARD CODE	**STANDARD**

MAFS.7.NS.1.1	Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.* b. Understand p + q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. c. Understand subtraction of rational numbers as adding the additive inverse, p – q = p + (–q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. d. Apply properties of operations as strategies to add and subtract rational numbers. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.NS.1.2	Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then –(p/q) = (–p)/q = p/(–q). Interpret quotients of rational numbers by describing real-world contexts. c. Apply properties of operations as strategies to multiply and divide rational numbers. d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.NS.1.3	Solve real-world and mathematical problems involving the four operations with rational numbers. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: EXPRESSIONS & EQUATIONS

Cluster 1: Use properties of operations to generate equivalent expressions.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.EE.1.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear

	expressions with rational coefficients. *Cognitive Complexity:* Level 1: Recall
MAFS.7.EE.1.2	Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.EE.2.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.EE.2.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. a. Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* b. Solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Draw, construct, and describe geometrical figures and describe the relationships between them.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.G.1.1	Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.G.1.2	Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.G.1.3	Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.G.2.4	Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.G.2.5	Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.G.2.6	Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: STATISTICS & PROBABILITY

Cluster 1: Use random sampling to draw inferences about a population.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.SP.1.1	Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.SP.1.2	Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 2: Draw informal comparative inferences about two populations.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.SP.2.3	Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.SP.2.4	Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Investigate chance processes and develop, use, and evaluate probability models.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.7.SP.3.5	Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2

	indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. *Cognitive Complexity:* Level 1: Recall
MAFS.7.SP.3.6	Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.7.SP.3.7	Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.7.SP.3.8	Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event. c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

GRADE: 8

Domain: THE NUMBER SYSTEM

Cluster 1: Know that there are numbers that are not rational, and approximate them by rational numbers.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.NS.1.1	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. *Cognitive Complexity:* Level 1: Recall
MAFS.8.NS.1.2	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: EXPRESSIONS & EQUATIONS

Cluster 1: Work with radicals and integer exponents.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.EE.1.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$* *Cognitive Complexity:* Level 1: Recall
MAFS.8.EE.1.2	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. *Cognitive Complexity:* Level 1: Recall
MAFS.8.EE.1.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3 × 10^8 and the population of the world as 7 × 10^9, and determine that the world population is more than 20 times larger.*

	Cognitive Complexity: Level 1: Recall
MAFS.8.EE.1.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Understand the connections between proportional relationships, lines, and linear equations.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.EE.2.5	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.EE.2.6	Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Analyze and solve linear equations and pairs of simultaneous linear equations.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.EE.3.7	Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

MAFS.8.EE.3.8	Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: FUNCTIONS

Cluster 1: Define, evaluate, and compare functions.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.F.1.1	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.F.1.2	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.F.1.3	Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Use functions to model relationships between quantities.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.F.2.4	Construct a function to model a linear relationship between two quantities. Determine

	the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.8.F.2.5	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY

Cluster 1: Understand congruence and similarity using physical models, transparencies, or geometry software.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.G.1.1	Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.G.1.2	Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.G.1.3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.G.1.4	Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.G.1.5	Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Understand and apply the Pythagorean Theorem.

Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.G.2.6	Explain a proof of the Pythagorean Theorem and its converse. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.G.2.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.G.2.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. *Cognitive Complexity:* Level 1: Recall

Cluster 3: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.G.3.9	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: STATISTICS & PROBABILITY

Cluster 1: Investigate patterns of association in bivariate data.

Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.8.SP.1.1	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

MAFS.8.SP.1.2	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.SP.1.3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.8.SP.1.4	Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

GRADE: 912

Domain: NUMBER & QUANTITY: THE REAL NUMBER SYSTEM

Cluster 1: Extend the properties of exponents to rational exponents.

Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.N-RN.1.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{1/3}$ *to be the cube root of 5 because we want* $(5^{1/3})^3 = 5^{(1/3)3}$ *to hold, so* $(5^{1/3})^3$ *must equal 5.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-RN.1.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Use properties of rational and irrational numbers.

Algebra 1 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.N-RN.2.3	Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER & QUANTITY: QUANTITIES

Cluster 1: Reason quantitatively and use units to solve problems.

Algebra 1 - Supporting Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.N-Q.1.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-Q.1.2	Define appropriate quantities for the purpose of descriptive modeling. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-Q.1.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: NUMBER & QUANTITY: THE COMPLEX NUMBER SYSTEM

Cluster 1: Perform arithmetic operations with complex numbers.

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.N-CN.1.1	Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real. *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-CN.1.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-CN.1.3	Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Represent complex numbers and their operations on the complex plane.

STANDARD CODE	STANDARD
MAFS.912.N-CN.2.4	Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-CN.2.5	Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}\, i)^3 = 8$ because $(-1 + \sqrt{3}\, i)$ has modulus 2 and

	argument 120°. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-CN.2.6	Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints. *Cognitive Complexity:* Level 1: Recall

Cluster 3: Use complex numbers in polynomial identities and equations.

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.N-CN.3.7	Solve quadratic equations with real coefficients that have complex solutions. *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-CN.3.8	Extend polynomial identities to the complex numbers. *For example, rewrite $x^2 + 4$ as $(x + 2i)(x – 2i)$.* *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-CN.3.9	Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. *Cognitive Complexity:* Level 1: Recall

Domain: NUMBER & QUANTITY: VECTOR & MATRIX QUANTITIES

Cluster 1: Represent and model with vector quantities.

STANDARD CODE	STANDARD
MAFS.912.N-VM.1.1	Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\boldsymbol{\lvert v \rvert}$, $\boldsymbol{\lVert v \rVert}$, $\boldsymbol{v}$). *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-VM.1.2	Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-VM.1.3	Solve problems involving velocity and other quantities that can be represented by vectors. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Perform operations on vectors.

STANDARD CODE	STANDARD
MAFS.912.N-VM.2.4	Add and subtract vectors. a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. c. Understand vector subtraction **v** – **w** as **v** + (–**w**), where –**w** is the additive inverse of **w**, with the same magnitude as **w** and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-VM.2.5	Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$. b. Compute the magnitude of a scalar multiple c**v** using ||c**v**|| = |c|v. Compute the direction of c**v** knowing that when |c|v ≠ 0, the direction of c**v** is either along **v** (for c > 0) or against **v** (for c < 0). *Cognitive Complexity:* Level 1: Recall

Cluster 3: Perform operations on matrices and use matrices in applications.

STANDARD CODE	STANDARD
MAFS.912.N-VM.3.10	Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-VM.3.11	Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-VM.3.12	Work with 2 × 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-VM.3.6	Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.N-VM.3.7	Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in

	a game are doubled. *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-VM.3.8	Add, subtract, and multiply matrices of appropriate dimensions. *Cognitive Complexity:* Level 1: Recall
MAFS.912.N-VM.3.9	Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS

Cluster 1: Interpret the structure of expressions

Algebra 1 - Major Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-SSE.1.1	Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-SSE.1.2	Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$*.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Write expressions in equivalent forms to solve problems

Algebra 1 - Supporting Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-SSE.2.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

	a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-SSE.2.4	Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: ALGEBRA: ARITHMETIC WITH POLYNOMIALS & RATIONAL EXPRESSIONS

Cluster 1: Perform arithmetic operations on polynomials

Algebra 1 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-APR.1.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. *Cognitive Complexity:* Level 1: Recall

Cluster 2: Understand the relationship between zeros and factors of polynomials

Algebra 1 - Supporting Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-APR.2.2	Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x). *Cognitive Complexity:* Level 1: Recall
MAFS.912.A-APR.2.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

	Cognitive Complexity: Level 1: Recall

Cluster 3: Use polynomial identities to solve problems

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-APR.3.4	Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. *Cognitive Complexity:* Level 1: Recall
MAFS.912.A-APR.3.5	Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 4: Rewrite rational expressions

Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-APR.4.6	Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-APR.4.7	Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: ALGEBRA: CREATING EQUATIONS

Cluster 1: Create equations that describe numbers or relationships

Algebra 1 - Major Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the

major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-CED.1.1	**Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational, absolute, and exponential functions.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-CED.1.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-CED.1.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.A-CED.1.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* *Cognitive Complexity:* Level 1: Recall

Domain: ALGEBRA: REASONING WITH EQUATIONS & INEQUALITIES

Cluster 1: Understand solving equations as a process of reasoning and explain the reasoning

Algebra 1 - Major Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-REI.1.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.A-REI.1.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 2: Solve equations and inequalities in one variable

Algebra 1 - Major Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-REI.2.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-REI.2.4	Solve quadratic equations in one variable. a. Use the method of completing the square to transform 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, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Solve systems of equations

Algebra 1 - Additional Cluster
Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-REI.3.5	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.A-REI.3.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. *Cognitive Complexity:* Level 1: Recall
MAFS.912.A-REI.3.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line $y = –3x$ and the circle $x^2 + y^2 = 3$.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-REI.3.8	Represent a system of linear equations as a single matrix equation in a vector variable. *Cognitive Complexity:* Level 1: Recall
MAFS.912.A-REI.3.9	Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 4: Represent and solve equations and inequalities graphically

Algebra 1 - Major Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.A-REI.4.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). *Cognitive Complexity:* Level 1: Recall
MAFS.912.A-REI.4.11	Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.A-REI.4.12	Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: FUNCTIONS: INTERPRETING FUNCTIONS

Cluster 1: Understand the concept of a function and use function notation

Algebra 1 - Major Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-IF.1.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). *Cognitive Complexity:* Level 1: Recall
MAFS.912.F-IF.1.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-IF.1.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts

Cluster 2: Interpret functions that arise in applications in terms of the context

Algebra 1 - Major Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-IF.2.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-IF.2.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-IF.2.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Analyze functions using different representations

Algebra 1 - Supporting Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-IF.3.7	**Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.** **a. Graph linear and quadratic functions and show intercepts, maxima, and minima.** **b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.** **c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.** **d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.**

	e. **Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude, and using phase shift.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-IF.3.8	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. b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-IF.3.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: FUNCTIONS: BUILDING FUNCTIONS

Cluster 1: Build a function that models a relationship between two quantities

Algebra 1 - Supporting Cluster
Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-BF.1.1	Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* c. Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.F-BF.1.2	Write arithmetic and geometric sequences both recursively and with an explicit formula,

	use them to model situations, and translate between the two forms. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Build new functions from existing functions

Algebra 1 - Additional Cluster
Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-BF.2.3	Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-BF.2.4	Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2 x^3 or f(x) = (x+1)/(x–1) for x ≠ 1.* b. Verify by composition that one function is the inverse of another. c. Read values of an inverse function from a graph or a table, given that the function has an inverse. d. Produce an invertible function from a non-invertible function by restricting the domain. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-BF.2.5	Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-BF.2.a	**Use the change of base formula.**

Domain: FUNCTIONS: LINEAR, QUADRATIC, & EXPONENTIAL MODELS

Cluster 1: Construct and compare linear, quadratic, and exponential models and solve problems

Algebra 1 - Supporting Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-LE.1.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.

	a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.F-LE.1.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-LE.1.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-LE.1.4	For exponential models, express as a logarithm the solution to ab^{ct} = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Interpret expressions for functions in terms of the situation they model

Algebra 1 - Supporting Cluster
Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-LE.2.5	Interpret the parameters in a linear or exponential function in terms of a context. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: FUNCTIONS: TRIGONOMETRIC FUNCTIONS

Cluster 1: Extend the domain of trigonometric functions using the unit circle

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-TF.1.1	Understand radian measure of an angle as the length of the arc on the unit circle

	subtended by the angle; Convert between degrees and radians. *Cognitive Complexity:* Level 1: Recall
MAFS.912.F-TF.1.2	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-TF.1.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–x, π+x, and 2π–x in terms of their values for x, where x is any real number. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-TF.1.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Model periodic phenomena with trigonometric functions

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-TF.2.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-TF.2.6	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-TF.2.7	Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Prove and apply trigonometric identities

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.F-TF.3.8	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to calculate trigonometric ratios. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.F-TF.3.9	**Prove the addition and subtraction, half-angle, and double-angle formulas for**

	sine, cosine, and tangent and use these formulas to solve problems. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: GEOMETRY: CONGRUENCE

Cluster 1: Experiment with transformations in the plane

Geometry - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-CO.1.1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. *Cognitive Complexity:* Level 1: Recall
MAFS.912.G-CO.1.2	Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-CO.1.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-CO.1.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-CO.1.5	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Understand congruence in terms of rigid motions

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-CO.2.6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-CO.2.7	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles

	are congruent. *Cognitive Complexity:* Level 1: Recall
MAFS.912.G-CO.2.8	**Explain how the criteria for triangle congruence (ASA, SAS, SSS, and Hypotenuse-Leg) follow from the definition of congruence in terms of rigid motions.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Prove geometric theorems

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-CO.3.9	**Prove theorems about lines and angles; use theorems about lines and angles to solve problems.** ***Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.*** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-CO.3.10	**Prove theorems about triangles; use theorems about triangles to solve problems.** ***Theorems include: measures of interior angles of a triangle sum to 180°; triangle inequality theorem; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-CO.3.11	**Prove theorems about parallelograms; use theorems about parallelograms to solve problems.** ***Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 4: Make geometric constructions

Geometry - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-CO.4.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.*

	Cognitive Complexity: Level 2: Basic Application of Skills & Concepts
MAFS.912.G-CO.4.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY: SIMILARITY, RIGHT TRIANGLES, & TRIGONOMETRY

Cluster 1: Understand similarity in terms of similarity transformations

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-SRT.1.1	Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-SRT.1.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-SRT.1.3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Prove theorems involving similarity

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-SRT.2.4	Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-SRT.2.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

	Cognitive Complexity: Level 3: Strategic Thinking & Complex Reasoning

Cluster 3: Define trigonometric ratios and solve problems involving right triangles

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-SRT.3.6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-SRT.3.7	Explain and use the relationship between the sine and cosine of complementary angles. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-SRT.3.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 4: Apply trigonometry to general triangles

STANDARD CODE	STANDARD
MAFS.912.G-SRT.4.10	Prove the Laws of Sines and Cosines and use them to solve problems. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-SRT.4.11	Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-SRT.4.9	Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY: CIRCLES

Cluster 1: Understand and apply theorems about circles

Geometry - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD

MAFS.912.G-C.1.1	Prove that all circles are similar. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-C.1.2	Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-C.1.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-C.1.4	Construct a tangent line from a point outside a given circle to the circle. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Find arc lengths and areas of sectors of circles

Geometry - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-C.2.5	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: GEOMETRY: EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS

Cluster 1: Translate between the geometric description and the equation for a conic section

Geometry - Additional Cluster
Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-GPE.1.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-GPE.1.2	Derive the equation of a parabola given a focus and directrix. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-GPE.1.3	Derive the equations of ellipses and hyperbolas given the foci and directrices.

	Cognitive Complexity: Level 3: Strategic Thinking & Complex Reasoning

Cluster 2: Use coordinates to prove simple geometric theorems algebraically

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-GPE.2.4	Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-GPE.2.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-GPE.2.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio. *Cognitive Complexity:* Level 1: Recall
MAFS.912.G-GPE.2.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. *Cognitive Complexity:* Level 1: Recall

Domain: GEOMETRY: GEOMETRIC MEASUREMENT & DIMENSION

Cluster 1: Explain volume formulas and use them to solve problems

Geometry - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-GMD.1.1	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.* *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-GMD.1.2	Give an informal argument using Cavalieri's principle for the formulas for the volume of

	a sphere and other solid figures. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.G-GMD.1.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Visualize relationships between two-dimensional and three-dimensional objects

Geometry - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-GMD.2.4	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: GEOMETRY: MODELING WITH GEOMETRY

Cluster 1: Apply geometric concepts in modeling situations

Geometry - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.G-MG.1.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). *Cognitive Complexity:* Level 1: Recall
MAFS.912.G-MG.1.2	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.G-MG.1.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios) *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Domain: STATISTICS & PROBABILITY: INTERPRETING CATEGORICAL & QUANTITATIVE DATA

Cluster 1: Summarize, represent, and interpret data on a single count or measurement variable

Algebra 1 - Additional Cluster
Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-ID.1.1	Represent data with plots on the real number line (dot plots, histograms, and box plots). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-ID.1.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-ID.1.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-ID.1.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Summarize, represent, and interpret data on two categorical and quantitative variables

Algebra 1 - Supporting Cluster
Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-ID.2.5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-ID.2.6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, and exponential models.* b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 3: Interpret linear models

Algebra 1 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-ID.3.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-ID.3.8	Compute (using technology) and interpret the correlation coefficient of a linear fit. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-ID.3.9	Distinguish between correlation and causation. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: STATISTICS & PROBABILITY: MAKING INFERENCES & JUSTIFYING CONCLUSIONS

Cluster 1: Understand and evaluate random processes underlying statistical experiments

Algebra 2 - Supporting Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-IC.1.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population. *Cognitive Complexity:* Level 1: Recall
MAFS.912.S-IC.1.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Algebra 2 - Major Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-IC.2.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-IC.2.4	Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

MAFS.912.S-IC.2.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-IC.2.6	Evaluate reports based on data. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: STATISTICS & PROBABILITY: CONDITIONAL PROBABILITY & THE RULES OF PROBABILITY

Cluster 1: Understand independence and conditional probability and use them to interpret data

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-CP.1.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). *Cognitive Complexity:* Level 1: Recall
MAFS.912.S-CP.1.2	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. *Cognitive Complexity:* Level 1: Recall
MAFS.912.S-CP.1.3	Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-CP.1.4	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-CP.1.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Use the rules of probability to compute probabilities of compound events in a uniform probability model

Algebra 2 - Additional Cluster

Don't … Sort clusters from Major to Supporting, and then teach them in that order. To do so would strip the coherence of the mathematical ideas and miss the opportunity to enhance the major work of the grade with the supporting clusters.

STANDARD CODE	STANDARD
MAFS.912.S-CP.2.6	Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-CP.2.7	Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-CP.2.8	Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-CP.2.9	Use permutations and combinations to compute probabilities of compound events and solve problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Domain: STATISTICS & PROBABILITY: USING PROBABILITY TO MAKE DECISIONS

Cluster 1: Calculate expected values and use them to solve problems

STANDARD CODE	STANDARD
MAFS.912.S-MD.1.1	Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-MD.1.2	Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-MD.1.3	Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-MD.1.4	Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 2: Use probability to evaluate outcomes of decisions

STANDARD CODE	STANDARD
MAFS.912.S-MD.2.5	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.* b. Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.* *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-MD.2.6	Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.S-MD.2.7	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

GRADE: K12

Domain: MATHEMATICAL PRACTICE	
Cluster 1: Make sense of problems and persevere in solving them.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.1.1	**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. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 2: Reason abstractly and quantitatively.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.2.1	**Reason abstractly and quantitatively**. Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 3: Construct viable arguments and critique the reasoning of others.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.3.1	**Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 4: Model with mathematics.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.4.1	**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. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 5: Use appropriate tools strategically.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.5.1	**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. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 6: Attend to precision.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.6.1	**Attend to precision.** Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Cluster 7: Look for and make use of structure.	
STANDARD CODE	**STANDARD**

MAFS.K12.MP.7.1	**Look for and make use of structure.** Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Cluster 8: Look for and express regularity in repeated reasoning.	
STANDARD CODE	**STANDARD**
MAFS.K12.MP.8.1	**Look for and express regularity in repeated reasoning.** Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

GRADE: 912 - CALCULUS

Standard 1: Limits and Continuity Develop an understanding of the concept of limit by estimating limits graphically and numerically and evaluating limits analytically. Extend the idea of a limit to one-sided limits and limits at infinity. Use limits to define and understand the concept of continuity, decide whether a function

is continuous at a point, and find types of discontinuities. Understand and apply continuity theorems.

BENCHMARK CODE	BENCHMARK
MAFS.912.C.1.1	**Understand the concept of limit and estimate limits from graphs and tables of values.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.10	**Decide if a function is continuous at a point.** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.1.11	**Find the types of discontinuities of a function.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.12	**Understand and use the Intermediate Value Theorem on a function over a closed interval.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.13	**Understand and apply the Extreme Value Theorem: If f(x) is continuous over a closed interval, then f has a maximum and a minimum on the interval.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.2	**Find limits by substitution.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.1.3	**Find limits of sums, differences, products, and quotients.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.1.4	**Find limits of rational functions that are undefined at a point.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.1.5	**Find one-sided limits.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.1.6	**Find limits at infinity.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.7	**Decide when a limit is infinite and use limits involving infinity to describe asymptotic behavior.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.8	**Find special limits such as** $\lim_{x \to 0} \frac{\sin x}{x}$ *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.1.9	**Understand continuity in terms of limits.** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Standard 2: Differential Calculus

Develop an understanding of the derivative as an instantaneous rate of change, using geometrical, numerical, and analytical methods. Use this definition to find derivatives of algebraic and transcendental functions and combinations of these functions (using, for example, sums, composites, and inverses). Find second and higher order derivatives. Understand and use the relationship between differentiability and continuity. Understand and apply the Mean

Value Theorem. Find derivatives of algebraic, trigonometric, logarithmic, and exponential functions. Find derivatives of sums, products, and quotients, and composite and inverse functions. Find derivatives of higher order, and use logarithmic differentiation and the Mean Value Theorem.

BENCHMARK CODE	BENCHMARK
MAFS.912.C.2.1	**Understand the concept of derivative geometrically, numerically, and analytically, and interpret the derivative as an instantaneous rate of change or as the slope of the tangent line.** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.2.10	**Understand and use the relationship between differentiability and continuity.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.2.11	**Understand and apply the Mean Value Theorem.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.2.2	**State, understand, and apply the definition of derivative.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.2.3	**Find the derivatives of functions, including algebraic, trigonometric, logarithmic, and exponential functions.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.2.4	**Find the derivatives of sums, products, and quotients.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.2.5	**Find the derivatives of composite functions using the Chain Rule.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.2.6	**Find the derivatives of implicitly-defined functions.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.2.7	**Find derivatives of inverse functions.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.2.8	**Find second derivatives and derivatives of higher order.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.2.9	**Find derivatives using logarithmic differentiation.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Standard 3: Applications of Derivatives

Apply knowledge about derivatives to find slopes of curves and the related tangent lines. Analyze and graph functions, finding where they are increasing or decreasing, their maximum and minimum points, their points of inflection, and their concavity. Solve optimization problems, find average and instantaneous rates of change (including velocities and accelerations), and model rates of change. Find slopes and equations of tangent lines, maximum and minimum points, and points of inflection. Solve optimization problems, and find rates of change.

BENCHMARK CODE	BENCHMARK
MAFS.912.C.3.1	**Find the slope of a curve at a point, including points at which there are vertical tangent lines and no tangent lines.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

MAFS.912.C.3.10	**Find the velocity and acceleration of a particle moving in a straight line.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.11	**Model rates of change, including related rates problems.** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.3.12	**Solve problems using the Newton-Raphson method.** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.3.2	**Find an equation for the tangent line to a curve at a point and a local linear approximation.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.3	**Decide where functions are decreasing and increasing. Understand the relationship between the increasing and decreasing behavior of *f* and the sign of *f'*.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.4	**Find local and absolute maximum and minimum points.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.5	**Find points of inflection of functions. Understand the relationship between the concavity of f and the sign of f". Understand points of inflection as places where concavity changes.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.6	**Use first and second derivatives to help sketch graphs. Compare the corresponding characteristics of the graphs of f, f', and f".** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.3.7	**Use implicit differentiation to find the derivative of an inverse function.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.8	**Solve optimization problems.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.3.9	**Find average and instantaneous rates of change. Understand the instantaneous rate of change as the limit of the average rate of change. Interpret a derivative as a rate of change in applications, including velocity, speed, and acceleration.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Standard 4: Integral Calculus

Understand that integration is used to find areas, and evaluate integrals using rectangular approximations. From this, develop the idea that integration is the inverse operation to differentiation — the Fundamental Theorem of Calculus. Use this result to find definite and indefinite integrals, including using the method of integration by substitution. Apply approximate methods, such as the Trapezoidal Rule, to find definite integrals. Define integrals using Riemann sums, use the Fundamental Theorem of Calculus to find integrals using antiderivatives, and use basic properties of integrals. Integrate by substitution, and find approximate integrals.

BENCHMARK CODE	BENCHMARK
MAFS.912.C.4.1	**Use rectangle approximations to find approximate values of integrals.** *Cognitive Complexity:* Level 1: Recall

MAFS.912.C.4.2	**Calculate the values of Riemann Sums over equal subdivisions using left, right, and midpoint evaluation points.** *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.4.3	**Interpret a definite integral as a limit of Riemann sums.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.4.4	**Interpret a definite integral of the rate of change of a quantity over an interval as the change of the quantity over the interval. That is, $\int_a^b f'(x)dx = f(b) - f(a)$ (Fundamental Theorem of Calculus).** *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.4.5	**Use the Fundamental Theorem of Calculus to evaluate definite and indefinite integrals and to represent particular antiderivatives. Perform analytical and graphical analysis of functions so defined.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.4.6	**Use these properties of definite integrals:** • $\int_a^b [f(x) + g(x)]dx = \int_a^b f(x)dx + \int_a^b g(x)dx$ • $\int_a^b k \cdot f(x)dx = k \int_a^b f(x)dx$ • $\int_a^a f(x)dx = 0$ • $\int_a^b f(x)dx = -\int_b^a f(x)dx$ • $\int_a^b f(x)dx + \int_b^c f(x)dx = \int_a^c f(x)dx$ • If $f(x) \le g(x)$ on $[a, b]$, then $\int_a^b f(x)dx \le \int_a^b g(x)dx$ *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.4.7	**Use integration by substitution (or change of variable) to find values of integrals.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.4.8	**Use Riemann Sums, the Trapezoidal Rule, and technology to approximate definite integrals of functions represented algebraically, geometrically, and by tables of values.** *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts

Standard 5: Applications of Integration

Apply knowledge about integrals to finding velocities from accelerations, solving separable differential equations, and finding areas and volumes. Apply integration to model, and solve problems in physics, biology, economics, etc. Find velocity functions and position functions from their derivatives, solve separable differential equations, and use definite integrals to find areas and volumes.

BENCHMARK CODE	BENCHMARK
MAFS.912.C.5.1	**Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position functions from velocity**

	functions, and solving applications related to motion along a line. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.5.2	Solve separable differential equations, and use them in modeling. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.5.3	Solve differential equations of the form $\frac{dy}{dt} = ky$ as applied to growth and decay problems. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.5.4	Use slope fields to display a graphic representation of the solution to a differential equation, and locate particular solutions to the equation. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.5.5	Use definite integrals to find the area between a curve and the x-axis or between two curves. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
MAFS.912.C.5.6	Use definite integrals to find the average value of a function over a closed interval. *Cognitive Complexity:* Level 1: Recall
MAFS.912.C.5.7	Use definite integrals to find the volume of a solid with known cross-sectional area, including solids of revolution. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
MAFS.912.C.5.8	Apply integration to model, and solve problems in physical, biological, and social sciences. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts