NORTH DAKOTA DEPARTMENT OF PUBLIC INSTRUCTION

Crosswalk Between the 2017 and 2023 North Dakota Mathematics Content Standards K-12

July 2023

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Introduction

The Standards Writing Committee has created a crosswalk between the 2017 and 2023 North Dakota Mathematics K-12 Standards. This document shows the changes made between the 2017 standards and the revised 2023 math standards. It was developed to help schools implement the revised standards.

General Changes

- The 2023 North Dakota Mathematics Content Standards consist of four main categories: Number and Operations, Algebraic Reasoning, Geometry and Measurement, and Data, Probability and Statistics.
- The order of the standards was changed to reflect the development of concepts and skills in mathematics.
- The committee examined the progression of mathematical knowledge throughout the grade levels, especially at the elementary level.
- The order of the sub-categories in the middle school area was changed. The Ratio and Proportion subcategory was placed within Algebraic Reasoning in grades six and seven.
- < UNK> High school standards are divided into two grade spans rather than broadly placed into categories, as this better identifies the assessed standards at grades 9-10 and allows districts to identify standards within courses.
- The 2023 standards focus on skills the students need to be proficient at the end of the grade level.
- The elementary standards focus on the development of arithmetic skills. In middle school, students start applying these skills and building pre-algebra skills. In high school, students develop and expand algebraic skills and knowledge of geometry.
- The committee adopted the 2022 North Dakota Learning Continuum version of math attributes. This action reduced the number of mathematical practices to three. An alignment document was created to identify the connections between each attribute and the 2017 mathematical practices.
    - **Problem-solving** – this attribute includes the practice of making sense of problems and persevering in solving them, as well as attending to precision.
    - **Connections** – this attribute includes looking for and using structure and looking for and expressing regularity in repeated reasoning.
    - **Reasoning and Proof** – this attribute includes the practices of modeling and using tools strategically, reasoning abstractly and quantitatively, and the communication practices of constructing viable arguments and critiquing the reasoning of others.
- The math attributes are embedded in the standards through justifications and explanations.

Grade Level Crosswalks

Kindergarten

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Counting and Cardinality (CC) *Learners will understand the relationship between numerical symbols, names, quantities, and counting sequences.*	**Counting and Cardinality** *Know number names and the count sequence. Count to tell the number of objects. Compare numbers.*	
K.NO.CC.1 Count verbally in sequential order by ones and tens to 100, making accurate decuple transitions (e.g., 89 to 0). Count verbally forward from any given number within 100.	**K.CC.1** Count to 100 by ones and tens. Count backward from 20 by ones. **K.CC.2** Count forward beginning from a given number within 100. Count backward from a given number within 10.	The new standard separates the skills of counting forward and backward from any given number. They add the ability to decuple or make transitions to the next ten.
K.NO.CC.2 Count backward from 20 by ones and from a given number within 10.	**K.CC.1** Count to 100 by ones and tens. Count backward from 20 by ones. **K.CC.2** Count forward beginning from a given number within 100. Count backward from a given number within 10.	The new standard separates the skills of counting forward and backward from any given number.
K.NO.CC.3 Identify and write any given numeral within 20.	**K.CC.3** Write numbers sequentially from 0-20. Write a given number from 0-20.	The new standard requires students to both identify and write numerals.
K.NO.CC.4 Recognize and verbally label arrangements, without counting, for briefly shown collections up to 10 (e.g., "I saw 5." How do you know? "I saw 3 and 2, that is 5.").		The new standards include subitizing, which was not included in 2017.
K.NO.CC.5 Count and tell how many objects up to 20 are in an arranged pattern or up to 10 objects in a scattered configuration. Represent a quantity of up to 20 with a numeral.	**K.CC.4** Understand the relationship between numbers and quantities up to 20; connect counting to cardinality. a. Use one-to-one correspondence when counting. **K.CC.5** Count to answer "how many?" questions. a. Tell how many objects up to 20 are in an arranged pattern (e.g., a line or an array) or up to 10 objects in a scattered configuration. b. Represent a number of objects up to 20 with a written numeral. c. Given a number from 1-20, count out that many objects.	The new standard combines the standards addressing counting objects in sets or groups.

	K.CC.4b. Understand that the last number name said tells the number of objects counted, regardless of their arrangement or order in which they were counted. **K.CC.4c.** Understand that each successive number name refers to a quantity that is one more.	These skills from the 2017 standard are skills that lead to proficiency with K.NO.CC.5. The skills are embedded into K.NO.CC.5 and lead to proficiency with that standard.
Base Ten (NBT) *Learners will understand the place value structure of the base-ten number system and represent, compare, and perform operations with multi-digit whole numbers and decimals.*	**Number and Operations in Base Ten** *Work with numbers 11-19 to gain foundations for place value.*	
K.NO.NBT.1 Compose and decompose numbers from 11 to 19 using a group of ten ones and some more ones using a model, drawing, or equation.	**K.NBT.1** Compose and decompose numbers from 11 to 19 using a group of ten ones and additional ones. Record each composition or decomposition with a drawing or equation.	The new standard provides examples of ways students may record compositions or decompositions.
K.NO.NBT.2 Compare two numbers between 1 and 20 using words greater than, less than, or equal to.	**K.CC.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, using groups of up to 10 objects. **K.CC.7** Compare two numbers between 1 and 10 presented as written numerals.	The new standard combines the two 2017 standards addressing number comparison.
Fractions (NF) *Learners will understand fractions and equivalency to represent, compare, and perform operations of fractions and decimals.*		
NOTE: Standards begin at first grade		
ALGEBRAIC REASONING (AR) **Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.**		
Operations and Algebraic Thinking (OA) *Learners will analyze patterns and relationships to generate and interpret numerical expressions.*	**Operations and Algebraic Thinking** *Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.*	
K.AR.OA.1 Automatically add and subtract within 5.	**K.OA.5** Fluently add and subtract within 5.	The new standard expects this skill to be automatic. Students should be able to add and subtract basic facts within 5 without conscious thought. They should have facts taught beyond five. They are expected to develop a flexible understanding of **both** vertical and horizontal orientation**.** (See Appendix B in the standards document.)

K.AR.OA.2 For any number from 1 to 9, find the number that makes 10 when added to the given number, sharing the answer with a model, drawing, or equation.	**K.OA.4** Find the number that makes 10 when added to a given number from 1 to 9. Record with a drawing or equation.	The new standard combines the two previous standards by embedding the representation methods.
K.AR.OA.3 Decompose numbers less than or equal to 10 into pairs in more than one way using verbal explanations, objects, or drawings.	**K.OA.3** Decompose numbers less than or equal to 10 into multiple combinations of two parts. Record each decomposition with a drawing or equation.	The new standard combines the two previous standards by embedding the representation methods.
K.AR.OA.4 Solve authentic word problems with addition by putting together or adding to within 10.	**K.OA.2** Use an appropriate strategy to solve word problems that involve adding and subtracting within 10. **K.OA.1** Represent addition and subtraction in a variety of ways.	The new standard separates addition and subtraction.
K.AR.OA.5 Solve authentic word problems with subtraction by taking apart or taking from within 10.	**K.OA.2** Use an appropriate strategy to solve word problems that involve adding and subtracting within 10. **K.OA.1** Represent addition and subtraction in a variety of ways.	The new standard separates addition and subtraction.
K.AR.OA.6 Recognize, duplicate, complete, and extend repeating patterns in a variety of contexts (e.g., shape, color, size, objects, sounds, movements).		The new standard adds pattern recognition, duplication, completion, and repetition.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Geometry (G) *Learners will compose and classify figures and shapes based on attributes and properties and represent and solve problems using a coordinate plane.*	**Geometry** *Identify and describe shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres. Compare, classify, and compose shapes.*	
K.GM.G.1 Name shapes and identify them as two-dimensional (squares, circles, triangles, rectangles) regardless of their orientations or overall sizes.	**K.G.1** Describe objects in the environment using names of shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres). **K.G.2** Correctly name shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres) regardless of their orientations or overall size. **K.G.3** Identify shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres) as two-dimensional or three-dimensional.	The new standard divides two- and three-dimensional components of the 2017 standards.

K.GM.G.2 Name shapes and identify them as three-dimensional (cubes and spheres) regardless of their orientations or overall sizes.	**K.G.1** Describe objects in the environment using names of shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres). **K.G.2** Correctly name shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres) regardless of their orientations or overall size. **K.G.3** Identify shapes and solids (squares, circles, triangles, rectangles, cubes, and spheres) as two-dimensional or three-dimensional.	The new standard divides two- and three-dimensional components of the 2017 standards.
K.GM.G.3 Compare and classify two-dimensional shapes to describe their similarities, differences, and attributes (squares, circles, triangles, rectangles).	**K.G.4** Compare and classify two-dimensional shapes (squares, circles, triangles, rectangles) of different sizes and orientations, using informal language to describe their similarities, differences, and attributes.	The new standard summarizes the 2017 standard.
K.GM.G.4 Compose a geometric shape by combining two or more simple shapes.	**K.G.6** Compose a new shape by combining two or more simple shapes.	The meaning of the two standards is the same.
Measurement (M) *Learners will represent and calculate measurement data, including time, money, and geometric measurement, and convert like measurement units within a given system.*	**Measurement and Data** *Describe and compare measurable attributes.*	
K.GM.M.1 Compare and order two objects with a common measurable attribute.	**K.MD.1** Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. **K.MD.2** Compare two objects with a common measurable attribute and describe the difference.	The new standard combines the two 2017 standards. Students demonstrate an understanding of measurable attributes as objects are compared and ordered.
K.GM.M.2 Tell time as it relates to daily life today, yesterday, tomorrow, morning, afternoon, night).		The standard was added to start building the concept of time. This standard includes days of the week and concepts of a.m. and p.m.

DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; draw inferences and conclusions and making predictions; and understand and apply basic concepts of probability.**		
Data (D) *Learners will represent and interpret data.*	**Measurement and Data** *Classify objects and count the number of objects in each category.*	
K.DPS.D.1 Sort and classify objects (up to 10) based on attributes and explain the reasoning used.	**K.MD.3** Classify objects into given categories limiting the number in each category to 10 or less. Count the number of objects in each category and sort the categories by count.	The new standard adds sorting the objects based on attributes. It also adds the requirement to explain the reasoning used.

Grade 1

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Counting and Cardinality (CC) *Learners will understand the relationship between numerical symbols, names, quantities, and counting sequences.*		
1.NO.CC.1 Count forward by ones and tens from any given point within 120.	**1.NBT.1** Count forward and backward within 120, starting at any given number. Read and write numerals within 120. Represent a number of objects up to 120 with a written numeral.	The new standard focuses on counting forward. The new standard divides the skills of counting forward and backward. It also separates counting and writing numbers.
1.NO.CC.2 Count backward by ones and tens from a given number within 120.	**1.NBT.1** Count forward and backward within 120, starting at any given number. Read and write numerals within 120. Represent a number of objects up to 120 with a written numeral.	The new standard focuses on counting backward. The new standard divides the skills of counting forward and backward. It also separates counting and writing numbers.
1.NO.CC.3 Represent several objects with a written numeral up to 120.	**1.NBT.1** Count forward and backward within 120, starting at any given number. Read and write numerals within 120. Represent a number of objects up to 120 with a written numeral.	The new standard focuses on writing numerals. The new standard divides the skills of counting forward and backward. It also separates counting and writing numbers.
1.NO.CC.4 Recognize and verbally label arrangements, without counting, for briefly shown collections up to 20 (e.g., “I saw 16.” How do you know?” “I saw 10 and 6, that is 16.”).		The new standard includes subitizing, which was not included in 2017.
1.NO.CC.5 Skip count forward and backward by 5s and 10s from multiples and recognize the patterns of up to 10 skip counts.		This is a new standard. Skip counting was added to first grade because this skill will be needed for time and money.

Base Ten (NBT) *Learners will understand the place value structure of the base-ten number system and represent, compare, and perform operations with multi-digit whole numbers and decimals.*	**Number and Operations in Base Ten** *Extend the counting sequence. Understand place value. Use place value understanding and properties of operations to add and subtract.*	
1.NO.NBT.1 Demonstrate that the two digits of a two-digit number represent a composition of some tens and some ones.	**1.NBT.2** Demonstrate understanding that the two digits of a two-digit number represent amounts of tens and ones, including: 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 additional ones. c. Multiples of 10 up to 90 represent a number of tens and 0 ones.	The new standard does not include the strategies listed in 2017. The standards identify knowledge and skills students need to be proficient, not strategies.
1.NO.NBT.2 Compare two two-digit numbers using the symbols >, <, and =. Justify comparisons based on the value of tens and ones.	**1.NBT.3** Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <.	The new standard summarizes the 2017 standard.
1.NO.NBT.3 Add within 100 using a two-digit number and a one-digit number. Use concrete models, drawings, and strategies that reflect an understanding of place value.	**1.NBT.4** Demonstrate understanding of place value when adding two-digit numbers within 100. a. Add a two-digit number and a one-digit number. b. Add a two-digit number and a multiple of 10. Use concrete models or drawing strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to add and subtract within 100. Relate the strategy to a written method and explain the reasoning used.	The new standard summarizes the 2017 standard.
1.NO.NBT.4 Subtract multiples of 10 within 100 using concrete models, drawings, and strategies that reflect an understanding of place value.	**1.NBT.6** Use concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to subtract multiples of 10 in the range of 10-90 from multiples of 10 in the same range resulting in a positive or zero difference. Use a written method to explain the strategy.	The new standard summarizes the 2017 standard.
1.NO.NBT.5 Mentally add or subtract 10 to or from a given two-digit number and explain the reasoning used.	**1.NBT.5** Mentally add or subtract 10 to or from a given two-digit number. Explain the reasoning used.	The standards are the same.

Fractions (NF) *Learners will understand fractions and equivalency to represent, compare, and perform operations of fractions and decimals.*		
1.NO.NF.1 Partition circles and rectangles into two and four equal shares using the language halves and fourths.	**1.G.3** Partition circles and rectangles into two equal shares. Describe the shares using the word halves and use the phrase half of. Describe the whole as two of the shares.	This standard was moved to the fraction area since it introduces fractions. The new standard adds fourths.
ALGEBRAIC REASONING (AR) **Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.**		
Operations and Algebraic Thinking (OA) *Learners will analyze patterns and relationships to generate and interpret numerical expressions.*	**Operations and Algebraic Thinking** *Represent and solve problems involving addition and subtraction. Understand and apply properties of operations and the relationship between addition and subtraction. Add and subtract within 20. Work with addition and subtraction equations.*	
1.AR.OA.1 Automatically add and subtract within 10.	**1.OA.6** Use strategies to add and subtract within 20. Fluently add and subtract within 10.	The new standard expects this skill to be automatic. Students should be able to add and subtract basic facts within 10 without conscious thought. They should have facts taught beyond ten. They are expected to develop a flexible understanding of **both** vertical and horizontal orientation. (See Appendix B in the standards document.)
1.AR.OA.2 For any number from 1 to 19, find the number that makes 20 when added to the given number, sharing the answer with a model, drawing, or equation.	**1.OA.1** Use strategies to add and subtract within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions. **1.OA.6** Use strategies to add and subtract within 20. Fluently add and subtract within 10.	The new standard focuses on adding on to find the answer to an addition problem.
1.AR.OA.3 Decompose numbers less than or equal to 20 into pairs more than one way.	**1.OA.1** Use strategies to add and subtract within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions. **1.OA.6** Use strategies to add and subtract within 20. Fluently add and subtract within 10.	The new standard focuses on decomposing numbers. It builds on the skills learned in K.AR.OA.3.

1.AR.OA.4 Solve authentic word problems with addition, including three numbers and unknowns, within 20.	**1.OA.1** Use strategies to add and subtract within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions. **1.OA.2** Use strategies to add and subtract within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions. **1.OA.3** Apply properties of operations as strategies to add and subtract. **1.OA.8** Determine the unknown whole number in an addition or subtraction equation that uses three whole numbers.	The new standard combines the four standards from 2017. It separates the concepts of addition and subtraction.
1.AR.OA.5 Solve authentic word problems with subtraction, including unknowns, within 20.	**1.OA.1** Use strategies to add and subtract within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions. **1.OA.2** Solve word problems that call for the addition of three whole numbers whose sum is less than or equal to 20. **1.OA.3** Apply properties of operations as strategies to add and subtract. **1.OA.4** Demonstrate understanding of subtraction as an unknown-addend problem.	The new standard combines the four standards from 2017. It separates the concepts of addition and subtraction.
1.AR.OA.6 Use the +, -, and = symbols accurately in an equation.	**1.OA.7** Demonstrate understanding of the meaning of the equal sign and determine if equations involving addition and subtraction are true or false	The new standard summarizes the 2017 standard.
1.AR.OA.7 Identify, create, complete, and extend patterns that are repeating, increasing, and decreasing in a variety of contexts.		The new standard adds work with patterns, which will lead to work with functions at middle school.
	1.OA.5 Relate counting to addition and subtraction.	The 2017 standard represents a strategy used to meet standards 1.AR.OA.4 and 1.AR.OA.5.

GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Geometry (G) *Learners will compose and classify figures and shapes based on attributes and properties and represent and solve problems using a coordinate plane.*	**Geometry** *Reason with shapes and solids and their attributes (squares, circles, triangles, rectangles, trapezoids, rhombuses, pentagons, hexagons, octagons, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prisms).*	
1.GM.G.1 Name shapes and identify them as two-dimensional (trapezoids, rhombuses, pentagons, hexagons, octagons).		This standard builds upon the two-dimensional shape recognition started in the previous grade (K.GM.G.1).
1.GM.G.2 Name and identify solids as three-dimensional (cylinders, cones, triangular prisms, and rectangular prisms).		This standard builds upon the three-dimensional shape recognition started in the previous grade (K.GM.G.2).
1.GM.G.3 Determine geometric attributes of two-dimensional and three-dimensional shapes (squares, circles, triangles, rectangles, trapezoids, rhombuses, pentagons, hexagons, octagons, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prisms).	**1.G.1** Distinguish between defining attributes versus non-defining attributes. Use defining attributes to build and draw two-dimensional shapes (squares, circles, triangles, rectangles, trapezoids, rhombuses, pentagons, hexagons, and octagons).	The new standard clarifies the expectations of the 2017 standard. This standard includes the shapes from K.GM.G.3.
1.GM.G.4 Compose a geometric shape or solid by combining multiple two-dimensional shapes and/or three-dimensional solids (squares, circles, triangles, rectangles, trapezoids, rhombuses, pentagons, hexagons, octagons, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prisms).	**1.G.2** Compose a new shape or solid from two-dimensional shapes and/or three-dimensional solids (squares, circles, triangles, rectangles, trapezoids, rhombuses, pentagons, hexagons, octagons, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prisms).	The new standard clarifies the expectations of the 2017 standard.
Measurement (M) *Learners will represent and calculate measurement data, including time, money, and geometric measurement, and convert like measurement units within a given system.*	**Measurement and Data** *Measure lengths indirectly and by iterating length units. Work with time. Identify and count money.*	
1.GM.M.1 Measure the length of an object as a whole number of same-size, non-standard units from end to end.	**1.MD.2** Demonstrate understanding that the length measurement of an object is the number of same-size length units that span the object with no gaps or overlaps. Measure and express the length of an object using whole non-standard units	The new standard clarifies and summarizes the 2017 standard.

1.GM.M.2 Compare the lengths of three objects using a common measurable attribute.	**1.MD.1** Order three objects by length. Compare the lengths of two objects indirectly by using a third object.	The new standard focuses on comparing the length of three objects using a common measurable attribute.
1.GM.M.3 Tell and write time to the hour and half-hour (including o'clock and half past) using analog and digital clocks.	**1.MD.3** Tell and write time to the hour and half-hour (including o'clock and half past) using analog and digital clocks	The standards are the same.
1.GM.M.4 Identify and tell the value of a dollar bill, quarter, dime, nickel, and penny.	**1.MD.5** Identify and tell the value of a dollar bill, quarter, dime, nickel, and penny.	The standards are the same.
1.GM.M.5 Count collections of coins (pennies, nickels, and dimes) relating to patterns of counting by 1s, 5s, and 10s up to one dollar.	**1.MD.6** Count and tell the value of combinations of dimes and pennies up to one dollar.	The new standard adds nickels and connects the skip counting learned in standard 1.NO.CC.5. This standard also applies to patterns and counting skills taught in kindergarten.
DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data, drawing inferences conclusions, and making predictions, and understanding and applying basic concepts of probability.**		
Data (D) *Learners will represent and interpret data.*	**Measurement and Data** *Represent and interpret data.*	
1.DPS.D.1 Collect, organize, and represent data in up to three categories using pictures and bar graphs.	**1.MD.4** Organize, represent, and interpret data with up to three categories. Ask and answer questions about the total number of data points, how many are in each category, and how many more or less are in one category than in another.	The new standard focuses on the collection of data and graphing the data on picture and bar graphs.
1.DPS.D.2 Analyze data by answering descriptive questions.	**1.MD.4** Organize, represent, and interpret data with up to three categories. Ask and answer questions about the total number of data points, how many are in each category, and how many more or less are in one category than in another.	The new standard focuses on the data analysis portion of the 2017 standard.

Grade 2

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Counting and Cardinality (CC) *Learners will understand the relationship between numerical symbols, names, quantities, and counting sequences.*		
2.NO.CC.1 Count forward from any given number within 1000.	**2.NBT.2** Count forward and backward from any given number within 1000.	The new standard separates counting forward and backward.
2.NO.CC.2 Count backward from any given number within 1000.	**2.NBT.2** Count forward and backward from any given number within 1000.	The new standard separates counting forward and backward.
2.NO.CC.3 Read and write numbers up to 1000 using standard, word, and expanded forms.	**2.NBT.3** Read and write numbers up to 1000 using base-ten numerals, number names, and expanded forms.	The new standard added writing the numbers in word form; spelling is not assessed.
2.NO.CC.4 Skip count forward and backward by 2s and 100s and recognize the pattern of skip counts.	**2.NBT.2** Skip-count by 5s, 10s, and 100s.	The new standard adds skip counting by twos. Skip counting by fives and tens was moved to first grade to align with the study of time and money. The new standard specifies skip counting both forward and backward and the recognition of patterns of skip counts.
Base Ten (NBT) *Learners will understand the place value structure of the base-ten number system and represent, compare, and perform operations with multi-digit whole numbers and decimals.*	**Number and Operations in Base Ten** *Understand place value. Use place value understanding and properties of operations to add and subtract.*	
2.NO.NBT.1 Understand that the three digits of a three-digit number represent a composition of some hundreds, some tens, and some ones.	**2.NBT.1** Demonstrate understanding that the three digits of a three-digit number represent amounts of hundreds, tens, and ones, including: a. 100 can be thought of as a bundle of ten tens called a “hundred”. b. Multiples of 100 represent a number of hundreds, 0 tens, and 0 ones.	The new standard summarizes the 2017 standard.
2.NO.NBT.2 Compare two three-digit numbers using the symbols >, <, and =. Justify comparisons based on the value of hundreds, tens, and ones.	**2.NBT.4** Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, recording the results of comparisons with the symbols >, =, and >.	The new standard summarizes the 2017 standards and adds the attribute/practice of justification.

2.NO.NBT.3 Add within 100 using place value strategies and/or the relationship between addition and subtraction.	**2.NBT.5** Use strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to fluently add and subtract within 100. **2.NBT.6** Use strategies based on place value and properties of operations to add up to four two-digit numbers. **2.MD.6** Represent whole numbers on a number line diagram with equally spaced points. Represent whole-number sums and differences within 100 on a number line diagram.	The new standard combines the two standards from 2017. Students are expected to develop a flexible understanding of **both** the vertical and horizontal orientation. The clarifications for this standard include the use of number line diagrams as one strategy.
2.NO.NBT.4 Subtract within 100 using place value strategies and/or the relationship between addition and subtraction.	**2.NBT.5** Use strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to fluently add and subtract within 100 **2.MD.6** Represent whole numbers on a number line diagram with equally spaced points. Represent whole-number sums and differences within 100 on a number line diagram.	The new standard combines the two 2017 standards. Students are expected to develop a flexible understanding of **both** the vertical and horizontal orientation. The clarifications for this standard include the use of number line diagrams as one strategy. The addition was placed in standard 2.NO.NBT.3.
2.NO.NBT.5 Mentally add or subtract 10 or 100 to or from a given number between 100 and 900.	**2.NBT.8** Mentally add or subtract 10 or 100 to or from a given number between 100 and 900.	The standards are the same.
	2.NBT.7 Demonstrate understanding of place value within 1000 when adding and subtracting three-digit numbers. Use concrete models or drawings and strategies based on place value, properties of operation, and/or the relationship between addition and subtraction to add and subtract within 1000. Use a written method to explain the strategy.	The second-grade standard was changed to add up to 100 to prevent a disconnect between the expectations in the 2017 standards. Students are expected to add up to 1000 in third grade. Adding and subtracting is part of standards 2.NO.NBT.3 and 2.NO.NBT.4.
Fractions (NF) *Learners will understand fractions and equivalency to represent, compare, and perform operations of fractions and decimals.*		
2.NO.NF.1 Partition circles and rectangles into two, three, and four equal shares. Describe the shares using the language of halves, thirds, fourths, half of, a third of, and a fourth of.	**2.G.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, and four-fourths.	The standard was moved to fractions since this skill is the beginning of learning about fraction concepts. The new standard summarizes the 2017 standard.

2.NO.NF.2 Recognize that identical wholes can be equally divided in different ways.	**2.G.3** Recognize that identical wholes can be equally divided in different ways.	The standard was moved to fractions since this skill is the beginning of learning about fraction concepts. The standards are the same.
2.NO.NF.3 Recognize that partitioning shapes into more equal shares creates smaller shares.	**2.G.3** Demonstrate understanding that partitioning shapes into more equal shares creates smaller shares. **2.G.2** Partition a rectangle into rows and columns of same-size squares and count to find the total number.	The standard was moved to fractions since this skill is the beginning of learning about fraction concepts. The new standard summarizes the standard from 2017 and embeds 2.G.2.
ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
Operations and Algebraic Thinking (OA) *Learners will analyze patterns and relationships to generate and interpret numerical expressions.*	**Operations and Algebraic Thinking** *Represent and solve problems involving addition and subtraction. Add and subtract within 20. Work with equal groups to gain a foundation for multiplication.*	
2.AR.OA.1 Automatically add and subtract within 20.	**2.OA.2** Use mental strategies to fluently add and subtract within 20.	The new standard expects addition and subtraction of basic facts to be automatic. Students should be able to add and subtract basic facts without conscious thought. They are expected to develop a flexible understanding of **both** vertical and horizontal orientation. (See Appendix B in the standards document.)
2.AR.OA.2 Apply the properties of operations to solve addition and subtraction equations within 100 and justify thinking.	**2.NBT.5** Use strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to fluently add and subtract within 100. **1.OA.3** Apply properties of operations as strategies to add and subtract.	The new standard maintains the consistency of working with problems within 100 using properties of operations. (See Appendix A, Table 1 in the standards document.) The justification of thinking as the problem is solved incorporates the attributes of practices.
2.AR.OA.3 Solve one and two-step authentic word problems with addition within 100, including the use of unknowns.	**2.OA.1** Use strategies to add and subtract 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.	The new standard summarizes the 2017 standard and does not identify strategies that may be used. The new standard expects students to experience problems in both horizontal and vertical orientations.
2.AR.OA.4 Solve one- and two-step authentic word problems with subtraction within 100, including the use of unknowns.	**2.OA.1** Use strategies to add and subtract 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.	The new standard summarizes the 2017 standard and does not identify strategies that may be used. The new standard expects students to experience problems in both horizontal and vertical orientations.

2.AR.OA.5 Use repeated addition to find the total number of objects arranged in a rectangular array.	**2.OA.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.	The new standard summarizes the 2017 standard and does not limit the size of the array.
2.AR.OA.6 Identify a group of objects from 0 to 20 as even or odd by showing even numbers as a sum of two equal parts.	**2.OA.3** Determine whether a given number of objects up to 20 is odd or even. Write an equation to represent an even number using two equal addends or groups of 2.	The new standard summarizes the concept within the 2017 standard.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Geometry (G) *Learners will compose and classify figures and shapes based on attributes and properties and represent and solve problems using a coordinate plane.*	**Geometry** *Reason with shapes and their attributes (squares, circles, triangles, rectangles, trapezoids, rhombuses, pentagons, hexagons, octagons, parallelograms, quadrilaterals, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prism).*	
2.GM.G.1 Identify two-dimensional shapes (parallelograms and quadrilaterals).	**2.G.1** Identify trapezoids, rhombuses, pentagons, hexagons, octagons, parallelograms, quadrilaterals, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prisms. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces (pentagons, hexagons, octagons).	The new standard builds upon standards at previous grade levels (K.GM.G.1 and 1.GM.G.1) and focuses on two-dimensional shapes.
2.GM.G.2 Identify two-dimensional shapes found within three-dimensional shapes.		The new standard builds the connection between two- and three-dimensional shapes and leads to the identification of attributes.
2.GM.G.3 Compose geometric shapes having specified geometric attributes such as a given number of edges, angles, faces, vertices, and/or sides.	**2.G.1** Identify trapezoids, rhombuses, pentagons, hexagons, octagons, parallelograms, quadrilaterals, cubes, spheres, cylinders, cones, triangular prisms, and rectangular prisms. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces (pentagons, hexagons, octagons).	The new standard develops the concepts of attributes students will use to describe shapes in later grades.

Measurement (M) *Learners will represent and calculate measurement data, including time, money, and geometric measurement, and convert like measurement units within a given system.*	**Measurement and Data** *Measure and estimate lengths in standard units. Relate addition and subtraction to equal intervals on a number line. Work with time and money.*	
2.GM.M.1 Measure the length of an object using two different standard units of measurement. Describe how the two measurements relate to the size of the units chosen.	**2.MD.1** Select and use appropriate tools to measure the length of an object. **2.MD.2** Measure the length of an object using two different standard units of measurement. Describe how the two measurements relate to the size of the units chosen.	The new standard combines three standards from 2017 that pertain to the same concept.
2.GM.M.2 Estimate and measure to determine how much longer one object is than another, expressing the difference with a standard unit of measurement.	**2.MD.3** Estimate lengths using units of inches, feet, centimeters, and meters. **2.MD.4** Measure to determine how much longer one object is than another, expressing the difference with a standard unit of measurement.	The new standard incorporates estimation prior to measuring.
2.GM.M.3 Tell and write time to the nearest five minutes (including quarter after and quarter to) with a.m. and p.m. using analog and digital clocks.	**2.MD.7** Tell and write time to the nearest five minutes (including quarter after and quarter to) with a.m. and p.m. using analog and digital clocks.	The standards are the same.
2.GM.M.4 Count collections of money (dollar bills, quarters, dimes, nickels, and pennies) relating to counting patterns by 1s, 5s, and 10s to one dollar.	**2.MD.8** Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately.	The new standard builds money-counting skills to help students develop the concept of money, further applying those concepts to solve problems using money. The problem-solving skills were moved to third grade.

DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data, drawing inferences and conclusions, making predictions, and understanding and applying basic concepts of probability.**		
Data (D) *Learners will represent and interpret data.*	**Measurement and Data** *Represent and interpret data.*	
2.DPS.D.1 Formulate questions to collect, organize, and represent data with up to four categories using single unit scaled pictures and bar graphs.	**2.MD.9** Generate data by measuring the lengths of objects to the nearest whole standard unit. Show the measurements by making a line plot using a horizontal scale marked off in whole-number units. **2.MD.10** Draw picture and bar graphs with single-unit scales to represent data sets with up to four categories. Solve simple, put-together, take-apart, and compare problems using information presented in a bar graph.	The new standard combines two standards from 2017. Students are expected to collect, organize, and represent data in scaled pictures and bar graphs.
2.DPS.D.2 Generate data and create line plots marked in whole-number units.	**2.MD.9** Generate data by measuring the lengths of objects to the nearest whole standard unit. Show the measurements by making a line plot using a horizontal scale marked off in whole-number units.	The new standard summarizes the 2017 standard.
2.DPS.D.3 Analyze data and interpret the results to solve one-step comparison problems using information from the graphs.	**2.MD.10** Draw picture and bar graphs with single-unit scales to represent data sets with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.	The new standard focuses on data analysis and the use of data in graphs to solve problems.

Grade 3

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Counting and Cardinality (CC) *Learners will understand the relationship between numerical symbols, names, quantities, and counting sequences.*		
3.NO.CC.1 Read and write numbers up to 10,000 using objects or visual representations, including standard, word, and expanded form.		The new standard builds upon the number sense developed in the earlier grades and applies that knowledge to larger numbers.
Base Ten (NBT) *Learners will understand the place value structure of the base-ten number system and represent, compare, and perform operations with multi-digit whole numbers and decimals.*	**Number and Operations in Base Ten** *Use place value understanding and properties of operations to perform multi-digit arithmetic.*	
3.NO.NBT.1 Compare two four-digit numbers using symbols >, <, and =. Justify comparisons based on the value of thousands, hundreds, tens, and ones.		The new standard expands the ability of students to compare numerals to larger numbers.
3.NO.NBT.2 Apply place value understanding to round whole numbers to the nearest 10 or 100.	**3.NBT.1** Use place value understanding to round whole numbers to the nearest 10 or 100.	The standards are the same.
3.NO.NBT.3 Add and subtract within 1000 using place value strategies, algorithms, and/or the relationship between addition and subtraction.	**3.NBT.2** Using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction, fluently add and subtract within 1000. **2.NBT.7** Demonstrate understanding of place value within 1000 when adding and subtracting three-digit numbers. Use concrete models or drawings and strategies based on place value, properties of operation, and/or the relationship between addition and subtraction to add and subtract within 1000. Use a written method to explain the strategy.	The new standard combines the 2017 second and third-grade standards. The second-grade standard was moved to third grade to allow a progression to develop addition skills. Students are expected to develop a flexible understanding of **both** the vertical and horizontal orientation of problems. The new standards include the use of the algorithm.
3.NO.NBT.4 Multiply one-digit whole numbers by multiples of 10 within 100.	**3.NBT.3** Using strategies based on place value and properties of operations, multiply one-digit whole numbers by multiples of 10 in the range 10-90.	The main concept is the same as the 2017 standard. The new standard does not specify strategies.

Fractions (NF) *Learners will understand fractions and equivalency to represent, compare, and perform operations of fractions and decimals.*	**Number and Operations – Fractions** *Develop an understanding of fractions as numbers.*	
3.NO.NF.1 Partition two-dimensional figures into equal areas and express the area of each part as a unit fraction of the whole. Describe using the language of sixths, eighths, a sixth of, and an eighth of.	**3.G.2** Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. **3.NF.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.	The new standard combines the concepts within two 2017 standards. This new standard builds on half, third, and fourth from 3.G.1 and 3.G.2 from 2017 but now expects the learners to use the fractional notation within the standard.
3.NO.NF.2 Represent and understand a fraction as a number on a number line.	**3.NF.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 length 1/b from 0. Recognize that the resulting interval has size a/b and its endpoint locates the number a/b on the number line.	The new standard summarizes the main concepts of the 2017 standard. It does not provide the strategies contained in the 2017 standard.
3.NO.NF.3 Represent equivalent fractions using visual representations and number lines.	**3.NF.3** Explain the equivalence of fractions in special cases and compare fractions by reasoning about their size. **3.NF.3a**. Understand two fractions as equivalent (equal) if they are the same size or the same point on a number line. **3.NF.3b** Recognize and generate simple equivalent fractions. Explain why the fractions are equivalent using a visual fraction model.	The new standard summarizes the concept within the 2017 standard and sub-standards. The new standard focuses on representing equivalent fractions on a number line and developing an understanding of equivalent fractions. The generation of equivalent fractions is part of 4.NO.NF.4.
3.NO.NF.4 Recognize whole numbers as fractions and express fractions that are equivalent to whole numbers.	**3.NF.3c** Recognize fractions, a/1 or a/a, that are equivalent to whole numbers. Express whole numbers as fractions, a/1 or a/a.	The new standard summarizes the 2017 standard.

3.NO.NF.5 Compare fractions of the same whole having the same numerators or denominators, using symbols >, <, and =, by reasoning about their size (fractions should be limited to denominators of 2, 3, 4, 6, and 8 and should not exceed the whole).	**3.NF.3d**. Compare two fractions with the same numerator or the same denominator by reasoning about their size. **3.NF.3e**. Recognize that comparisons are valid only when the two fractions refer to the same whole. **3.NF.3f**. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions by using a visual fraction model.	The new standard combines the three sub-standards from 2017.
ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
Operations and Algebraic Thinking (OA) *Learners will analyze patterns and relationships to generate and interpret numerical expressions.*	**Operations and Algebraic Thinking** *Represent and solve problems involving multiplication and division. Understand the properties of multiplication and the relationship between multiplication and division. Multiply and divide within 100. Solve problems involving the four operations and identify and explain patterns in arithmetic.*	
3.AR.OA.1 Using mental strategies, multiply and divide basic facts within 100. Automatically multiply and divide up to 5 x 5 and 10s facts.	**3.OA.7** Using mental strategies, fluently multiply and divide within 100.	The new standard expects basic facts up to 5 x 5 and 10s to be automatic. Students should be able to multiply basic facts without conscious thought. (See Appendix B in the standards document.) The portion of the standard pertaining to multiplication and division facts within 100 is the same as in the 2017 standard. They are expected to develop a flexible understanding of **both** vertical and horizontal orientation**.**
3.AR.OA.2 Apply the properties of operations to solve multiplication and division equations and justify thinking.	**3.OA.5** Apply properties of operations as strategies to multiply and divide (without the use of formal terms).	The new standard concept is the same as the 2017 standard. The new standard embeds the justification attribute/practice.
3.AR.OA.3 Solve two-step authentic word problems using addition and subtraction within 1000, including equations with a letter as an unknown.	**3.OA.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.	The new standard focuses on addition and subtraction since 3.AR.Oa.4 and 3.AR.OA.5 focus on multiplication and division. The 2017 standard combined all operations into one standard.

3.AR.OA.4 Use strategies and visual models to solve authentic word problems with multiplication within 100, including unknowns, using grouping models and equations.	**3.OA.7** Using mental strategies, fluently multiply and divide within 100. **3.OA.1** Interpret and model products of whole numbers. **3.OA.3** Using drawings and equations with a symbol for an unknown number, solve multiplication and division word problems within 100 in situations involving equal groups, arrays, and measurement quantities. **3.OA.4** Determine the unknown whole number in a multiplication or division equation relating three whole numbers.	The new standard combines the 2017 standards and focuses on multiplication in equations using unknowns and grouping models. It does not identify the strategies that may be used with the details of 2017. The new standard breaks multiplication and division into separate standards.
3.AR.OA.5 Use strategies and visual models to solve word problems with the division within 100, including unknowns, using grouping models and equations.	**3.OA.7** Using mental strategies, fluently multiply and divide within 100. **3.OA.3** Using drawings and equations with a symbol for an unknown number, solve multiplication and division word problems within 100 in situations involving equal groups, arrays, and measurement quantities. **3.OA.4** Determine the unknown whole number in a multiplication or division equation relating three whole numbers. **3.OA.2** Interpret and model whole-number quotients of whole numbers, as the number in a group or the number of groups. **3.OA.6** Understand division as an unknown-factor problem.	The new standard combines the 2017 standards and focuses on division in equations using unknowns and grouping models. It does not identify the strategies that may be used with the details of 2017. The new standards break multiplication and division into separate standards.
3.AR.OA.6 Identify arithmetic patterns and explain them using the properties of operations.	**3.OA.9** Identify arithmetic patterns and explain them using properties of operations.	The standards are the same.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Geometry (G) *Learners will compose and classify figures and shapes based on attributes and properties and represent and solve problems using a coordinate plane.*	**Geometry** *Reason with shapes and their attributes.*	
3.GM.G.1 In two-dimensional shapes, identify lines, angles (right, acute, obtuse), and perpendicular and parallel lines.		The new standard builds some of the conceptual knowledge needed to classify shapes in fourth grade. It builds on the concepts about two-dimensional shapes previously taught.

3.GM.G.2 Sort quadrilaterals into categories based on attributes.	**3.G.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. Draw examples of quadrilaterals that do not belong to any of these subcategories.	The new standard focuses on the use of attributes to categorize quadrilaterals which is the second half of the 2017 standard.
3.GM.G.3 Identify lines of symmetry in quadrilaterals.	**4.G.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. Draw lines of symmetry.	The 2017 standard was split between grades three and four. Students draw lines of symmetry in standard 4.GM.G.3.
Measurement (M) *Learners will represent and calculate measurement data, including time, money, and geometric measurement, and convert like measurement units within a given system.*	**Measurement and Data** *Measure and estimate lengths in standard units. Relate addition and subtraction to equal intervals on a number line. Work with time and money.*	
3.GM.M.1 Measure lengths using rulers marked with halves and fourths of an inch.	**3.MD.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 in appropriate units—whole numbers, halves, or quarters.	The new standard summarizes the 2017 standard. The use of line plots is addressed in the data category.
3.GM.M.2 Measure and estimate liquid volumes and masses of objects using standard units. Solve one-step authentic word problems involving masses on volumes that are given in the same units.	**3.MD.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.	The new standard summarizes the 2017 standard.
3.GM.M.3 Tell and write time to the nearest minute and measure time intervals in minutes.	**3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve elapsed time word problems on the hour and the half-hour, using a variety of strategies.	The new standard separates telling time to the nearest minute and elapsed time.
3.GM.M.4 Solve elapsed time authentic word problems on the hour and the half-hour, using a variety of strategies.	**3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve elapsed time word problems on the hour and the half-hour, using a variety of strategies.	The new standard separates telling time to the nearest minute and elapsed time.

3.GM.M.5 Solve authentic word problems involving dollar bills, quarters, dimes, nickels, and pennies appropriately, including the $ and ¢ symbols.	**2.MD.8** Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately.	The standard was moved to third grade to provide students more time to become proficient with counting money and understanding the concept of money taught in the earlier grades.
3.GM.M.6 Solve problems involving the perimeters of rectangles given the side lengths or when given the perimeter and unknown side length(s).	**3.MD.8** Solve real-world and mathematical problems involving the perimeters of polygons, including finding the perimeter given the side lengths. Find an unknown side length. Exhibit with the same perimeter and different area or with the same area and different perimeters.	The new standard focuses on the perimeter within rectangles. This aligns with the expectations in grades 4-5, allowing for a progression of skills.
3.GM.M.7 Recognize area as an attribute of plane figures and understand concepts of area measurement.	**3.MD.5** Recognize area as an attribute of plane figures and understand concepts of area measurement. a. A square with a side length of 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.	The new standard summarizes the main concept of the 2017 standard. It does not include the strategies identified in the sub-standards of the 2017 standards.

3.GM.M.8 Find the area of a rectangle with whole-number side lengths by modeling with unit squares; show that area can be additive and is the same as would be found by multiplying the side lengths.	**3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). **3.MD.7** Relate area to the operations of multiplication and addition. a. Find the area of a rectangle with a whole number of side lengths by tiling it and show that the area is the same as it 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 x b and a x c. Use area model to represent the distributive property in mathematical reasoning. d. Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping parts, applying this technique to solve real-world problems.	The new standard combines the two 2017 standards and does not provide specific strategies to find the area.
DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; drawing inferences and conclusions and making predictions; and understanding and applying basic concepts of probability.**		
Data (D) *Learners will represent and interpret data.*	**Measurement and Data** *Represent and interpret data.*	
3.DPS.D.1 Formulate questions to collect, organize, and represent data with more than four categories using scaled pictures and bar graphs.	**3.MD.3** Draw scaled picture and scaled bar graphs to represent data sets with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.	The new standard focuses on collecting, organizing, and representing data using scaled pictures and bar graphs. The analysis of data included in 2017 is the focus of 3.DPS.D.3.

3.DPS.D.2 Generate data and create line plots marked in whole numbers, halves, and fourths of a unit.	**3.MD.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 in appropriate units—whole numbers, halves, or quarters.	The new standard summarizes the 2017 standard.
3.DPS.D.3 Analyze data and make simple statements to solve one- and two-step problems using information from the graphs.	**3.MD.3** Draw scaled picture graphs and scaled bar graphs to represent data sets with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.	The new standard focuses on data analysis and using data to solve problems. The representation of data from the 2017 standard is part of standard 3.DPS.D.1.

Grade 4

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Counting and Cardinality (CC) *Learners will understand the relationship between numerical symbols, names, quantities, and counting sequences.*		
4.NO.CC.1 Read numbers to the millions place, including word, standard, and expanded form. Write numbers to the millions place, including standard and expanded forms.	**4.NBT.2** Read and write multi-digit whole numbers to the one millions place using base-ten numerals, word form, and expanded form. Compare two multi-digit numbers based on the meanings of the digits in each place, using >, =, < symbols to record the results of comparisons.	The new standard focuses on reading and writing numerals to the millions. The 2017 standard was broken into two separate standards. Comparisons of numbers have been placed in 4.NO.NBT.2.
Base Ten (NBT) *Learners will understand the place value structure of the base-ten number system and represent, compare, and perform operations with multi-digit whole numbers and decimals.*	**Number and Operations in Base Ten** *Use place value understanding and properties of operations to perform multi-digit arithmetic.*	
4.NO.NBT.1 Understand that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right	**4.NBT.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.	The standards are the same.
4.NO.NBT.2 Compare two numbers to the millions place and decimals to the hundredths place, using symbols >, <, and =. Justify comparisons based on the value of the digits.	**4.NBT.2** Read and write multi-digit whole numbers to the one millions place using base-ten numerals, word form, and expanded form. Compare two multi-digit numbers based on the meanings of the digits in each place, using >, =, < symbols to record the results of comparisons. **4.NF.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.	The new standard focuses on comparing numbers and justifying those comparisons based on the application of place value concepts. The 2017 standard was broken into two separate standards. Reading and writing numbers is part of standard 4.NO.CC.1.

4.NO.NBT.3 Apply place value understanding to round multi-digit whole numbers to any place.	**4.NBT.3** Use place value and/or understanding of numbers to round multi-digit whole numbers to any place.	The new standard summarizes the 2017 standard.
4.NO.NBT.4 Add and subtract multi-digit whole numbers to the one millions place using strategies, including the algorithm.	**4.NBT.4** Fluently add and subtract multi-digit whole numbers to the one millions place using strategies flexibly, including the standard algorithm.	The new standard summarizes the 2017 standard.
4.NO.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number and multiply two two-digit numbers. Show and justify the calculation by using equations, rectangular arrays, and models.	**4.NBT.5** Using strategies based on place value and the properties of operations, multiply a whole number of up to four digits by a one-digit whole number and multiply two two-digit numbers. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	The new standard summarizes the 2017 standard.
4.NO.NBT.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors using place value strategies. Show and justify the calculation by using equations, rectangular arrays, and models.	**4.NBT.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.	The new standard summarizes the 2017 standard.
Fractions (NF) *Learners will understand fractions and equivalency to represent, compare, and perform operations of fractions and decimals.*	**Number and Operations – Fractions** *Develop an understanding of fractions as numbers.*	
4.NO.NF.1 Express equivalent fractions with a denominator of 10 and a denominator of 100 to generate a decimal notation.	**4.NF.5** Express a fraction with denominator 10 as an equivalent fraction with denominator 100. Use this technique to add two fractions with respective denominators 10 and 100. **4.NF.6** Use decimal notation for fractions with denominators 10 or 100.	The new standard combines the two 2017 standards and expects students to generate a decimal.
4.NO.NF.2 Explain and demonstrate how a mixed number is equivalent to a fraction greater than one and how a fraction greater than one is equivalent to a mixed number using visual fraction models and reasoning strategies (proper and improper fractions limited to denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100).		This new standard develops the concept of how mixed numbers and fractions greater than one connect. The students need to be exposed to **both** proper and improper fractions to prepare them to work with improper fractions in later grades.

4.NO.NF.3 Generate equivalent fractions using numerical representations, visual representations, and number lines (proper and improper fractions limited to denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100).	**3.NF.3b** Recognize and generate simple equivalent fractions. Explain why the fractions are equivalent using a visual fraction model. **4.NF.1** Using visual fraction models, explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b)). Use this principle to recognize and generate equivalent fractions. Attention should focus on how the number and size of the parts differ even though the two fractions themselves are the same size.	This standard expands standard 3.NO.NF.3 and the 2017 standard. The students need to be exposed to **both** proper and improper fractions to prepare them to work with improper fractions in later grades.
4.NO.NF.4 Demonstrate how equivalent fractions are generated by multiplying a fraction equivalent to 1 or the properties of multiplication (proper and improper fractions limited to denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100).	**4.NF.1** Using visual fraction models, explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b)). Use this principle to recognize and generate equivalent fractions. Attention should focus on how the number and size of the parts differ even though the two fractions themselves are the same size.	The new standard focuses on the generation of equivalent fractions and does not provide the strategy or note for the teacher included in 2017. The students need to be exposed to **both** proper and improper fractions to prepare them to work with improper fractions in later grades.
4.NO.NF.5 Compare and order fractions having unlike denominators. Record comparisons using symbols >, <, and =. Justify using a visual fraction model (proper and improper fractions limited to denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100).	**4.NF.2** By creating common denominators or numerators, or by comparing them to a benchmark fraction such as 1, compare two fractions with different numerators 2 and different denominators. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or	The new standard clarifies the expectations in the 2017 standard. Comparing and ordering fractions with unlike denominators applies equivalent fraction concepts taught previously. The students need to be exposed to **both** proper and improper fractions to prepare them to work with improper fractions in later grades.

4.NO.NF.6 Solve authentic word problems by adding and subtracting fractions and mixed numbers with like denominators (proper and improper fractions limited to denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100).	**4.NF.3** Understand a fraction a/b with a > 1 as a sum of unit 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 with an equation. Justify decompositions by using a visual fraction model or other strategies. c. Add and subtract mixed numbers with like denominators. d. Using visual fraction models and equations, solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators	The new standard focuses on adding and subtracting fractions. In a progression, students would learn how to add and subtract fractions and mixed numbers (2017 standard) to apply the understanding to authentic word problems. The students need to be exposed to **both** proper and improper fractions to prepare them to work with improper fractions in later grades.
4.NO.NF.7 Solve problems by multiplying fractions and whole numbers using visual fraction models (proper and improper fractions limited to denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100).	**4.NF.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. b. Understand a multiple of a/b as a multiple of 1/b and use this. c. Using visual fraction models and equations, solve word problems involving multiplication of a fraction by a whole number.	The new standard focuses on the skill of multiplying fractions to solve problems, which is 4.NF.4c of the 2017 standards. The preceding sub-standards in 2017 identify prerequisite skills to multiply fractions when solving problems. The students need to be exposed to **both** proper and improper fractions to prepare them to work with improper fractions in later grades.

ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
Operations and Algebraic Thinking (OA) *Learners will analyze patterns and relationships to generate and interpret numerical expressions.*	**Operations and Algebraic Thinking** *Use the four operations with whole numbers to solve problems. Gain familiarity with factors and multiples. Generate and analyze patterns.*	
4.AR.OA.1 Automatically multiply and divide through 10 x 10.		The new standard expects this skill to be automatic. Students should be able to multiply basic facts without conscious thought. Basic facts within 100 are taught in 3.AR.OA.1. This standard extends the automaticity expectation. They are expected to develop a flexible understanding of **both** vertical and horizontal orientation**.** (See Appendix B in the standards document.)
4.AR.OA.2 Identify and apply the properties of operations for addition, subtraction, multiplication, and division and justify thinking.		The new standard focuses on learning to apply the properties of operations to solve problems. Students are expected to develop a flexible understanding of **both** the vertical and horizontal orientation. (See Appendix A, Table 1 in the standards document for properties.)
4.AR.OA.3 Solve multi-step authentic word problems using the four operations, including problems with interpreted remainders. Represent problems using equations, including a symbol as an unknown.	**4.OA.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 using a letter for the unknown quantity (variable). Assess the reasonableness of answers using mental computation and estimation strategies, including rounding. **4.OA.2** Use drawings and equations with a symbol for the unknown number (variable) to represent the problem. Multiply or divide to solve word problems involving multiplicative comparison, distinguishing multiplicative comparison from additive comparison.	The new standard summarizes the 2017 standard. The students are expected to develop a flexible understanding of **both** the vertical and horizontal orientation.

4.AR.OA.4 Find factor pairs and multiples within the range of 1-36 while classifying numbers as prime or composite.	**4.OA.4** Find all factor pairs for a whole number in the range 1-36. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1-36 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1-36 is prime or composite.	The new standard summarizes the 2017 standard.
4.AR.OA.5 Interpret multiplication equations as a comparison. Represent multiplicative comparisons as multiplication equations.	**4.OA.1** Interpret a multiplication equation as a comparison. Represent verbal statements of multiplicative comparisons as multiplication equations. **4.OA.2** Use drawings and equations with a symbol for the unknown number (variable) to represent the problem. Multiply or divide to solve word problems involving multiplicative comparison, distinguishing multiplicative comparison from additive comparison.	The new standard combines the focuses of the two 2017 standards.
4.AR.OA.6 Generate a number or shape pattern that follows a given rule while identifying apparent features of the pattern that were not explicit in the rule itself.	**4.OA.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.	The standards are the same.

GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Geometry (G) *Learners will compose and classify figures and shapes based on attributes and properties and represent and solve problems using a coordinate plane.*	**Geometry** *Draw and identify lines and angles and classify shapes by the properties of their lines and angles.*	
4.GM.G.1 Identify, label, and draw points, lines, line segments, rays, and angles (right, acute, obtuse).	**4.G.1** Draw and label points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. **4.MD.5** Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint. 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.	The new standard combines the 2017 standards, focusing on points, lines, rays, line segments, and angles. The standard builds on the concepts moved and taught in third grade.
4.GM.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines or the presence or absence of angles of specified size.	**4.G.2** Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines or the presence or absence of angles of specified size. Recognize right triangles as a category and identify right triangles.	The new standard summarizes the 2017 standard and focuses on the classification of two-dimensional figures. The identification of right triangles is embedded within the classification of two-dimensional figures. Guidance is provided in Appendix D of the standards document.
4.GM.G.3 Draw lines of symmetry in two-dimensional figures.	**4.G.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. Draw lines of symmetry.	The 2017 standard was split between grades three and four. Students identify lines of symmetry in standard 3.GM.G.3. The new standard builds upon that standard and focuses on drawing lines of symmetry.

Measurement (M) *Learners will represent and calculate measurement data, including time, money, and geometric measurement, and convert like measurement units within a given system.*	**Measurement and Data** *Solve problems involving measurement and conversion of measurements from larger to smaller units. Solve problems involving measurement and conversion of measurements from larger to smaller units.*	
4.GM.M.1 Know the relative sizes of measurement units within one system of units, including km, m, cm; kg, g; lb., oz.; l, ml; hr., min., sec. Record measurement equivalents in a two-column table.	**4.MD.1** Know relative sizes of measurement units within one system of units, including km, m, cm; kg, g; lb., oz.; l, ml; hr., min., sec. Within a single system of measurement, express measurements in larger units in terms of a smaller unit. Record measurement equivalents in a two-column table.	The new standard summarizes the focus of the 2017 standard.
4.GM.M.2 Generate simple conversions from a larger unit to a smaller unit to solve authentic problems within a single system of measurement, both customary and metric systems.	**4.MD.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Using diagrams such as number line diagrams that feature a measurement scale to represent measurement quantities.	The new standard summarizes the focus of the 2017 standard.
4.GM.M.3 Identify and use the appropriate tools, operations, and units of measurement, both customary and metric, to solve problems involving time, length, weight, mass, and capacity.	**4.MD.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Using diagrams such as number line diagrams that feature a measurement scale to represent measurement quantities.	The new standard focuses on using appropriate measurement tools, units, and operations.
4.GM.M.4 Solve authentic word problems involving dollar bills, quarters, dimes, nickels, and pennies, including the $ and ¢ symbols and decimal notation appropriately.	**4.MD.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Using diagrams such as number line diagrams that feature a measurement scale, to represent measurement quantities.	This is a new standard to expand proficiency in solving money-related problems and using money symbols and decimal notation.

4.GM.M.5 Apply the area and perimeter formulas for rectangles, including connected rectangular figures, in problems.	**4.MD.3** Apply the area and perimeter formulas for rectangles in real-world and mathematical problems.	The new standard adds connected rectangular figures.
4.GM.M.6 Measure angles in whole-number degrees using a protractor. Using a protractor and ruler, draw angles of a specified measure.	**4.MD.6** Measure angles in whole-number degrees using a protractor. Using a protractor and ruler, draw angles of a specified measure. **4.MD.5** Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint. 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.	
4.GM.M.7 Recognize angle measures as additive and solve addition and subtraction problems to find unknown angles on a diagram.	**4.MD.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.	The new standard summarizes the focus of the 2017 standard.

DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; drawing inferences and conclusions and making predictions; and understanding and applying basic concepts of probability.**		
Data (D) *Learners will represent and interpret data.*	**Measurement and Data** *Represent and interpret data.*	
4.DPS.D.1 Formulate questions to collect, organize, and represent data to reason with math and across disciplines.		The new standard expands skills in collecting, organizing, and representing data.
4.DPS.D.2 Generate data and create line plots to display a data set of fractions of unit fractions (½, ¼, ⅛). Solve problems involving addition and subtraction of fractions by using information presented in line plots.	**4.MD.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.	The standards are similar. The new standard has students generate the data used to make the line plot.
4.DPS.D.3 Utilize graphs and diagrams to represent and solve word problems using the four operations involving whole numbers, benchmark fractions, and decimals.		The new standard expands skills in analyzing data and using data to solve problems.

Grade 5

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Counting and Cardinality (CC) *Learners will understand the relationship between numerical symbols, names, quantities, and counting sequences.*		
5.NO.CC.1 Read and write decimals to thousandths, including standard, word, and expanded forms.	**5.NBT.3a** Read, write, and compare decimals to thousandths. a. Read and write decimals to thousandths using base-ten numerals, word form, and expanded form.	The new standard is the same as the 2017 substandard. A comparison of decimals is contained in 5.NO.NBT.2. Spelling is not assessed when writing the word forms since this standard measures the ability to write the number using words, not the spelling of the words.
Base Ten (NBT) *Learners will understand the place value structure of the base-ten number system and represent, compare, and perform operations with multi-digit whole numbers and decimals.*	**Number and Operations in Base Ten** *Understand the place value system. Perform operations with multi-digit whole numbers and with decimals to hundredths.*	
5.NO.NBT.1 Understand that in a multi-digit whole number, a digit in one place represents ten 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.	**5.NBT.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.	The standards are the same.
5.NO.NBT.2 Compare two decimals to the thousandth place using symbols >, <, and =. Justify comparisons based on the value of the digits.	**5.NBT.3b** Compare two decimals to thousandths based on the meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.	The new standard is the same as the 2017 substandard. The justification of the comparisons in the new standard embeds the attribute/practice.
5.NO.NBT.3 Apply place value understanding to round decimals to any place.	**5.NBT.4** Use place value understanding to round decimals to any place.	The standards are the same.
5.NO.NBT.4 Multiply multi-digit whole numbers using strategies flexibly, including the algorithm.	**5.NBT.5** Fluently multiply multi-digit whole numbers using strategies flexibly, including the standard algorithm.	The standards are the same. Students are expected to develop a flexible understanding of both the vertical and horizontal orientation.
5.NO.NBT.5 Use concrete models, drawings, place value strategies, properties of operations and/or relationships to add, subtract, and multiply decimals to hundredths.	**5.NBT.7** Using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction, add, subtract, multiply, and divide decimals to hundredths. Relate the strategy to a written method and explain the reasoning used.	The new standard addresses adding, subtracting, or multiplying using decimals. The division of decimals is addressed in standard 6.NO.O.3.

5.NO.NBT.6 Find whole number quotients and remainders with up to four-digit dividends and two-digit divisors using place value strategies. Show and justify the calculation by using equations, rectangular arrays, and/or area models.	**5.NBT.6** Using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division, find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	The new standard summarizes the 2017 standard. Strategies are not identified in the new standard.
5.NO.NBT.7 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10. 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.	**5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10. 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.	The standards are the same.
Fractions (NF) *Learners will understand fractions and equivalency to represent, compare, and perform operations of fractions and decimals.*	**Number and Operations – Fractions** *Use equivalent fractions as a strategy to add and subtract fractions.*	
5.NO.NF.1 Generate equivalent forms of commonly used fractions and decimals (e.g., halves, fourths, fifths, tenths).		The new standard expands proficiency with equivalent fractions and decimals.
5.NO.NF.2 Explain why multiplying a given number by a fraction greater than one results in a product greater than the given number and explain why multiplying a given number by a fraction less than one results in a product smaller than the given number.	**5.NF.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). c. Relating the principle of fraction equivalence a/b = (n × a) / (n × b) to the effect of multiplying a/b by 1.	The new standard summarizes the concept within the 2017 standard. The new standard does not describe strategies.

5.NO.NF.3 Solve authentic word problems by adding and subtracting fractions and mixed numbers with unlike denominators using a visual fraction model and equations.	**5.NF.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. **5.NF.2** Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, by using visual fraction models and equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.	The new standard combines the two 2017 standards and places the focus on solving problems involving adding and subtracting fractions with unlike denominators. Strategies were not provided in the new standard. In a progression, students may practice adding and subtracting fractions and mixed numbers with unlike denominators prior to using the understanding in authentic word problems.
5.NO.NF.4 Solve authentic word problems by multiplying fractions and mixed numbers using visual fraction models and equations.	**5.NF.6** Solve real-world problems involving multiplication of fractions and mixed numbers using visual fraction models and equations to represent the problem. **5.NF.4** Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. **5.NF.4a**. Interpret the product (a/b) × q as a part of a partition of q into b equal parts; equivalently, as the result of a sequence of operations a × q ÷ b.	The new standard combines standards from 2017. It places the focus on solving problems involving the multiplication of fractions and mixed numbers.
	5 NF.3 Interpret a fraction as a division of the numerator by the denominator (a/b = a ÷ b). Solve word problems involving the division of whole numbers leading to answers in the form of fractions or mixed numbers by using visual fraction models and equations to represent the problem.	This concept was moved to standard 6.NO.O.3. Students at this level are still developing proficiency with the division of whole numbers.

	5.NF.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. a. Interpret the division of a unit fraction by a non-zero whole number and compute such quotients. b. Interpret the division of a whole number by a unit fraction and compute such quotients. c. Solve real-world problems involving the division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions using visual fraction models and equations to represent the problem.	This concept was moved to standard 6.NO.O.3. Students at this level are still developing proficiency with the division of whole numbers.
ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
Operations and Algebraic Thinking (OA) *Learners will analyze patterns and relationships to generate and interpret numerical expressions.*	**Operations and Algebraic Thinking** *Write and interpret numerical expressions. Analyze patterns and relationships. Gain familiarity with factors and multiples.*	
5.AR.OA.1 Automatically multiply and divide through 12 x 12.		The new standard extends the automaticity of basic facts to 12x12. Students should be able to multiply basic facts without conscious thought. They have been taught these facts in grades three and four. They are expected to develop a flexible understanding of **both** vertical and horizontal orientation. (See Appendix B in the standards document.)
5.AR.OA.2 Analyze problems using the order of operations to solve and evaluate expressions while justifying thinking.	**5.OA.1** Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols	The standards are the same. The new standard uses the terminology order of operations described in 2017.
5.AR.OA.3 Write simple expressions that record calculations with numbers. Interpret numerical expressions without evaluating them.	**5.OA.2** Write simple expressions that record calculations with numbers. Interpret numerical expressions without evaluating them.	The standards are the same.

5.AR.OA.4 Find factor pairs and multiples within the range of 1-100 while classifying numbers as prime or composite.	**5.OA.4** Find all factor pairs for a whole number in the range 1-100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1-100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1-100 is prime or composite.	The new standard summarizes the content of the 2017 standard.
5.AR.OA.5 Generate two numerical patterns using two given rules and form ordered pairs consisting of corresponding terms from the two patterns. (Graphing on a coordinate plane.)	**5.OA.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. Graph the ordered pairs on a coordinate plane. Use the graph to verify relationships.	The new standard summarizes the content of the 2017 standard. The standard introduces the coordinate plane and the use of ordered pairs.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Geometry (G) *Learners will compose and classify figures and shapes based on attributes and properties and represent and solve problems using a coordinate plane.*	**Geometry** *Graph points on the coordinate plane to solve real-world and mathematical problems. Classify two-dimensional figures into categories based on their properties.*	
5.GM.G.1 Classify two-dimensional figures in a hierarchy based on properties.	**5.G.3** Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. **5.G.4** Classify two-dimensional figures in a hierarchy based on properties.	The new standard is the same as 5.G.4 in 2017. The standard applies the attributes of two-dimensional shapes taught in previous grades to classify figures. (See Appendix D in the standards document for guidance.)
5.GM.G.2 Identify the x-coordinate and y-coordinate to graph and name points in the first quadrant of the coordinate plane.	**5.G.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 (x-coordinate and x-axis, y-coordinate and y-axis.	The new standard focuses on the introduction of the coordinate plane. It summarizes and combines the two standards from 2017. In a progression, students may begin by learning about the origin in the direction of the axis and how the coordinates respond.

5.GM.G.3 Form ordered pairs and graph points in the first quadrant on the coordinate plane to solve authentic word problems.	**5.G.2** Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane. Interpret coordinate values of points in the context of the situation.	The new standard focuses on forming ordered pairs and graphing them on the coordinate plane. It summarizes and combines the two standards from 2017.
Measurement (M) *Learners will represent and calculate measurement data, including time, money, and geometric measurement, and convert like measurement units within a given system.*	**Measurement and Data** *Convert like measurement units within a given measurement system. Geometric measurement: understand concepts of volume and relate volume to multiplication and division.*	
5.GM.M.1 Generate conversions among different-sized standard measurement units within a given measurement system, both customary and metric systems. Use these conversions in solving multi-step, real-world problems.	**5.MD.1** Convert among different-sized standard measurement units within a given measurement system. Use these conversions in solving multi-step, real-world problems.	The standards are the same.
5.GM.M.2 Find the area and perimeter of a rectangle, including connected rectangular figure with fractional side lengths.	**5.NF.4b**. 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. Represent fraction products as rectangular areas.	The new standard and 2017 substandard are the same. The new standard expands proficiency with the skills of perimeter and area taught previously.
5.GM.M.3 Recognize volume as an attribute of rectangular prisms and measure volume by counting unit cubes.	**5.MD.3** Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with a side length of 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. **5.MD.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft., and improvised units	The new standard combines the standards from 2017. It does not include the strategies used to count cubes to find the volume.

	5.MD.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. 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. b. Represent threefold whole-number products as volumes to represent the associative property of multiplication. c. 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. d. 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.	The 2017 standard was moved to 6.GM.AV.2. In fifth grade, students develop the concept of volume in 5.GM.M.3. The concept is built upon in sixth grade.
DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; drawing inferences and conclusions and making predictions; and understanding and applying basic concepts of probability.**		
Data (D) *Learners will represent and interpret data.*	**Measurement and Data** *Represent and interpret data.*	
5.DPS.D.1 Generate data and create line plots to display a data set of fractions of a unit (½, ¼, ⅛). Use grade-level operations for fractions to solve problems involving information presented in line plots.	**5.MD.2** Make a line plot to display a data set of measurements in fractions of a unit (½, ¼, ⅛). Use operations on fractions for this grade to solve problems involving information presented in line plots.	The standards are the same. The new standard focuses on generating the data used in the line plot.

5.DPS.D.2 Utilize graphs and diagrams to represent, analyze, and solve authentic problems using information presented in one or more tables or line plots, including whole numbers, fractions, and decimals.		The new standard continues to build the data representation and analysis skills in graphs and tables learned previously. This standard encompasses all graphs and assumes that fifth-grade students will be able to select the type of graph that best fits the problem presented.

Grade 6

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Number Systems (NS) *Learners will expand their knowledge of the number system to create connections and solve problems within and across concepts.*	**The Number System** *Apply and extend previous understandings of multiplication and division to divide fractions by fractions. Compute fluently with multi-digit numbers and find common factors and multiples. Apply and extend previous understandings of numbers to the system of rational numbers.*	The new standards separate operations into separate subcategories.
6.NO.NS.1 Explain and show the relationship between non-zero rational numbers and their opposites using horizontal and vertical number lines, including authentic problems. Use rational numbers to represent quantities in real-world contexts and explain the meaning of 0 in certain situations.	**6.NS.5** Understand that rational numbers are used together to describe quantities having opposite directions or values (may include temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge, etc.). Use rational numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.	The standards are the same. The new standard expects students to use horizontal and vertical number lines to show relationships. It builds the concept of absolute value without using formal notation. Absolute value is addressed further in standard 7.NO.NS.1

6.NO.NS.2 Write, interpret, and explain statements of order for rational numbers on a number line diagram and in authentic contexts.	**6.NS.6** Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes 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. b. Recognize that the opposite of a number is the number itself, for example: –(–3)=3, and that 0 is its own opposite. c. 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	The new standard summarizes the 2017 standard and focuses on ordering rational numbers.
	6.NS.7 Understand the 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. b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. 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. d. Distinguish comparisons of absolute value from statements about order.	Absolute value was moved to standard 7.NO.NS.1. The concept of absolute value is introduced in standard 6.NO.NS.1.

Operations (O) *Learners will expand their computational fluency to create connections and solve problems within and across concepts.*		This is a new subcategory in the new standards.
6.NO.O.1 Divide multi-digit whole numbers up to four-digit dividends and two-digit divisors using strategies or procedures.	**6.NS.2** Fluently divide multi-digit numbers using strategies flexibly, including the standard algorithm	The new standard builds proficiency with multiplication and division from previous grades specifying the number of digits to be used. The 2017 standard specified the algorithm as a strategy, whereas the new standards do not identify specific strategies.
6.NO.O.2 Add and subtract fractions and decimals up to the hundredths place, including authentic problems.	**6.NS.3** Fluently add, subtract, multiply, and divide multi-digit decimals using strategies flexibly, including the standard algorithm for each operation.	The new standard focuses on addition and subtraction of fractions and decimals. Multiplication and division were moved to standard 6.NO.O.3.
6.NO.O.3 Apply multiplication and division of fractions and decimals to solve and interpret problems using visual models, including authentic problems.	**6.NS.1** Use visual fraction models and equations to interpret and compute quotients of fractions. Use models and equations to solve word problems involving the division of fractions by fractions. **5.NF.7** Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. a. Interpret the division of a unit fraction by a non-zero whole number and compute such quotients. b. Interpret the division of a whole number by a unit fraction and compute such quotients. c. Solve real-world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions using visual fraction models and equations to represent the problem. **5 NF.3** Interpret a fraction as a division of the numerator by the denominator (a/b = a ÷ b). Solve word problems involving the division of whole numbers leading to answers in the form of fractions or mixed numbers by using visual fraction models and equations to represent the problem.	The new standard combines the 2017 standards. The new standard develops the skill of multiplying and dividing fractions. The strategies and prerequisite skills identified in the 2017 standards are not included in the standard but are necessary to show proficiency with the standard.

6.NO.O.4 Determine 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.	**6.NS.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 to 100 with a common factor as a multiple of a sum of two whole numbers with no common factor.	The standard is the same as the beginning of the 2017 standard. The new standard focuses on determining the greatest common factor and least common multiple. (See Appendix B in the standards document for recommended automaticity.) This skill leads to algebraic topics, including factoring expressions and the distributive property with variables.
ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
Ratios and Proportional Relationships (RP) *Learners will use ratios, rates, and proportions to model relationships and solve problems.*	**Ratios and Proportional Relationships** *Understand ratio concepts and use ratio reasoning to solve problems.*	
6.AR.RP.1 Describe the concept of a ratio relationship between two quantities using ratio language and visual models.	**6.RP.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.	The new standard focuses on describing the ratio relationship adding rigor to the 2017 standard.
6.AR.RP.2 Describe and calculate a unit rate when given a ratio relationship between two quantities using rate language and visual models.	**6.RP.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.	The new standard focuses on calculation unit rates adding rigor to the 2017 standard.
6.AR.RP.3 Make and use tables of equivalent ratios, tape diagrams, double number line diagrams, and equations to solve problems involving ratios, rates, and unit rates, including authentic problems.	**6.RP.3** Use tables of equivalent ratios, tape diagrams, double number line diagrams, and equations to reason about ratios and rates in real-world and mathematical problems. 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. d. Use ratio reasoning to convert measurement units. Manipulate and transform units appropriately when multiplying or dividing quantities.	The new standard focuses on the representation of ratios, rates, and unit rates when solving problems summarizing the sub-standards.

6.AR.RP.4 Calculate a percent of a quantity as a rate per 100. Solve problems using ratio reasoning involving finding the whole when given a part and the percent.	**6.RP.3c** Find a percent of a quantity as a rate per 100.	The new standard applies the concept in problem-solving situations, increasing the rigor of the 2017 standard.
6.AR.RP.5 Convert measurement units within and between measurement systems using ratio reasoning given conversion factors.	**6.RP.3** Use tables of equivalent ratios, tape diagrams, double number line diagrams, and equations to reason about ratios and rates in real-world and mathematical problems. 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. d. Use ratio reasoning to convert measurement units. Manipulate and transform units appropriately when multiplying or dividing quantities.	The new standard focuses on using ratios for conversion factors to convert measurement units between systems embedding the strategies identified in 2017.
Expressions and Equations (EE) *Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adapting approaches in novel situations.*	**Expressions and Equations** *Apply and extend previous understanding of arithmetic to algebraic expressions. Reason about and solve one-variable equations and inequalities. Represent and analyze quantitative relationships between dependent and independent variables.*	
6.AR.EE.1 Read, write, and evaluate numerical expressions, including expressions with whole number exponents and grouping symbols.	**6.EE.1** Write and evaluate numerical expressions involving whole-number exponents.	The new standard includes reading the expression and using grouping symbols that were not included in 2017.

6.AR.EE.2 Read and evaluate algebraic expressions, including expressions with whole number exponents and grouping symbols. Write algebraic expressions to represent simple and authentic situations.	**6.EE.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. b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient, difference, quantity, etc.); view one or more parts of an expression as a single entity. 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). **6.EE.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.	The new standard combines the 2017 standards to focus on reading, writing, and evaluating expressions.
6.AR.EE.3 Identify when two expressions are equivalent. Apply the properties of operations to generate equivalent expressions.	**6.EE.3** Apply the properties of operations to generate equivalent expressions. **6.EE.4** Identify when two expressions are equivalent.	The new standard combines the two standards from 2017. It focuses on identifying and generating equivalent expressions.
6.AR.EE.4 Describe the concept of a solution to an equation or an inequality. Determine whether a given number is a solution to an equation or an inequality.	**6.EE.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.	The new standard clarifies the focus of the 2017 standard on developing the concept of solving equations and inequalities.
6.AR.EE.5 Write and solve equations of the form x + p = q and px = q for cases in which p and q are non-negative whole numbers or decimals, including authentic problems.	**6.EE.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 nonnegative rational numbers.	The standards address the same concept. The new standard includes non-negative whole numbers or decimals.

6.AR.EE.6 Write a statement of inequality of the form x > c or the form x < c to represent a constraint or condition. Recognize that inequalities of the form x > c or the form x < c have infinitely many solutions and represent solutions of such inequalities on number line diagrams.	**6.EE.8** Write a statement of inequality of the form $x > c$ or the form $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or the form $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.	The new standard summarizes the 2017 standard. The new standard focuses on writing the statement of inequality and understanding the concept that inequalities have infinite solutions.
	6.EE.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 (dependent variable) in terms of the other quantity (independent variable). Analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation.	The standard moved to seventh grade (7.AR.RP.2).
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Area and Volume (AV) *Learners will use visualization and spatial reasoning to solve authentic and mathematical problems involving the area, surface area, and volume of geometric figures.*	**Geometry** *Solve real-world and mathematical problems involving area, surface area, and volume.*	
6.GM.AV.1 Derive the relationship of the areas of triangles using the area of rectangles. Calculate the areas of triangles and quadrilaterals by composing and/or decomposing them into rectangles and triangles, including authentic problems.	**6.G.1** Based on prior knowledge of the area of rectangles, decompose or compose triangles to find the area of a triangle. Using knowledge of an area of triangles and rectangles, compose and/or decompose triangles, special quadrilaterals, and polygons to find their areas. Apply these techniques in the context of solving real-world mathematical problems	The new standard summarizes the 2017 standard. The new standard focuses on finding the area of a triangle.

6.GM.AV.2 Describe the concept of volume of a right rectangular prism. Apply given formulas to calculate the volume of right rectangular prisms, including fractional edge lengths, including authentic problems.	**6.G.2** Using cubes of an appropriate size, pack a right rectangular prism having fractional edge lengths to find its volume. Then show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = \ell wh$ and $V = Bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. **5.MD.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. 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. b. Represent threefold whole-number products as volumes to represent the associative property of multiplication. c. 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. d. 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.	The new standard builds upon the basic concepts of volume learned in fifth grade. Understanding is extended from whole numbers to include fractional sizes. The standard combines 2017 volume standards from fifth and sixth grade.

Geometric Figures (GF) *Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.*		The new subcategory focuses on the manipulation of geometric figures.
6.GM.GF.1 Identify and position ordered pairs of rational numbers in all four quadrants of a coordinate plane.	**6.NS.8** Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include the use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.	The new standard was moved from number and operations (2017) to geometry and measurement. The new standard focuses on learning how to position ordered pairs in the four quadrants of the coordinate plane. This is a prerequisite skill for many of the concepts in later grades.
6.GM.GF.2 Draw polygons in the coordinate plane given coordinates for the vertices. Determine the length of a side joining points with the same first or second coordinate, including authentic problems.	**6.G.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.	The new standard summarizes the 2017 standard. It focuses on using coordinates to draw and measure the side length of polygons.
6.GM.GF.3 Represent three-dimensional figures using nets made up of rectangles and triangles (right prisms and pyramids whose bases are triangles and rectangles). Calculate the surface area of prisms with rectangular and triangular bases using nets, including authentic problems.	**6.G.4** Represent three-dimensional figures using nets made up of rectangles and triangles (right prisms and pyramids whose bases are triangles and rectangles). Use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.	The new standard summarizes the 2017 standard. It focuses on using nets to represent three-dimensional figures and calculate the surface area of prisms.
DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; draw inferences and conclusions and making predictions; and understand and apply basic concepts of probability.**		
Data Analysis (D) *Learners will ask and answer questions by collecting, organizing, and displaying relevant data, drawing inferences and conclusions, and making predictions.*	**Statistics and Probability** *Develop an understanding of statistical variability. Summarize and describe distributions.*	
6.DSP.D.1 Write a statistical question that can be answered using measures of the center or variability of a data set.	**6.SP.1** Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.	The new standard focuses on writing statistical questions that can be answered by using measures of the center of variability, which increases the rigor of the 2017 standard.

6.DSP.D.2 Calculate measures of center (median and mean) and variability (range and mean absolute deviation) to answer a statistical question. Identify mode(s) if they exist.	**6.SP.3** Recognize that a measure of center for a numerical data set summarizes all of its values using a single number, while a measure of spread (variation) describes how its values vary with a single number. **6.SP.5c** Calculating 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 was gathered.	The new standard combines the 2017 standards and focuses on calculating measures of center and variability and identifying mode if it exists.
6.DSP.D.3 Identify outliers by observation and describe their effect on measures of center and variability. Justify which measures would be appropriate to answer a statistical question.	**6.SP.2** Understand that a set of data collected to answer a statistical question has a distribution that can be described by its center, spread, and overall shape.	The new standard focuses on the identification of outliers and measuring their impact, increasing the rigor of the 2017 standard. Students are expected to justify measures used to answer statistical questions.
6.DSP.D.4 Display numerical data in plots on a number line, including dot plots and histograms. Describe any overall patterns in data, such as gaps, clusters, and skews.	**6.SP.4** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. **6.SP.5** Summarize numerical data sets in relation to their context by: a. Reporting the number of observations. b. Describing the nature of the attribute being investigated, including how it was measured and its units of measurement. 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.	The new standard combines the two standards from 2017 and focuses on displaying data on number lines and describing data patterns.

Grade 7

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Number Systems (NS) *Learners will expand their knowledge of the number system to create connections and solve problems within and across concepts.*	**The Number System** *Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.*	The new standards separate operations into a separate subcategory.
7.NO.NS.1 Describe the absolute value of a number as its distance from zero on a number line.	**6.NS.7** Understand the 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. b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. 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. d. Distinguish comparisons of absolute value from statements about order.	The new standard focuses on describing absolute value, which summarizes the sub-standards of the 2017 standard. This standard builds upon the introduction to the absolute value in standard 6.NO.NS.1.
7.NO.NS.2 Recognize common fractions and decimal equivalencies up to a denominator of 10. Convert a rational number to a decimal using technology.	**7.NS.2d** Convert a rational number to a decimal using long division. Know that the decimal form of a rational number terminates or eventually repeats.	The new standard connects fraction and decimal equivalencies summarizing the main concept of the 2017 substandard.

Operations (O) *Learners will expand their computational fluency to create connections and solve problems within and across concepts.*		This is a new subcategory in the new standards.
7.NO.O.1 Add, subtract, multiply, and divide integers using visual models and properties of operations in multi-step problems, including authentic problems.	**7.NS.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. b. Understand p + q as the number located a distance $\|q\|$ from p on a number line, in the direction indicated by the sign of q. 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.	The new standard summarizes the 2017 standard. It focuses on adding, subtracting, multiplying, and dividing integers. Strategies included in 2017 are not included.
7.NO.O.2 Add, subtract, multiply, and divide non-negative fractions in multi-step problems, including authentic problems.		The new standard expands proficiency in applying basic operations of non-negative fractions learned in previous grades.
7.NO.O.3 Add, subtract, multiply, and divide non-negative decimals to the hundredth place in multi-step problems using appropriate strategies, including authentic problems.	**6.NS.3** Fluently add, subtract, multiply, and divide multi-digit decimals using strategies flexibly, including the standard algorithm for each operation.	This standard expands proficiency in applying basic operations of decimals learned in previous grades. The 2017, the sixth-grade standard was moved to seventh grade.

	7.NS.2 Apply and extend previous understandings of multiplication, division, and 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 rational numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided provided 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 fluently multiply and divide rational numbers. **7.NS.3** Solve real-world and mathematical problems involving the four operations with rational numbers.	These standards were moved to eighth grade (8.NO.O.2).
ALGEBRAIC REASONING (AR) **Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.**		
Ratios and Proportional Relationships (RP) *Learners will use ratios, rates, and proportions to model relationships and solve problems.*	**Ratios and Proportional Relationships** *Understand ratio concepts and use ratio reasoning to solve problems.*	
7.AR.RP.1 Calculate unit rates associated with ratios of rational numbers, including ratios of lengths, areas, and other quantities measured in like or different units.	**7.RP.1** Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.	The standards are the same.

7.AR.RP.2 Analyze the relationship between the dependent and independent variables of the proportional relationship using graphs and tables. 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, k) where k is the unit rate.	**7.RP.2** Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship 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. 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.	The new standard focuses on analyzing the relationship between dependent and independent variables of a proportional relationship. It summarizes the 2017 standard and sub-standards.
7.AR.RP.3 Identify the constant of proportionality in tables, graphs, equations, diagrams, and descriptions of proportional relationships. Represent proportional relationships by an equation of the form y = kx, where k is the constant of proportionality, and describe the meaning of each variable (y,k,x) in the context of the situation.	**7.RP.2b** Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations	The new standard summarizes the 2017 sub-standards. It focuses on identifying the constant of proportionality and using equations to represent proportional relationships.
7.AR.RP.4 Use proportional relationships to solve multi-step problems involving ratios, percents, and scale drawings of geometric figures, including authentic problems.	**7.RP.3** Use proportional relationships to solve multistep ratio and percent problems. **7.G.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.	The new standard combines the 2017 standards regarding proportional relationships and scale drawings which applies the concept of proportionality.
Expressions and Equations (EE) *Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adapting approaches in novel situations.*	**Expressions and Equations** *Apply and extend previous understanding of arithmetic to algebraic expressions. Reason about and solve one-variable equations and inequalities. Represent and analyze quantitative relationships between dependent and independent variables.*	
7.AR.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions involving variables, integers, and/or non-negative fractions and decimals with an emphasis on writing equivalent expressions.	**7.EE.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients with an emphasis on writing equivalent expressions. **7.EE.2** Understand that rewriting an expression in different forms in a problem context can clarify the problem and how the quantities in it are related.	The new standard connects the two standards from 2017.

7.AR.EE.2 Write and solve equations of the form px + q = r and p(x + q) = r, including authentic problems.	**7.EE.4a** 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 the algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.	The new standard summarizes the 2017 standard. It focuses on writing and solving equations.
7.AR.EE.3 Write and solve one- or two-step inequalities where coefficients and solutions are integers and/or non-negative fractions and decimals, including authentic problems. Graph the solution set of the inequality and interpret it in the context of the problem.	**7.EE.3** Solve multi-step real-life and mathematical problems posed with rational numbers in any form (positive and negative, fractions, decimals, and integers), using tools strategically. Apply properties of operations to calculate numbers in any form. Convert between forms as appropriate. Assess the reasonableness of answers using mental computation and estimation strategies. **7.EE.4b** 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.	The new standard combines standards from 2017. It focuses on writing and solving inequalities and graphing solutions sets.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Area and Volume (AV) *Learners will use visualization and spatial reasoning to solve authentic and mathematical problems involving the area, surface area, and volume of geometric figures.*	**Geometry** *Solve real-world and mathematical problems involving area, surface area, and volume.*	
7.GM.AV.1 Describe the relationship between the circumference and diameter of a circle (pi). Apply given formulas to calculate the area and circumference of a circle, including authentic problems.	**7.G.4** Know the formulas for the area and circumference of a circle and use them to solve problems. Informally derive the relationship between the circumference and area of a circle.	The concepts within the two standards are the same. The new standard applies given formulas to calculate the area and circumference of a circle. The new standard focuses on describing the relationship between the circumference and diameter of a circle.

7.GM.AV.2 Calculate areas of polygons by composing and/or decomposing them into rectangles and triangles, including authentic problems. Solve problems involving the surface area of prisms and right pyramids using nets, including authentic problems.	**7.G.6** Solve real-world and mathematical problems involving the area of two-dimensional figures composed of polygons and/or circles, including composite figures. Use nets to solve real-world and mathematical problems involving the surface area of prisms and cylinders, including composite solids.	The new standard clarifies the 2017 standard. The new standard focuses on calculating the area of polygons and solving problems involving surface area using nets.
7.GM.AV.3 Solve problems involving the volume of prisms and composite solids, including authentic problems.	**7.G.6** Solve real-world and mathematical problems involving volumes of right prisms, including composite solids.	The standards are the same.
Geometric Figures (GF) *Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.*		The new subcategory focuses on the manipulation of geometric figures.
7.GM.GF.1 Draw triangles from given conditions using appropriate tools. Defend whether a unique triangle, multiple triangles, or no triangle can be constructed when given three measures of angles or sides.	**7.G.2** Draw geometric shapes from 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. Use a variety of methods such as freehand, with ruler and protractor, and with technology.	The new standard summarizes the 2017 standard.
7.GM.GF.2 Describe the following angle-pair relationships: supplementary angles, complementary angles, vertical angles, and adjacent angles. Solve for an unknown angle in a figure by applying facts about these angles.	**7.G.5** Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve equations for an unknown angle in a figure.	The new standard focuses on applying knowledge of angle characteristics to describe angle-pair relationships. This standard clarifies the 2017 standard.
	7.G.3 Describe the cross-sections (two-dimensional figures that result from slicing three-dimensional figures, as in plane sections) of right rectangular prisms and right rectangular pyramids.	This standard was deleted because it did not connect to the other standards. The cross-sections of prisms and pyramids are first used in advanced mathematics courses at the high school level.

DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; draw inferences, and conclusions and making predictions; and understand and apply basic concepts of probability.**		
Data Analysis (D) *Learners will ask and answer questions by collecting, organizing, and displaying relevant data, drawing inferences, and conclusions, and making predictions.*	**Statistics and Probability** *Develop an understanding of statistical variability. Summarize and describe distributions.*	
7.DPS.D.1 Identify the strengths and weaknesses of a population sample, including possible bias in the process of the data collection.	**7.SP.1** Understand that statistics can be used to gain information about a population by examining a sample of the population. Understand that 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.	The new standard summarizes the 2017 standard. It focuses on describing the strengths and weaknesses of a population sample.
7.DPS.D.2 Analyze and draw inferences about a population using single and multiple random samples by using given measures of center and variability for the numerical data set.	**7.SP.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. **7.SP.3** Informally assess the degree of visual overlap of two numerical data distributions with similar variability, measuring the difference between the centers by expressing it as a multiple of a measure of variability. **7.SP.4** Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.	The new standard combines the 2017 standards. It focuses on analyzing and making inferences from random samples.

Probability (P) *Learners will understand and apply basic concepts of probability.*		
7.DPS.P.1 Develop a probability model to find probabilities of theoretical events and contrast probabilities from an experimental model.	**7.SP.7** Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies. If there is a discrepancy, explain possible sources. a. Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.	The new standard focuses on developing a probability model to find the probability of theoretical events and contrast it with an experimental model. It summarizes the 2017 standard.
7.DPS.P.2 Develop a probability model to find theoretical probabilities of independent compound events.	**7.SP.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 (such as “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.	The new standard summarizes the 2017 standard and focuses on developing a probability model to find the theoretical probability of compound events.
	7.SP.5 Understand that the probability of a chance event is a number from 0 through 1 that expresses the likelihood of the event occurring. Larger numbers indicate a greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	This standard was omitted because it is a description of a sub-concept that leads toward proficiency with the new probability standards.

	7.SP.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. Predict the approximate relative frequency given the probability.	This standard was omitted because it described a classroom activity.

Grade 8

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
Number Systems (NS) *Learners will expand their knowledge of the number system to create connections and solve problems within and across concepts.*	**The Number System** *Know that there are numbers that are not rational and approximate them by rational numbers.*	The new standards separate operations into a separate subcategory.
8.NO.NS.1 Compare and classify real numbers within the real number system.	**8.NS.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. Convert a decimal expansion that repeats eventually into a rational number.	The new standard summarizes the 2017 standard. It focuses on comparing and classifying numbers in the real number system.
8.NO.NS.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 irrational expressions involving one operation.	**8.NS.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 (such as π^2).	The standards are the same. The new standard limits the estimation to irrational expressions involving one operation.
8.NO.NS.3 Use scientific notation to represent very large or very small quantities. Interpret scientific notation generated by technology. Compare and order numbers in both scientific and standard notation.	**8.EE.3** Use numbers expressed in the form of a single digit multiplied by 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. **8.EE.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 (such as using millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.	The new standard combines the 2017 standards. Scientific notation was moved to the numbers and operations category. The new standard focuses on using, interpreting, and comparing numbers in scientific and standard notation.

Operations (O) *Learners will expand their computational fluency to create connections and solve problems within and across concepts.*		This is a new subcategory in the new standards.
8.NO.O.1 Evaluate mentally the square roots of perfect squares up to 225 and cube roots of perfect cubes up to 1000.	**8.EE.2** Evaluate square roots of small perfect squares and cube roots of small perfect cubes.	The standards are the same. The new standard limits the amount within which the students are to evaluate square and cube roots.
8.NO.O.2 Add, subtract, multiply, and divide rational numbers using strategies or procedures.	**7.NS.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. b. Understand $p + q$ as the number located a distance $\|q\|$ from p on a number line, in the direction indicated by the sign of q. 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. **7.NS.2** Apply and extend previous understandings of multiplication, division, and 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 rational numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided provided the divisor is not zero, and every quotient of integers (with non-	These standards were moved to eighth grade to allow seventh graders to deepen their understanding of integers before moving to rational numbers. The new standard combines the 2017 standards.

	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 fluently multiply and divide rational numbers. **7.NS.3** Solve real-world and mathematical problems involving the four operations with rational numbers.	
ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
Expressions and Equations (EE) *Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adapting approaches in novel situations.*	**Expressions and Equations** *Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations. Analyze and solve linear equations and pairs of simultaneous linear equations.*	
8.AR.EE.1 Explain the relationship between repeated multiplication and the properties of integer exponents. Apply a single exponent property to generate equivalent numeric expressions and algebraic expressions that include numerical coefficients.	**8.EE.1** Develop, know and apply the properties of integer exponents to generate equivalent numeric and algebraic expressions.	The new standard builds connections between previously learned concepts and properties of integer exponents. The new standard expands the concept of repeated multiplication and connects it to the properties of integer exponents. It narrows the application of the exponent properties to single exponents.
8.AR.EE.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 non-negative rational number.	**8.EE.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. Classify radicals as rational or irrational.	The new standard focuses on use of the square and cube root symbols within equations. The portions of the 2017 standard referring to “evaluate” was merged into the two eighth grade NO.NS standards.

8.AR.EE.3 Explain the characteristics of a linear relationship including identifying the slope and y-intercept in tables, graphs, equations, and descriptions.	**8.EE.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.	The new standard focuses on explaining the characteristics of linear relationships.
8.AR.EE.4 Represent linear relationships using tables, graphs, equations, and descriptions when given one of these forms.	**8.EE.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.	The new standard focuses on representations of linear relationships.
8.AR.EE.5 Solve linear equations with rational number coefficients and variables on both sides, including equations that require using the distributive property and/or combining and collecting like terms. Interpret the number of solutions. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions	**8.EE.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. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	The new standard summarizes the 2017 standard.
8.AR.EE.6 Read, write, and evaluate numerical and algebraic expressions including expressions involving absolute value. Solve and graph equations of the form |x|=r where r is a nonnegative rational number.		The new standard focuses on solving equations containing integers. This develops skills needed in algebra.
8.AR.EE.7 Solve and graph inequalities in one variable with rational number coefficients and variables on both sides, including inequalities that require using the distributive property and/or combining like terms.		The new standard expands work with expressions to include solving inequalities.
8.AR.EE.8 Graph linear inequalities in two variables on a coordinate plane. Interpret the possible solutions in the context of authentic problems.		The new standard builds upon 8.AR.E.7 by including inequalities with two variables.

	8.EE.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. c. Solve real-world and mathematical problems leading to two linear equations	This standard was moved to grades 9-10 (9-10.AR.8).
Functions (F) *Learners will develop a foundational knowledge of functions and use them to model relationships between quantities.*	**Functions** *Define, evaluate, and compare functions. Use functions to model relationships between quantities.*	
8.AR.F.1 Defend whether a relation is a function from various representations using appropriate function language.	**8.F.1** Understand that a function is a rule that assigns to each input exactly one output. Understand that the graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	The new standard applies knowledge of functions to defend whether a relationship is a function which raises the rigor of the 2017 standard.
8.AR.F.2 Compare and contrast properties of two linear functions, each represented in a different way (algebraically, graphically, numerically in tables, and/or by descriptions).	**8.F.2** Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, and/or by verbal descriptions)	The standards are the same.
8.AR.F.3 Compare and contrast linear and non-linear functions represented in different ways (algebraically, graphically, numerically in tables, and/or by descriptions).	**8.F.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.	The new standard both compares and contrasts linear and nonlinear functions, clarifying the 2017 standard.
8.AR.F.4 Model a linear function between two quantities by creating a table, graph, and equation. Interpret the rate of change and initial value of a linear function in terms of the situation it models.	**8.F.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 (xx, yy) 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.	The new standard summarizes the 2017 standard and focuses on constructing a function modeling a linear relationship and interpreting the rate of change.

8.AR.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph, including where the function is constant, increasing, or decreasing; linear or nonlinear; and discrete or continuous. Create a graph that exhibits the qualitative features of a function described.	**8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (may include where the function is increasing or decreasing, linear or nonlinear, etc.). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	The standards are the same.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
Area and Volume (AV) *Learners will use visualization and spatial reasoning to solve authentic and mathematical problems involving area, surface area, and volume of geometric figures.*	**Geometry** *Solve real-world and mathematical problems involving area, surface area, and volume.*	
8.GM.AV.1 Apply given formulas to solve problems involving volume of cones, cylinders, and spheres, including authentic problems.	**8.G.9** Know the formulas for the volume of cones, cylinders, and spheres. Use the formulas to solve real-world and mathematical problems.	The standards are the same. The new standard applies given formulas to solve problems.
Geometric Figures (GF) *Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.*		The new subcategory focuses on the manipulation of geometric figures.
8.GM.GF.1 Perform single transformations to a figure on the coordinate plane and determine whether the figures are congruent or similar.	**8.G.1** Understand the properties of rotations, reflections, and translations by experimentation: a. Lines are transformed into lines, and line segments into line segments of the same length. b. Angles are transformed onto angles of the same measure. c. Parallel lines are transformed onto parallel lines.	The new standard summarizes the 2017 standard, focusing on performing single transformations.

8.GM.GF.2 Describe the characteristics of transformations on the coordinate plane using transformation language.	**8.G.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 of transformations that exhibits the congruence between them. **8.G.3** Describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates.	The new standard combines two 2017 standards and focuses on describing characteristics of transformations on the coordinate plane.
8.GM.GF.3 Name the type of transformations needed to map a pre-image to its image.	**8.G.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 of transformations that exhibits the similarity between them.	The new standard summarizes the 2017 standard, focusing on naming types of transformations needed to map a pre-image to its image.
8.GM.GF.4 Describe the following angle-pair relationships: interior and exterior angles of triangles and angles formed when a transversal cuts parallel lines or intersecting lines. Solve for an unknown angle in a figure by applying facts about these angles.	**8.G.5** Use informal arguments to establish facts about: a. the angle sum and exterior angles of triangles. b. the angles created when parallel lines are cut by a transversal. c. the angle-angle criterion for similarity of triangles.	The new standard clarifies the 2017 standard, focusing on describing angle-pair relationships and solving for unknown angles.
8.GM.GF.5 Describe the relationship between the leg lengths and hypotenuse length of a right triangle. Determine whether a triangle is a right triangle using this relationship.	**8.G.6** Explain a proof of the Pythagorean Theorem and its converse.	The new standard focuses on explaining the relationship between the legs and hypotenuse rather than proving the theorem.
8.GM.GF.6 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in two and three dimensions on and off a coordinate plane, including authentic problems.	**8.G.6** Explain a proof of the Pythagorean Theorem and its converse. **8.G.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **8.G.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	The new standard combines three 2017 standards and focuses on the application of the Pythagorean Theorem to determine unknown side lengths.

DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; draw inferences and conclusions, and making predictions; and understand and apply basic concepts of probability.**		
Data Analysis (D) *Learners will ask and answer questions by collecting, organizing, and displaying relevant data; drawing inferences, conclusion, and making predictions.*	**Statistics and Probability** *Develop an understanding of statistical variability. Summarize and describe distributions.*	
8.DPS.D.1 Interpret scatter plots for bivariate measurement data to investigate patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	**8.SP.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.	The new standard summarizes the 2017 standard and focuses on interpreting scatter plots for bivariate data.
8.DPS.D.2 Draw an informal trend line on a given scatter plot with a linear association and justify its fit by describing the closeness of the data points to the line.	**8.SP.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.	The new standard summarizes the 2017 standard, focusing on drawing trend lines for data on a scatter plot.
8.DPS.D.3 Solve authentic problems in the context of bivariate measurement data by interpreting the slope and intercept(s) and making predictions using a linear model.	**8.SP.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept(s).	The new standard summarizes the 2017 standard, focusing on using bivariate data to solve problems.
8.DPS.D.4 Construct and interpret a two-way table summarizing bivariate categorical data collected from the same subjects.	**8.SP.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 associations between the two variables.	The new standard summarizes the 2017 standard, focusing on the construction and interpretation of two-way tables summarizing bivariate data.

Grades 9-10

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
9-10.NO.1 Explain how the definition of rational exponents follows from extending the properties of integer exponents; rewrite simple expressions involving radicals and rational exponents using the properties of exponents.	**HS.N-RN.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. **HS.N-RN.2** Rewrite expressions involving radicals and rational exponents using the properties of exponents.	The new standard combines the 2017 standards. It limits rewriting to simple expressions involving radical and rational exponents. The standard is expanded in grades 11-12 to focus on rewriting complex expressions.
9-10.NO.2 Perform basic operations on simple radical expressions to write a simplified equivalent expression.	**HS.N-RN.4** Perform basic operations on radicals and simplify radicals to write equivalent expressions.	The standard is the same. This standard is expanded in grades 11-12 to work with complex radical expressions.
9-10.NO.3 Choose and interpret the scale and the units in graphs and data displays.	**HS.N-Q.1*** Use units as a way to understand problems and to guide the solution of multi-step problems (e.g., unit analysis). Choose and interpret units consistently in formulas. Choose and interpret the scale and the origin in graphs and data displays.	The new standard summarizes the 2017 standard and focuses on interpreting the scale and units used to represent data. This standard is expanded in grades 11-12 to include units used consistently in formulas.
9-10.NO.4* Define appropriate quantities and units for the purpose of descriptive modeling.	**HS.N-Q.2*** Define appropriate quantities for the purpose of descriptive modeling.	The standards are the same.
9-10.NO.5 Choose a level of accuracy or precision appropriate to limitations on measurement when reporting quantities.	**HS.N-Q.3*** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	The standards are the same.
	HS.N-RN.3 Demonstrate that 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.	This standard is addressed in grades 11-12 (11-12.NO.3)IF.8.
	HS.N-VM.6* Use matrices to represent and manipulate data.	This standard was embedded into the matrix standards in grades 11-12 (11-12.NO.17, 11-12.NO.18).
	HS.N-VM.7 Multiply matrices by scalars to produce new matrices	This standard was embedded in standard (+)11-12.NO.18

*High School Symbols used: * indicates a modeling standard (See Appendix C for the explanation of modeling.), and (+) indicates a "plus" standard used for advanced concepts or skills.*

	HS.N-VM.8 Add, subtract, and multiply matrices of appropriate dimensions	This standard was moved to grades 11-12 (11-12.NO.17 and (+) 11-12.NO.19).
	HS.N-VM.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.	This standard was moved to grades 11-12 ((+) 11-12.NO.19).
ALGEBRAIC REASONING (AR) Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.		
9-10.AR.1 Use the structure of an expression (i.e., quadratic and exponential) to identify ways to rewrite it.	**HS.A-SSE.2** Use the structure of an expression to identify ways to rewrite it.	The standards are the same. The example in the new standard helps provide the scope of the standard. This standard is expanded in grades 11-12 to include polynomials and rational expressions.
9-10.AR.2 Rearrange formulas to isolate a quantity or variable(s) of interest using the same reasoning as in solving equations.	**HS.A-CED.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	The standards are the same. This standard is expanded in grades 11-12.
9-10.AR.3* Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear, quadratic, and exponential functions.	**HS.A-CED.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 and exponential functions. **HS.F-LE.2*** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a table, a description, or two input-output pairs given their relationship.	The standard embeds the 2017 standards regarding linear, quadratic, and exponential functions. This standard is also expanded in grades 11-12 to include rational functions.
9-10.AR.4* Create linear and exponential equations in two or more variables to represent relationships between quantities. Graph equations on coordinate axes with appropriate labels and scales.	**HS.A-CED.2*** Create equations in two or more variables to represent relationships between quantities Graph equations on coordinate axes with labels and scales. **HS.F-LE.5 *** Interpret the parameters in a linear, quadratic, or exponential function in terms of context.	The new standard focuses on creating linear and exponential equations in two or more variables. This standard is also expanded in grades 11-12 to include quadratics.

9-10.AR.5 Justify each step in solving a linear equation that may or may not have a solution.	**HS.A-REI.1** Explain each step in solving a simple equation as following from the equality of numbers asserted in the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.	The new standard focuses on solving linear equations and justifying the solution. It does not state the steps that need to be taken, as was done in 2017.
9-10.AR.6 Solve linear equations and inequalities(to include compound inequalities) in one variable.	**HS.A-REI.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	The new standard summarizes the standard from 2017, focusing on solving linear equations and inequalities in one variable.
9-10.AR.7* Solve a system of linear equations graphically and algebraically. Create and solve a system of linear equations in context.	**8.EE.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. c. Solve real-world and mathematical problems leading to two linear equations. **HS.A-REI.6** Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables.	The new standard combines standards from 2017 focusing on solving systems of equations.

9-10.AR.8 Graph the solution set to a two-variable system of linear inequalities. Create and graph the solution set to a two-variable system of linear inequalities in context.	**8.EE.8c.** Solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations. Solve simple cases by inspection. **HS.A-REI.11** Using graphs, technology, tables, or successive approximations, show that the solution(s) to the equation f(x) = g(x) are the x-value(s) that result in the y-values of f(x) and g(x) being the same. **HS.A-REI.12** Graph the solutions to a linear inequality in two variables as a half-plane. Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	The new standard combines the 2017 standards focused on graphing systems of linear equations and solutions sets for inequalities.
9-10.AR.9 Solve absolute value equations and inequalities in one or two variables.		The new standard focuses on solving absolute value equations and inequalities. It builds on the absolute value concepts learned in grade 7 (7.NO.NS.1).
9-10.AR.10 Solve quadratic equations in one variable by inspection (e.g., for $x^2=49$) taking square roots, the quadratic formula, and factoring, as appropriate to the initial form of the equation.	**HS.A-REI.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. b. Solve quadratic equations by inspection (e.g., for x2=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 ± bi for real numbers a and b.	The new standard combines the 2017 standards, focusing on solving quadratic equations in one variable. Completing the square was removed. This standard is expanded in grades 11-12.
9-10.AR.11 Add, subtract, and multiply polynomials.	**HS.A-APR.1** Add, subtract, and multiply polynomials. Understand that polynomials form a system comparable to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication.	The new standard is the same as the first part of the 2017 standard. This standard is expanded in grades 11-12.
	HS.A-CED.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.	Standard addressed in grades 11-12.

	HS.A-SSE.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.	This standard is addressed in grades 11-12.
Functions (F) *Learners will develop a foundational knowledge of functions and use them to model relationships between quantities.*	**Functions** *Understand the concept of a function and use the function notation.*	
9-10.AR.F.1 Determine whether a relationship is a function given a table, graph, or words, identifying x as an element of the domain and f(x) as an element in the range. Determine the domain and range of a function in context.	**HS.F-IF.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).	The new standard summarizes the 2017 standard focusing on determining if relationships are functions.
9-10.AR.F.2* Use function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of context.	**HS.F-IF.2*** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of context.	The standards are the same.
9-10.AR.F.3* Sketch the key features (to include intercepts, maximums, minimums, and lines of symmetry where applicable) of linear, exponential, and quadratic functions modeling the relationship between two quantities using tables, graphs, written descriptions, and equations.	**HS.F-IF.4*** Use tables, graphs, verbal descriptions, and equations to interpret and sketch the key features of a function modeling the relationship between two quantities. **HS.F-IF.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. e. Graph exponential functions, showing intercepts and end behavior.	The new standard combines the standards from 2017 regarding graphing functions. This standard is expanded in grades 11-12.
9-10.AR.F.4* Relate the domain of a linear, quadratic, or exponential function to its graph and, where applicable, to the quantitative relationship it describes.	**HS.F-IF.5*** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	The standards are the same. This standard is expanded in grades 11-12.

9-10.AR.F.5* Calculate and interpret the average rate of change of a linear, quadratic, or exponential function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	**HS.F-IF.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.	The standards are the same. This standard is expanded in grades 11-12.
9-10.AR.F.6* Write a function defined by an expression in different but equivalent forms to reveal and explain the different properties of the function. a. Use appropriate forms of linear, quadratic, and exponential functions to show zeros, extreme values, and symmetry (where applicable) and interpret these in context. b. Use the properties of an exponential function to classify it as growth or decay.	**HS.F-IF.8*** Write a function defined by an expression in different but equivalent forms to reveal and explain the 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 context. b. Use the properties of exponents to interpret expressions for exponential functions. **HS.F-BF.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.	The new standard combines the 2017 standards about writing functions. This standard is expanded in grades 11-12 to include completing the square and the process of factoring in quadratic functions.
9-10.AR.F.7* Compare key features of two linear, exponential, or quadratic functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	**HS.F-IF.9*** Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). **HS.F-LE.3*** Compare the end behavior of linear, quadratic, and exponential functions using graphs and/or tables to show that a quantity increasing exponentially eventually exceeds a quantity increasing as a linear or quadratic function.	The new standard combines the 2017 standards. The new standard focuses on linear, exponential, and quadratic functions. This standard is expanded in grades 11-12.
9-10.AR.F.8* Identify situations that can be modeled with linear, quadratic, and exponential functions. Justify the most appropriate model for a situation based on the rate of change over equal intervals. Include situations in which a quantity grows or decays.	**HS.F-LE.1*** Identify situations that can be modeled with linear, quadratic, and exponential functions. Justify the most appropriate model for a situation based on the rate of change over equal intervals. Include situations in which a quantity grows or decays.	The standards are the same.

9-10.AR.F.9* Identify the effect of transformations on the graph of a linear or quadratic function by replacing f(x) with af(x), f(x – h), *and* f(x) + k, for specific values of a, h, and k (both positive and negative). Find the value of a, h, and k given the graph of the function.	**HS.F-BF.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. Recognize even and odd functions from their graphs.	The standards are the same. This standard is expanded in grades 11-12.
9-10.AR.F.10 Find the inverse of a linear function and describe the relationship between the domain, range, and graph of the function and its inverse in context.	**HS.F-BF.4*** Find inverse functions. a. Write an equation for the inverse given a function has an inverse.	The new standard focuses on finding and graphing the inverse of a linear function. This standard is expanded in grades 11-12.
9-10.AR.F.11* Interpret the parameters in a linear, quadratic, or exponential function in context.	**HS.F-LE.5 *** Interpret the parameters in a linear, quadratic, or exponential function in terms of context.	The standards are the same.
9-10.AR.F.12 Identify, using graphs or tables, the solution(s) to linear and exponential functions f(x) = g(x) as x-value(s) that result in equivalent y-values.	**HS.A-REI.10** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.	This standard focuses on graphing solutions to linear and exponential functions. This standard is expanded in grades 11-12.
	HS.F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	This standard was moved to grades 11-12 as a part of 11-12.AR.F.13 and 11-12.AR.F.14.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
9-10.GM.1 Know precise definitions and notations of angle, circle, perpendicular line, parallel line, and line segment based on the undefined notions of point, line, and plane.	**HS.G-CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment based on the undefined notions of point, line, and plane.	The standards are the same.
9-10.GM.2 Represent transformations in the plane. Describe transformations as functions taking points in the plane as inputs and giving others as outputs. Compare transformations that preserve distance and angle to those that do not (i.e., rigid versus non-rigid motion).	**HS.G-CO.2** Represent transformations in the plane. 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).	The standards are the same. The examples provided in the clarifications of the new standard changed.
9-10.GM.3 Describe the rotations and reflections of a triangle, rectangle, parallelogram, trapezoid, or regular polygon that map each figure onto itself or another figure.	**HS.G-CO.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.	The 2017 standard was reworded to add clarification.

9-10.GM.4 Develop or verify the characteristics of rotations, reflections, and translations in angles, circles, perpendicular lines, parallel lines, and line segments.	**G-CO.4** Develop or verify experimentally the characteristics of rotations, reflections, and translations I terms of angles, circles, perpendicular lines, parallel lines, and line segments.	The standard is the same.
9-10.GM.5 Draw the image of a figure that has undergone a series of transformations [rotation(s), reflection(s), or translation(s)] of a geometric figure using a variety of methods (e.g., graph paper, tracing paper, or geometry software).	**HS.G-CO.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.	The 2017 standard was reworded to add clarification.
9-10.GM.6 Predict the effect of a specified rigid motion on a given figure using geometric descriptions of rigid motions. Determine whether two figures are congruent using the definition of congruence in terms of rigid motions.	**HS.G-CO.6** Use geometric descriptions of rigid motions to predict the effect of a given rigid motion on a given figure. Use the definition of congruence in terms of rigid motions to decide if two figures are congruent.	The new standard was reworded to add clarification.
9-10.GM.7 Use the definition of congruence, based on rigid motions, to show two triangles are congruent if and only if their corresponding sides and corresponding angles are congruent.	**HS.G-CO.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.	The standards are the same.
9-10.GM.8 Prove two triangles are congruent using the congruence theorems.	**HS.G-CO.8** Prove two triangles are congruent using the congruence theorems such as ASA, SAS, and SSS.	The new standard does not list the congruence theorems for triangles.
9-10.GM.9 Prove and apply theorems about lines and angles.	**HS-G-CO.9** Prove and apply theorems about lines and angles.	The standards are the same.
9-10.GM.10 Prove and apply theorems about triangles.	**HS-G-CO.10** Prove and apply theorems about triangle properties.	The standards are the same.
9-10.GM.11 Prove and apply theorems about parallelograms.	**HS-G-CO.11** Prove and apply theorems about parallelograms.	The standards are the same.
9-10.GM.12 Make basic geometric constructions (e.g., segments, angles, bisectors, parallel and perpendicular lines) with a variety of tools and methods.	**HS.G-CO.12** Make basic geometric constructions with a variety of tools and methods.	The standard's content is the same. The new standard provides examples.
(+) 9-10.GM.13 Apply basic constructions to create polygons such as equilateral triangles, squares, and regular hexagons inscribed in circles.	**(+) HS.G-CO.13** Apply basic constructions to create polygons such as equilateral triangles, squares, and regular hexagons inscribed in circles.	The standards are the same.
9-10.GM.14 Verify experimentally and justify the properties of dilations given by a center and a scale factor.	**HS.G-SRT.1** Verify experimentally the properties of dilations given by a center and a scale factor.	The standard is the same. The new standard adds a justification.

9-10.GM.15 Use transformations to decide if two given figures are similar. Apply the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	**HS.G-SRT.2** Given two figures, use transformations to decide if they are similar. Apply the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	The standards are the same.
9-10.GM.16 Prove similarity theorems about triangles.	**HS.G-SRT.4** Prove similarity theorems about triangles. **HS.G-SRT.3** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	The new standard embeds the first of the 2017 standards as a part of proving similarity.
9-10.GM.17 Apply knowledge of congruence and similarity criteria for triangles to solve problems and to prove relationships in various geometric figures.	**HS.G-SRT.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	The new standard clarifies the concept outlined in the 2017 standard.
9-10.GM.18 Recognize how the properties of similar right triangles allow the trigonometric ratios to be defined and determine the sine, cosine, and tangent of an acute angle in a right triangle.	**HS.G-SRT.6** Understand how the properties of similar right triangles allow the trigonometric ratios to be defined and determine the sine, cosine, and tangent of an acute angle in a right triangle.	The standards are the same.
(+) 9-10.GM.19 Explain and use the relationship between the sine and cosine of complementary angles.	**HS.G-SRT.7** Explain and use the relationship between the sine and cosine of complementary angles.	The standards are the same.
9-10.GM.20* Solve applied problems involving right triangles using trigonometric ratios, the Pythagorean Theorem, and special right triangles (30°-60°-90° and 45°-45°-90°).	**HS.G-SRT.8** Use special right triangles (30°-60°-90° and 45°-45°-90°), trigonometric ratios, and the Pythagorean Theorem to solve right triangles in applied problems.	The new standard clarifies the expectation of the 2017 standard.
(+) 9-10.GM.21* Solve unknown sides and angles of non-right triangles using the Laws of Sines and Cosines.	**(+)HS.G-SRT.10** Solve unknown sides and angles of non-right triangles using the Laws of Sines and Cosines. **(+) HS.G-SRT.11*** Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in context.	The new standard combines the 2017 standard focusing on the use of the Laws of Sines and Cosines to solve problems.
9-10.GM.22 Apply theorems about relationships between line segments and circles or angles and circles formed by radii, diameter, secants, tangents, and chords to find unknown lengths or angles.	**HS.G-C.1** Understand and apply theorems about relationships with line segments and circles, including radii, diameter, secants, tangents, and chords. **HS.G-C.2** Understand and apply theorems about relationships with angles formed by radii, diameter, secants, tangents, and chords. Understand and apply properties of angles for a quadrilateral inscribed in a circle.	The new standard applies the theorems which require understanding. The standard was reworded to indicate the relationship between line segments and circles and between angles and circles. It combines the two standards from 2017.

(+) 9-10.GM.23 Construct the incenter and circumcenter of a triangle. Relate the incenter and circumcenter to the inscribed and circumscribed circles.	**HS.G-C.3** Construct the incenter and circumcenter of a triangle. Relate the incenter and circumcenter to the inscribed and circumscribed circles.	Due to the construction portions of this standard, this standard was considered a more advanced standard and noted as such. The standard is the same as the 2017 standard.
(+) 9-10.GM.24 Construct a tangent line from a point outside a given circle to the circle.	**(+) HS.G-C.4** Construct a tangent line from a point outside a given circle to the circle.	The standards are the same.
9-10.GM.25 Explain and use the formulas for arc length and area of sectors of circles.	**HS.G-C.5** Explain and use the formulas for arc length and area of sectors of circles.	The standards are the same.
9-10.GM.26 Recognize that the radian measure of an angle is the ratio of the length of the arc to the length of the radius of a circle.	**HS.F-TF.1** Understand that the radian measure of an angle is the ratio of the length of the arc to the length of the radius of a circle.	The standards are the same.
9-10.GM.27 Develop and verify the slope criteria for parallel and perpendicular lines. Apply the slope criteria for parallel and perpendicular lines to solve problems.	**HS.G-GPE.4** Use coordinates to verify simple geometric theorems algebraically. Use coordinates to verify algebraically that a given set of points produces a particular type of triangle or quadrilateral.	The new standard uses the slope criteria language implied in 2017.
9-10.GM.28 Verify simple geometric theorems algebraically using coordinates. Verify algebraically, using coordinates, that a given set of points produces a particular type of triangle or quadrilateral.	**HS.G-GPE.5** Develop and verify the slope criteria for parallel and perpendicular lines. Apply the slope criteria for parallel and perpendicular lines to solve geometric problems using algebra.	The new standard uses the slope criteria language implied in 2017.
9-10.GM.29 Determine the midpoint or endpoint of a line segment using coordinates. (+) Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	**HS.G-GPE.6** Use coordinates to find the midpoint or endpoint of a line segment. (+) Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	The new standard was reworded to clarify the expectation of the 2017 standard.
9-10.GM.30* Compute perimeters of polygons and areas of triangles, parallelograms, trapezoids, and kites using coordinates.	**HS.G-GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles, parallelograms, trapezoids, and kites.	The new standard was reworded to clarify the expectation of the 2017 standard.
9-10.GM.31 Explain derivations of the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone.	**HS.G-GMD.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.	The new standard was reworded to clarify the expectation of the 2017 standard.
9-10.GM.32 Calculate the surface area for prisms, cylinders, pyramids, cones, and spheres to solve problems.	**HS.G-GMD.2** Calculate the surface area for prisms, cylinders, pyramids, cones, and spheres to solve problems.	The standards are the same.
9-10.GM.33 Know and apply volume formulas for prisms, cylinders, pyramids, cones, and spheres to solve problems.	**HS.G-GMD.3*** Know and apply volume formulas for prisms, cylinders, pyramids, cones, and spheres to solve problems.	The standards are the same.

9-10.GM.34 Identify the shapes of two-dimensional cross-sections of three-dimensional objects and identify three-dimensional objects generated by rotations of two-dimensional objects.	**HS.G-GMD.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.	The standards are the same.
9-10.GM.35* Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	**HS.G-MG.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	The standards are the same.
9-10.GM.36* Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; scaling a model).	**HS.G-MG.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).	The standards are the same. The new standard changes the example to "scaling a model."
	HS.G-MG.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).	This standard was omitted because these skills are taught prior to high school.
DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; draw inferences and conclusions, and making predictions; and understand and apply basic concepts of probability.**		
9-10.DPS.1* Represent data with plots on the real number line (dot plots, histograms, and box plots).	**HS.S-ID.1*** Represent data with plots on the real number line (dot plots, histograms, and box plots).	The standards are the same.
9-10.DPS.2* Compare the center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets using statistics appropriate to the shape of the data distribution.	**HS.S-ID.2*** Use statistics appropriate to the shape of the data distribution to compare the center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. **HS.S-ID.3*** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	The new standard clarifies the concept to be measured by rewording the 2017 standard.

9-10.DPS.3* Represent data on two quantitative variables on a scatter plot and describe how the variables are related. a. Fit a linear function to the data (with or without technology) if appropriate. b. Compute (using technology) and interpret the correlation coefficient of a linear fit. c. Interpret the meaning of the slope and y-intercept of the liner model in context. d. Interpolate and extrapolate the linear model to predict values.	**HS.S-ID.6*** Represent data on two quantitative variables on a scatter plot and describe how the variables are related. Fit a function to the data (with or without technology) a. Use functions fitted to data to solve problems in the context of the data. b. (+) Informally assess the fit of a function by plotting and analyzing residuals. **HS.S-ID.7*** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. Interpolate and extrapolate the linear model to predict values. **HS.S-ID.8*** Compute (using technology) and interpret the correlation coefficient of a linear fit.	The new standard combines standards from 2017. It focuses on representing and comparing data. This is also a standard in grades 11-12, where the focuses expand beyond linear function.
9-10.DPS.4* Distinguish between correlation and causation.	**HS.S-ID.9*** Distinguish between correlation and causation.	The standards are the same.
9-10.DPS.5* 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").	**HS.S-CP.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").	The standards are the same.
9-10.DPS.6* Recognize that event A is independent of event B if the probability of event A does not change in response to the occurrence of event B. Apply the formula P(A and B) = P(A)·P(B), given that events A and B are independent.	**HS.S-CP.2*** Understand that event A is independent of event B if the probability of event A does not change in response to the occurrence of event B. Apply the formula $P(A$ and $B)$ = $P(A) * P(*B)$ given that events A and B are independent.	The standards are the same.
9-10.DPS.7* Recognize that the conditional probability of an event A given B is the probability that event A will occur given the knowledge that event B has already occurred. Calculate the conditional probability of A given B and interpret the answer in context.	**HS.S-CP.3*** Understand that the conditional probability of an event A given B is the probability that event A will occur given the knowledge that event B has already occurred. Apply the formula P(A given B) = P(A and B)/P(B) given a conditional probability situation. **HS.S-CP.6*** Find the conditional probability of A given B and interpret the answer in terms of the model.	The new standard combines standards from 2017.
9-10.DPS.8* Apply the formula P(A or B) = P(A) + P(B) – P(A and B) and interpret the answer in context.	**HS.S-CP.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.	The standards are the same.

9-10.DPS.9* Determine the number of outcomes using permutations and combinations in context.	**HS.S-CP.9*** Use permutations and combinations to determine the number of outcomes in terms of the model.	The 2017 standard was reworded to clarify the meaning.
9-10.DPS.10* Construct and interpret two-way frequency tables of data for two categorical variables. Use the two-way table as a sample space to decide if events are independent and approximate conditional probabilities.	**HS.S-CP.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 approximate conditional probabilities. **HS.S-ID.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.	The new standard combines two 2017 standards.
	HS.S-CP.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.	This standard was omitted as a separate standard. The concepts are embedded within other standards (e.g.,9-10.DPS.6, 9-10.DPS.8).
	HS.S-CP.5* Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.	This standard was omitted as a separate standard. The concepts are embedded within other standards.

Grades 11-12

2023 MATH STANDARDS	2017 MATH STANDARDS	CHANGES
NUMBER AND OPERATIONS (NO) **Learners will develop a foundational understanding of the number system, operations, and computational fluency to create and solve problems within and across concepts.**		
11-12.NO.1 Rewrite complex expressions involving radicals and rational exponents using the properties of exponents.	**HS.N-RN.2** Rewrite expressions involving radicals and rational exponents using the properties of exponents.	The new standard builds on prior knowledge developed in grades 9-10 (9-10.NO.1) to complex expressions. Clarification was added to the 2017 standard.
11-12.NO.2 Perform operations on complex radical expressions and simplify radicals to write equivalent expressions.	**HS.N-RN.4** Perform basic operations on radicals and simplify radicals to write equivalent expressions.	The new standard focuses on the use of complex radical expressions. It builds on the standard in grades 9-10 (9-10.NO.2), where students wrote simplified expressions.
11-12.NO.3 Demonstrate that 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.	**HS.N-RN.3** Demonstrate that 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.	The standards are the same.
11-12.NO.4* Use units to understand problems and to guide the solution of multi-step problems (e.g., unit analysis). Choose and interpret units consistently in formulas. Choose and interpret the scale and the units in graphs and data displays.	**HS.N-Q.1** Use units as a way to understand problems and to guide the solution of multistep problems. Choose and interpret (e.g., unit analysis). units consistently in formulas. Choose and interpret the scale and the origin in graphs and data displays.	The standards are the same. This standard continues to expand the standard in grades 9-10 (9-10.NO.4 and 9-10.NO.3) in which students defined appropriate quantities and units.
11-12.NO.5* Choose a level of accuracy or precision appropriate to limitations on measurement when reporting quantities.	**HS.N-Q.3 *** Choose a level of accuracy or precision appropriate to limitations on measurement when reporting quantities.	The standards are the same. This standard builds on the 9-10.NO.5 in which students focused on accuracy.
11-12.NO.6 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. Understand the hierarchal relationships among subsets of the complex number system.	**HS.N-CN.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. Understand the hierarchal relationships among subsets of the complex number system.	The standards are the same.
11-12.NO.7 Use the definition $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	**HS.N-CN.2** Use the definition $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	The standards are the same.

*High School Symbols used: * indicates a modeling standard (See Appendix C for the explanation of modeling.), and (+) indicates a "plus" standard used for advanced concepts or skills.*

11-12.NO.8 Use conjugates to find quotients of complex numbers.	**HS.N-CN.3** Use conjugates to find quotients of complex numbers.	The standards are the same.
11-12.NO.9 Apply the Fundamental Theorem of Algebra to determine the number of zeros for polynomial functions. Find all solutions to a polynomial equation.	**(+) HS.N-CN.9** Apply the Fundamental Theorem of Algebra to determine the number of zeros for polynomial functions. Find all solutions to a polynomial equation.	The standards are the same. The new standard removes the (+), indicating this is an advanced concept. This standard applies to multiple high school mathematics courses.
(+) 11-12.NO.10 Represent complex numbers on the complex plane in rectangular, trigonometric, and polar forms. Find the modulus (absolute value) of a complex number. Explain why the rectangular, trigonometric, and polar forms of a given complex number represent the same number.	**(+) HS.N-CN.4** Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers). Find the moduli (absolute value) of a complex number. Explain why the rectangular and polar forms of a given complex number represent the same number.	The standards are the same.
(+) 11-12.NO.11 Represent addition, subtraction, multiplication, conjugation, powers, and roots of complex numbers geometrically on the complex and/or polar plane; use properties of this representation for computation.	**(+) HS.N-CN.5** Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation**.**	The standards are the same.
(+) 11-12.NO.12 Extend polynomial identities to the complex numbers.	**(+) HS.N-CN.8** Extend polynomial identities to the complex numbers.	The standards are the same.
(+) 11-12.NO.13 Apply the Fundamental Theorem of Algebra to find all roots of a polynomial equation and determine the nature (i.e., integer, rational, irrational, real, complex) of the roots.	**(+) HS.N-CN.9** Apply the Fundamental Theorem of Algebra to determine the number of zeros for polynomial functions. Find all solutions to a polynomial equation.	The new standard focuses on using the Fundamental Theorem of Algebra to find the roots of a polynomial equation and determine the nature of the complexity of the roots. The standard applies across multiple high school mathematics courses.
(+) 11-12.NO.14 Recognize vector quantities as having both magnitude and direction, writing them in polar form.	**+) HS.N-VM.1** Recognize vector quantities direction. Represent vector quantities by directed line segments and use appropriate symbols for vectors and their magnitudes (e.g., **v, /v/, //v//, v**).	The new standard clarifies the expectation of the 2017 standard.
(+) 11-12.NO.15 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	**(+) HS.N-VM.2** Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	The standards are the same.
(+) 11-12.NO.16 Solve problems involving magnitude and direction that can be represented by vectors.	**(+) HS.N-VM.3** Solve problems involving velocity and other quantities that can be represented by vectors.	The new standard clarifies the expectation of the 2017 standard.

(+) 11-12.NO.17 Add and subtract vectors. a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Know 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 that vector subtraction ***v*** – ***w*** is defined 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 using the components to perform vector subtraction.	**(+) HS.N-VM.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 that vector subtraction v – w is defined 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 using the components to perform vector subtraction. **HS.N-VM.8** Add, subtract, and multiply matrices of appropriate dimensions	The new standard includes 2017 standards regarding the addition and subtraction of vectors.
(+) 11-12.NO.18 Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction. Use the components to perform scalar multiplication (e.g., as $c(v_x, v_y) = (cv_x, cv_y)$). b. Compute the magnitude of a scalar multiple $c\mathbf{v}$ using $\|c\mathbf{v}\| = \|c\|\mathbf{v}$. Compute the direction of cv knowing that when $\|c\|\mathbf{v} \neq 0$, the direction of $c\mathbf{v}$ is either along ***v*** (for $c > 0$) or against ***v*** (for $c < 0$).	**(+)HS.N-VM.5** Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction. Use the components to perform scalar multiplication (e.g., as $c(v_x, v_y) = (c_x, cv_y)$). b. Compute the magnitude of a scalar multiple c**v** using $\|c\mathbf{v}\| = \|c\|\mathbf{v}$. Compute the direction of cv knowing that when $\|c\|\mathbf{v} \neq 0$, the direction of c**v** is either along **v** (for $c > 0$) or against **v** (for $c < 0$). **HS.N-VM.7** Multiply matrices by scalars to produce new matrices.	The new standard combines the 2017 standards on multiplying vectors by scalars.

(+) 11-12.NO.19 Represent data in a matrix. Perform operations (i.e., addition, subtraction, multiplication) on matrices of appropriate dimensions to solve problems and in context. Know that matrix multiplication is not commutative.	**(+) HS.N-VM.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. **(+) HS.N-VM.11** Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Understand a matrix as a transformation of vectors. **HS.N-VM.8** Add, subtract, and multiply matrices of appropriate dimensions. **HS.N-VM.9** Understand that, unlike the multiplication of numbers, matrix multiplication for square matrices is not a commutative operation but still satisfies the associative and distributive properties.	The new standard combines 2017 standards. The new standard clarifies the expectation that students should perform operations on matrices.
	(+) HS.N-VM.12 Understand a 2 × 2 matrix as a transformation of the plane. Interpret the absolute value of the determinant in terms of area.	This standard was omitted. This is a concept that is embedded in standards requiring students to use matrices to solve problems.
ALGEBRAIC REASONING (AR) **Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.**		
11-12.AR.1* Rearrange multi-variable formulas to highlight a quantity of interest.	**HS.A-CED.4*** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	The 2017 standard was reworded. This standard expands standards 9-10.AR.2 to focus on multi-variable formulas.
11-12.AR.2 Use the structure of an expression (to extend to polynomial and rational expressions) to identify ways to rewrite it.	**HS.A-SSE.2** Use the structure of an expression to identify ways to rewrite it.	The standards are the same. This standard builds on the standard 9-10.AR.1 by adding quadratic and exponential structures.
11-12.AR.3* Interpret expressions that represent a quantity in 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.	**HS. A-SSE.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.	The standards are the same. This standard extends 9-10.AR.9 by increasing the complexity of the expressions.

11-12.AR.4* 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. Use the properties of exponents to transform exponential expressions. c. Complete the square in a quadratic expression to produce an equivalent expression.	**HS.A-SSE.3*** Choose and produce an equivalent form of an expression to reveal and explain the 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 produce an equivalent expression. c. Use the properties of exponents to transform exponential expressions.	The standards are the same.
11-12.AR.5 Add, subtract, and multiply, and divide rational expressions. Understand that rational expressions form a system analogous to rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression	**HS.A-APR.1** Add, subtract, and multiply polynomials. Understand that polynomials form a system comparable to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication. **HS.A-APR.7** Add, subtract, multiply, and divide rational expressions. Understand that rational expressions form a system comparable to rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression.	The new standard focuses on rational expressions, extending understanding beyond quadratic expressions.
11-12.AR.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 technology for the more complicated examples.	**HS.A-APR.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.	The standards are the same.
11-12.AR.7* Create equations and inequalities and use them to solve problems. Include equations arising from linear and quadratic function and simple rational and exponential functions.	**HS.A-CED.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 and exponential functions.	The standards are the same. This standard builds on standard 9-10.AR.3 by adding simple rational functions.
11-12.AR.8* Create equations in two or more variables to represent relationships between quantities. Graph equations on coordinate axes with appropriate labels and scales.	**HS.A-CED.2*** Create equations in two or more variables to represent relationships between quantities. Graph equations on coordinate axes with appropriate labels and scales.	The standards are the same. This standard expands the standard 9-10.AR.4 by no longer limiting the equations to linear and exponential.
11-12.AR.9* 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.	**HS. A-CED.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.	The standards are the same. This standard extends standard in 9-10.AR.8 in which students graph systems of equations or inequalities.

*High School Symbols used: * indicates a modeling standard (See Appendix C for the explanation of modeling.), and (+) indicates a "plus" standard used for advanced concepts or skills.*

11-12.AR.10 Derive the quadratic formula from the form $0 = ax^2 + bx + c$.	**HS.A-REI.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.	The new standard combines concepts involving real coefficients from the 2017 standards. It builds on 9-10.AR.10 by adding real coefficients when solving quadratic equations.
(+) 11-12.AR.11 Solve quadratic equations with real coefficients that have solutions of the form a + bi and a - bi.	**HS.A-REI.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. b. Solve quadratic equations by inspection (e.g., for x taking square roots, completing the square, 2 =49) 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 ± bi for real numbers a and b. **HS.N-CN.7** Solve quadratic equations with real coefficients that have complex solutions.	The new standard clarifies the (+) portion of the 2017 standard. The new standard focuses on deriving the quadratic formula to build upon the standard 9-10.AR.10.
11-12.AR.12 Solve simple rational and radical equations in one variable and identify extraneous solutions.	**HS.A-REI.2** Solve simple rational and radical equations in one variable and give examples showing how extraneous solutions may arise.	The standards are the same.
11-12.AR.13 Add, subtract, and multiply polynomials beyond quadratics. Understand that polynomials form a system comparable to integers, namely, they are closed under the operations of addition, subtraction, and multiplication.	**HS.A-APR.1** Add, subtract, and multiply polynomials. Understand that polynomials form a system comparable to integers, namely, they are closed under the operations of addition, subtraction, and multiplication.	The new standard moves beyond the expectation of the 2017 standard. It builds on the standard 9-10.AR.11 by extending operations beyond quadratics.
11-12.AR.14 Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.	**HS.A-APR.3** Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.	The standards are the same.
11-12.AR.15 Apply the Factor and Remainder Theorem to determine efficiently whether a linear expression is a factor of a polynomial expression. Apply the Remainder Theorem in context.	**A-APR.2** Apply the Remainder Theorem.	The new standard clarifies the expectation of the 2017 standard.

11-12.AR.16 Using graphs, technology, tables, or successive approximations, show that the solution(s) to the equation f(x) = g(x) is the x-value(s) that result in the y-values of f(x) and g(x) being the same.	**HS.A-REI .11** Using graphs, technology, tables, or successive approximations, show that the solution(s) to the equation f(x) = g(x) is the x-value(s) that result in the y-values of f(x) and g(x) being the same.	The standards are the same. This standard extends standard 9-10.AR.F.12 by increasing the complexity of the equations.
11-12.AR.17 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.	**HS.A-REI.7** Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.	The standards are the same.
(+) 11-12.AR.18 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).	**(+) HS.A-REI.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).	The standards are the same.
(+) 11-12.AR.19 Solve a system of equations in three or more variables with matrices (using technology).		This is a new standard building upon prior work with matrices.
(+) 11-12.AR.20 Apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n and integers a and b.	**(+) HS.A-APR.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.	The standards are the same.
	(+)HS.A-REI.8 Represent a system of linear equations as a single matrix equation.	This is a skill that is embedded within the other standards requiring students to use matrices to solve problems ((+) 11-12.AR.19).
Functions (F) *Learners will develop a foundational knowledge of functions and use them to model relationships between quantities.*	**Functions** *Understand the concept of a function and use the function notation.*	
11-12.AR.F.1* Write a function that describes a relationship between two quantities. a. Combine standard function types using arithmetic operations. b. Compose functions.	**HS.F-BF.1*** Write a function that describes a relationship between two quantities. b. Combine standard function types using arithmetic operations. c. Compose functions.	The standards are the same.
11-12.AR.F.2* 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.	**HS.F-IF.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.	The standards are the same. This standard builds upon standard 9-10.AR.F.5 by removing the limitation to linear, quadratic, or exponential functions.

11-12.AR.F.3* Write a function defined by an expression in different but equivalent forms to reveal and explain the 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 context. b. Use the properties of exponents to interpret expressions for exponential functions.	**HS .F-IF.8*** Write a function defined by an expression in different but equivalent forms to reveal and explain the 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 context. b. Use the properties of exponents to interpret expressions for exponential functions.	The standards are the same. The standard builds upon standard 9-10.AR.F.6 by adding the completion of the square in a quadratic function.
11-12.AR.F.4* Identify the effect of transformations on the graph of a function by replacing f(x) with af(x), f(bx), f(x-h), and f(x) + k, for specific values of a, h, and k (both positive and negative). Find the value of a, b, h, and k given the graph of the function. Recognize even and odd functions from their graphs and equations.	**HS .F-BF.3*** Identify the effect on the graph of replacing f(x) by f(x) + k, f(x + k), k f(x), and f(kx), for specific values of k (both positive and negative); find the value of k given the graphs. Recognize even and odd functions from their graphs.	The new standard clarifies the 2017 standard. This standard builds upon standard 9-10.AR.F.9 by removing the limitation to examine the effect of transformations of linear, absolute value, or quadratic functions.
11-12.AR.F.5* Find inverse functions. a. Verify by composition that one function is the inverse of another. b. Recognize that the graph of a function and its inverse are reflection images over the line y = x. c. Produce an invertible function from a non-invertible function by restricting the domain.	**HS .F-BF.4*** Find inverse functions. a. Write an equation for the inverse given a function has an inverse. 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.	The new standard clarifies the more complex aspects of the 2017 standard. The new standard builds on standard 9-10.AR.F.10 by adding the composition, recognition of the graph of the function and inverse, and producing an invertible function from a non-invertible function.
11-12.AR.F.6* Apply the inverse relationship between exponents and logarithms to solve problems.	**HS.F-BF.5*** Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	The new standard increases the rigor of the 2017 standard. The new standard expects students to apply the inverse relationship between exponents and logarithms.
11-12.AR.F.7* Compare key features of two functions, each represented in a different way (algebraically, graphically, numerically, in tables, or by verbal descriptions).	**HS.F-IF.9*** Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	The standards are the same. This standard builds upon standard 9-10.AR.F.7 by removing the limitation to linear, quadratic, or exponential functions.

11-12.AR.F.8* Use tables, graphs, verbal descriptions, and equations to interpret and sketch the key features of a function modeling the relationship between two quantities.	**HS .F-IF.4*** Use tables, graphs, verbal descriptions, and equations to interpret and sketch the key features of a function modeling the relationship between two quantities.	The standards are the same. This standard builds on standard 9-10.F.3 by adding tables, graphs, descriptions, and equations.
11-12.AR.F.9* Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	**HS.F-IF.5*** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	The standards are the same. The standard expands standard 9-10.AR.F.4 by removing the limits in functions used.
11-12.AR.F.10* 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 square root, cube root, piecewise-defined, step, and absolute value functions. b. Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior. c. Graph exponential and logarithmic functions, showing intercepts and end behavior. d. Graph f(x) = sin x and f(x) = cos x as representations of periodic phenomena.	**HS.F-IF.7*** Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. 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. e. Graph exponential and logarithmic functions, showing intercepts and end behavior. f. Graph f(x) = sin x and f(x) = cos x as representations of periodic phenomena.	The standards are the same. This standard builds upon standard 9-10.AR.F.3 by adding logarithmic and exponential functions.
(+) 11-12.AR.F.11* Analyze and graph functions expressed symbolically (by hand in simple cases and using technology for more complicated cases), identifying key features of the graph. a. (+) Graph rational functions, identifying domain, range, asymptote(s), removable and non-removable discontinuities, intercepts, behavior at the asymptote(s), and end behavior. b. (+) Graph trigonometric functions, showing period, midline, phase shift and amplitude.	**HS.F-IF.7*** Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available and showing end behavior. g. (+) Graph trigonometric functions, showing period, midline, phase shift, and amplitude.	The new standard increases the rigor of the 2017 standard by adding the analysis component. This standard builds upon standard 9-10.AR.F.3 by adding a rough analysis of functions as well as graphing them.

11-12.AR.F.12* Compare the end behavior of linear, quadratic, and exponential functions using graphs and/or tables to show that a quantity increasing exponentially eventually exceeds a quantity increasing as a linear or quadratic function.	**HS.F-LE.3*** Compare the end behavior of linear, quadratic, and exponential functions using graphs and/or tables to show that a quantity increasing exponentially eventually exceeds a quantity increasing as a linear or quadratic function.	The standards are the same.
11-12.AR.F.13* Determine whether a linear, quadratic, polynomial, exponential, logarithmic, or trigonometric model fits a situation. Determine an appropriate mathematical model in context (with or without technology).	**HS.F-BF.2*** Write arithmetic and geometric sequences both recursively and with an explicit formula and convert between the two forms. Use sequences to model situations.	The new standard clarifies the concept measured in the 2017 standard. The new standard expects students to determine if the functional model fits the situation and determine which model to use in different situations. This standard builds upon standard 9-10.AR.F.7 by adding polynomial, logarithmic, and trigonometric functions.
11-12.AR.F.14* Write arithmetic and geometric sequences both recursively and with an explicit formula and convert between the two forms. Use sequences to model situations.	**HS.F-BF.2*** Write arithmetic and geometric sequences both recursively and with an explicit formula and convert between the two forms. Use sequences to model situations.	The standards are the same.
11-12.AR.F.15* Use properties of logarithms to express the solution to $ab^{ct}= d$ where a, c, and d are real numbers and b is a positive real number. Evaluate the logarithm using technology when appropriate.	**HS.F-LE.4*** Use logarithms to express the solution to $ab^{ct} = d$ where a, c, and d are real numbers, and b is a positive real number. Evaluate the logarithm using technology when appropriate.	The new standard clarifies the 2017 standard. It clarifies the focus on the properties of logarithms.
11-12.AR.F.16 Extend right triangle trigonometry and apply knowledge of the unit circle to determine values of sine, cosine, and tangent for multiples of π/3, π/4, and π/6.	**HS.F-TF.2** Extend right triangle trigonometry to the four quadrants. **HS.F-TF.3** Use special triangles to determine geometrically the values of sine, cosine, and tangent for π /3, π/4, and π/6.	The new standard combines two related 2017 standards. It extends the concept of measuring right triangles in standards 9-10.GM.18 and 9-10.GM.20.
11-12.AR.F.17 Use the Pythagorean Identity $\sin^2(\theta) + \cos^2(\theta) = 1$ to find sin (θ), cos (θ), or tan (θ) given sin (θ), cos (θ), or tan (θ) and the quadrant of the angle.	**HS.F-TF.8** Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.	The intent of the standards is the same.
(+) 11-12.AR.F.18 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.	**HS.F-TF.2** Extend right triangle trigonometry to the four quadrants. (+) 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.	The new standard is the same as the (+) section of the 2017 standard.
(+) 11-12.AR.F.19 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.	**HS.F-TF.3** Use special triangles to determine geometrically the values of sine, cosine, and tangent for $\pi/3$, $\pi/4$, and $\pi/6$. (+) Use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$, in terms of their values for x, where x is any real number.	The new standard is the same as the second half of the 2017 standard.

*High School Symbols used: * indicates a modeling standard (See Appendix C for the explanation of modeling.), and (+) indicates a "plus" standard used for advanced concepts or skills.*

(+) 11-12.AR.F.20 Use the unit circle to explain the symmetry (odd and even) and periodicity of trigonometric functions.	**(+) HS.F-TF.4** Use the unit circle to explain the symmetry (odd and even) and periodicity of trigonometric functions.	The standards are the same.
(+) 11-12. AR.F.21 Create a trigonometric function to model periodic phenomena.	**(+) HS.F-TF.5** Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.	The new standard clarifies the expectation of the 2017 standard.
(+) 11-12. AR.F.22 Restrict the domain of a trigonometric function to construct its inverse.	**(+) HS.F-TF.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.	The new standard clarifies the 2017 standard.
(+) 11-12. R.F.23* Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions and interpret them in context.	**(+) HS.F-TF.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.	The new standard does not specify how the students should evaluate solutions as was done in 2017.
(+) 11-12. AR.F.24 Know and apply the addition and subtraction formulas for sine, cosine, and tangent to solve problems.	**(+) HS.F-TF.9** Know and apply the addition and subtraction formulas for sine, cosine, and tangent.	The new standard applies trigonometric formulas to solve problems.
GEOMETRY AND MEASUREMENT (GM) **Learners will use visualization, spatial reasoning, and geometric modeling to investigate the characteristics of figures, perform transformations, and construct logical arguments.**		
11-12.GM.1 Write the equation of a conic section given its special features. Convert between the standard form and general form equations of conic sections.	**HS.G-GPE.2** Convert between the standard form and general form of conic sections.	The new standard focuses on writing the equation of a conic section and converting between the standard and general form of those equations.
11-12.GM.2* Identify key features of a conic section given its equation. Apply properties of conic sections in context.	**HS.G-GPE.3** Identify key features of conic sections given their equations. Apply properties of conic sections in real-world situations. **HS.G-GPE.1** Derive the equation of a circle of a given center and radius. Derive the equation of a parabola given a focus and directrix. (+) Derive the equations of ellipses and hyperbolas given foci, using the fact that the sum or difference of distances from the foci is constant.	The new standard combines standards from 2017. The new standard uses the clarification section to embed parabolas into this standard.
11-12.GM.3 Determine and apply appropriate formulas to solve right and non-right triangle problems in context.		The new standard expects students to apply the formulas to solve problems. The standard builds upon 9-10.GM.20, which focuses on using trigonometric ratios, Pythagorean Theorem, and special right triangles.

(+) 11-12.GM.4 Derive the formula $A=\frac{1}{2}ab\sin C$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	**(+) HS.G-SRT.9** Derive the formula $A=\frac{1}{2}ab\sin C$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	The standards are the same.
DATA, PROBABILITY, AND STATISTICS (DPS) **Learners will ask and answer questions by collecting, organizing, and displaying relevant data; draw inferences, conclusions, and make predictions; and understand and apply basic concepts of probability.**		
11-12.DPS.1* Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	**HS.S-ID.3*** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	The standards are the same.
11-12.DPS.2* Use the mean and standard deviation of a data set to fit it to a normal distribution and estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate.	**HS.S-ID.4*** Use the mean and standard deviation of a data set to fit it to a normal distribution and 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.	The new standard does not specify the tools that may be used to calculate mean and standard deviation as was done in 2017. The standard extends standards 9-10.DPS.2 which focuses on interpreting and comparing data distribution.
11-12.DPS.3* Evaluate reports based on data. a. Identify and explain misleading use of data; recognize when claims based on data confuse correlation and causation. b. Recognize and describe how graphs and data can be distorted to support different points of view.	**HS.S-IC.6*** Evaluate reports based on data. a. Evaluate articles, reports, or websites based on data published in the media by identifying the source of the data, the design of the study, and the way the data are analyzed and displayed. b. Identify and explain misleading use of data; recognize when claims based on data confuse correlation and causation.	The new standard clarifies the concepts measured. It expands the analysis to include recognition and description of distortion of data to support different points of view, which was not included in 2017.
11-12.DPS.4* Represent data on a scatter plot for two quantitative variables and describe how the variables are related. a. Fit a function to the data (with or without technology) and interpret the special features (e.g., meaning of a and b in the exponential function $y = ab^x$) of the function in context. b. Use functions fitted to data to solve problems in the context of the data.	**HS.S-ID.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 (with or without technology). Use functions fitted to data to solve problems in the context of the data. b. (+) Informally assess the fit of a function by plotting and analyzing residuals.	The new standard clarifies the concepts measured in 2017. The new standard expands on the standard 9-10.DPS.3 to include functions beyond linear functions.
(+) 11-12.DPS.5* Informally assess the fit of a function by plotting and analyzing residuals.	**HS.S-ID.9** Distinguish between correlation and causation.	The new standard more clearly defines the concept measured. The new standard focuses on informally

		assessing the fit of a function which would incorporate distinguishing between correlation and causation.
(+) 11-12.DPS.6* Use data from a sample survey to estimate a population means or proportion; develop a margin of error through the use of simulation models for random sampling.	**(+) HS.S-IC.4*** Use data from a sample survey to estimate a population means or proportion; develop a margin of error through the use of simulation models for random sampling.	The standards are the same.
(+) 11-12.DPS.7* Understand the process of making inferences about population parameters based on a random sample from that population.	**HS.S-IC.1** Understand the process of making inferences about population parameters based on a random sample from that population.	The standards are the same.
(+) 11-12.DPS.8* Decide if a specified model is consistent with results from a given data-generating process (e.g., using simulation).	**HS.S-IC.2** Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.	The standards are the same.
(+) 11-12.DPS.9* Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	**HS.S-IC.3** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	The standards are the same.
11-12.DPS.10* Determine when the order in counting matters and use permutations and combinations to compute probabilities of events accordingly. Determine probability situations as conditional, “or” (union), or “and” (intersection), and determine the probability of an event.		The new standards build upon skills using permutations and combinations in standards • 9-10.DPS.7 • 9-10.DPS.8 • 9-10.DPS.9 • 9-10.DPS.10.
(+) 11-12.DPS.11* Use permutations and combinations to compute probabilities of compound events and solve problems.	**HS.S-CP.9*** Use permutations and combinations to determine the number of outcomes in terms of the model. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.	The new standard is the same as the (+) portion of the 2017 standard.
(+) 11-12.DPS.12* 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.	**(+) HS.S-MD.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.	The standards are the same.
(+) 11-12.DPS.13* Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.	**(+) HS.S-MD.2*** Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.	The standards are the same.

(+) 11-12.DPS.14* 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. Evaluate and compare strategies on the basis of expected values.	**(+) HS.S-MD.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. b. Evaluate and compare strategies on the basis of expected values.	The standards are the same.
(+) 11-12.DPS.15* Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities are calculated; find the expected value.	**(+) HS.S-MD.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.	The standards are the same.
(+) 11-12.DPS.16* Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.	**(+) HS.S-MD.4*** Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.	The standards are the same.
(+) 11-12.DPS.17* Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).	**(+) HS.S- MD.6*** Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).	The standards are the same.
(+) 11-12.DPS.18* Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	**(+) HS.S-MD.7*** Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	The standards are the same.