Ohio | Department of Education

Ohio's Academic Content Standards - Extended Mathematics

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Published 4/2012

Introduction

In June 2010, the state of Ohio adopted the Common Core State Standards (CCSS) for English Language Arts and Mathematics. The CCSS are now a part of Ohio's Content Standards. Recognizing the need to make the content standards accessible for all students, the Offices of Curriculum, Assessment and Exceptional Children at the Ohio Department of Education developed the Ohio's Academic Content Standards-Extended (OACS-E).

The OACS-E, found on the following pages, are designed to assist teachers in providing access to the general education curriculum for students with significant cognitive disabilities. Students receiving instruction based on the grade band Extensions total approximately 1% of Ohio's student population and are assessed using the Alternate Assessment for Students with Significant Cognitive Disabilities (AASCD). These Extensions are not meant to replace the CCSS for Mathematics, but to serve as a complement to them. The Extensions will be the first resource teachers should use when designing instruction for students with significant cognitive disabilities. The Extensions have been written and designed to provide a continuum of entry points related to the Mathematics Standards. However, this document has been designed so that the reader can reference the CCSS for each grade level on the left hand page with Extensions displayed on the right hand page (with the exception of high school which has the standards and extensions on one page). There may be times when the instructor may want to further supplement the Extensions with the CCSS listed on the left hand page. This was the intent of the design of this document; to further enhance curricular content for students with significant cognitive disabilities.

At the same time, in planning academic activities for students with significant cognitive disabilities, teachers must consider incorporation of non-academic skills necessary for student success such as communication, self-determination, gross/fine motor, and social skills as well as individual accommodations or supports that may be necessary for students to access the curriculum. Life Skills should also serve to be taught as complements to the Extensions. These Extensions will assist teachers in the instruction of content that is directly aligned with the Common Core State Standards for Mathematics.

Grade Band

Standards (academic skills) from the CCSS were identified within the following grade bands:

K-2
3-5
6-8
9-12

Some standards within specific grade bands were not extended due to the complexity of the skills and are not included in this document. As such, you will see certain components of the CCSS are not addressed within the Extensions. However, it should be noted that the Extensions presented here will provide a strong foundation for learning for all students.

It is critical when designing instruction for students, it is to be completed using the student's assigned grade band. In other words, if the student is officially registered as an eighth grade student, they would be instructed using the grade 6-8 Extensions. This will ensure proper grade level content and progression within the standards.

Complexity Levels

Specific standards were extended among three complexity levels from "most complex" to "least complex". The three levels comprise varying difficulty levels for students based on a standard from the CCSS. The Extensions have been codified individually for clearer designation. The last letter in the extension "code" indicates the complexity level: "a" denotes the highest level of complexity, "b" denotes the middle complexity level and "c" denotes the lowest complexity level. In some instances, the verb of the extension simply changes to a lower taxonomy level. In other cases, there is different content to be included in the instructional process. It is important to move from left to right when reading the Extensions; that is, begin with the most complex level when determining where student instruction should begin before reverting to the lower complexity levels. *Please note: Students should not be categorized according to a particular extension level. Instead, instruction should target Extensions appropriate to individual strengths which may vary across standards. Ideally, one should see instruction occurring at all ranges of complexity when these Extensions are applied within each grade band.*

Utilization

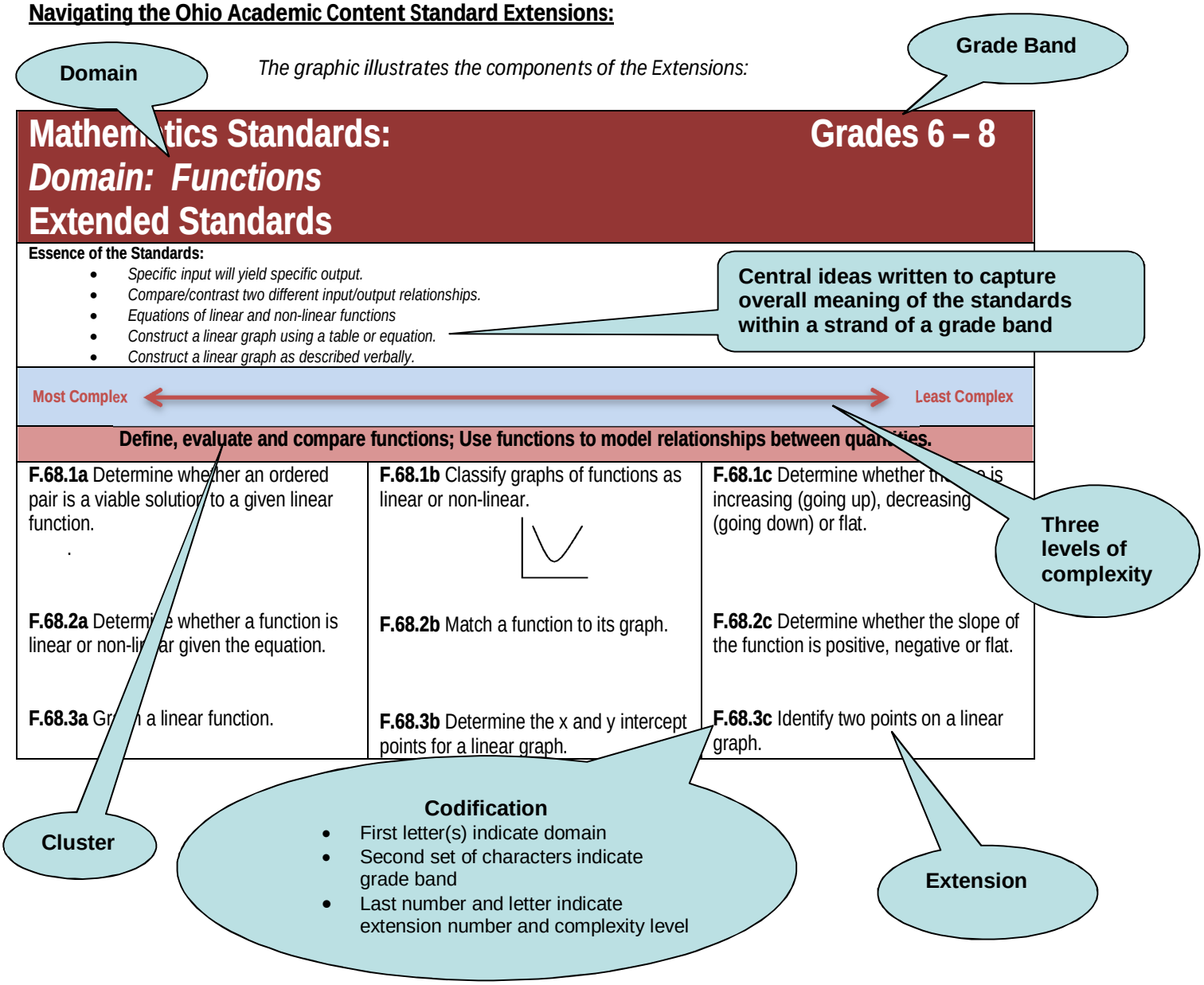
The Ohio Academic Content Standards-Extended do not specify individual accommodations or supports that may be necessary for students across the curriculum. When designing lessons based on the Extensions, teachers should consider the unique learning needs of each student and employ the necessary accommodations. According to the CCSS *Application to Students with Disabilities* document (CCSSO 2010),

> "These supports and accommodations should ensure that students receive access to multiple means of learning and opportunities to demonstrate knowledge, but retain the rigor and high expectations of the Common Core State Standards."

The Extensions will be used by school personnel to plan and implement lessons based upon academic standards. The use of these Extensions is intended for the population of students that will be engaged in Ohio's Alternate Assessment.[1]

Navigating the Ohio Academic Content Standard Extensions:

The graphic illustrates the components of the Extensions:



[1] *During the roll out process of this document, many educators felt that OACS-E could help with the differentiation of instruction for all students. These Extensions may be utilized for this purpose, but it must be done with caution. The CCSS are written and will be assessed with general assessments at a much higher level of expectation. Thus, while these Extensions can provide entry points into the CCSS for students who need differentiation in the classroom-but are not engaged in the Alternate Assessment-it is imperative to remember that these students must transition and be assessed using the CCSS.*

Acknowledgements

Development of Ohio's Academic Content Standards-Extended was a collaborative effort between the Ohio Department of Education's Office of Curriculum and Assessment and the Office for Exceptional Children. The writing committee, comprised of special educators, regular educators, administrators, parents and other stakeholders around the state of Ohio came together to create these Extensions. Additional credit is due to the states of Delaware and North Carolina whose already completed Extensions provided great insight for our work.

The following individuals served on our writing committee who provided extensive time, dedication, thought and expertise to this project. Sincere appreciation goes to:

Shawna Benson *OCALI, Urbana University*
Marilyn Brigati *State Support Team Region 10*
Pat Cronin *State Support Team Region 4*
Hope Douglas *Coshocton County Board of Developmental Disabilities*
Beth Duffy *State Support Team Region 16*
Cindy Ford *State Support Team Region 1*
Barb Gentile Green *Mt. Gilead Exempted Village Schools*
Randy Grieser *K12 Incorporated*
Joan Griest *Marion County Schools*
Bette Hackett *State Support Team Region 16*
Vickie Hesler *State Support Team Region 10*
Kate Kandel *Parent*
Caren McCoy *State Support Team Region 12*
Michelle Miller *Groveport Madison Local Schools*
Bill Nellis *State Support Team Region 6*
Gretchen Schmitz *Auglaize County ESC*
Amy Szymanski *State Support Team Region 1*
Angie Chappel-Wang *Cuyahoga County ESC, State Support Team Region 3*
Ilana Webber *Groveport Madison Local Schools*

Special thanks to Kathy Staugler who led the committee work and revised rough drafts through several iterations of these Extensions.

Gratitude is due to the following individuals from the American Institutes for Research for their time and knowledge during this process:

Dee Wagner	John Kwening	Heather Williams	Paula Sable
Leslie Booth	Kevin Mirkoff	Jim McCain	

Four Ohio Department of Education staff members led the project while providing valuable insight and global thinking:

Cathy Csanyi	Andrew Hinkle	Bill Sternberg	Wendy Stoica

Finally, thanks to all who provided comments, support and guidance along the way including family and community members, university faculty, school administrators, teachers and others. Ohio's Academic Content Standards-Extended would not be possible without the support of all who worked tirelessly to create a guiding tool to support access to the general education curriculum for all students.

Mathematics – Table of Contents

High School – Grades 9-12

Mathematics Standards — Grade K

Domain: Counting and Cardinality

Kindergarten	Grade 1	Grade 2
Know number names and the count sequence. 1. Count to 100 by ones and by tens. 2. Count forward beginning from a given number within the known sequence (instead of having to begin at 1). 3. Write numbers from 0 to 20. Represent a number of objects with a written numeral 0-20 (with 0 representing a count of no objects). **Count to tell the number of objects.** 4. Understand the relationship between numbers and quantities; connect counting to cardinality. a. When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. b. Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted. c. Understand that each successive number name refers to a quantity that is one larger. 5. Count to answer "how many?" questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1–20, count out that many objects. **Compare numbers.** 6. Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies.1 7. Compare two numbers between 1 and 10 presented as written numerals.	***N/A***	***N/A***

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

Mathematics Standards: Grades K-2
Domain: Counting and Cardinality
Extended Standards

Essence of the Standards:

- *Counting*
- *Count up from a given number.*
- *Represent objects with written numerals.*
- *One-to-one correspondence and concept of one more.*
- *Count to answer "how many?"*
- *Compare groups of objects.*
- *Compare written numerals.*

Most Complex ← → Least Complex

Know number names and the count sequence.		
CC.K2.1a Count by 1s up to 50.	**CC.K2.1b** Count up to 20 by 1s using a model or concrete objects.	**CC.K2.1c** Count up to 10 by 1s using a model or concrete objects.
CC.K2.2a Count forward beginning from a given number between 1 and 50.	**CC.K2.2b** Count forward beginning from a given number between 1 and 20.	**CC.K2.2c** Identify the next number when given a starting number between 1 and 10.
CC.K2.3a Write the numbers (within a range of 1-20) to represent a number of objects.	**CC.K2.3b** Write a number (within a range of 1-15) to represent a number of objects.	**CC.K2.3c** Match a spoken number to quantity of objects up to 10.
Count to tell the number of objects.		
CC.K2.4a Match the correct numeral for objects up to 20, including 0.	**CC.K2.4b** Match the correct numeral to objects up to 15.	**CC.K2.4c** Match the correct numeral to objects up to 10.
CC.K2.5a Count the total number of objects up to 20.	**CC.K2.5b** Count the total number of objects up to 10.	**CC.K2.5c** Count the total number of objects up to 5.
Compare numbers.		
CC.K2.6a Compare two numerals between 1and10 to determine which is "greater than", "less than", or "equal to."	**CC.K2.6b** Compare two numerals between1 and10 to determine which is "greater than" or "less than."	**CC.K2.6c** Identify whether the number of objects in one group is "greater than," "less than," or the same as the objects in another group, for up to 10 objects.

Mathematics Standards: Grades K – 2

Domain: Operations and Algebraic Thinking

Kindergarten

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

1. Represent addition and subtraction with objects, fingers, mental images, drawings2, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations.
2. Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings to represent the problem.
3. Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawings, and record each decomposition by a drawing or equation (e.g., 5 = 2 + 3 and 5 = 4 + 1).
4. For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or drawings, and record the answer with a drawing or equation.
5. Fluently add and subtract within 5.

Grade 1

Represent and solve problems involving addition and subtraction.

1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

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

3. Apply properties of operations as strategies to add and subtract.3 Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)
4. Understand subtraction as an unknown-addend problem. For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.

Add and subtract within 20.

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

Work with addition and subtraction equations.

7. Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.
8. Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. For example, determine the unknown number that makes the equation true in each of the equations 8 +? = 11, 5 = □ – 3, 6 + 6 = □.

Grade 2

Represent and solve problems involving addition and subtraction.

1. Use addition and subtraction within 100 to solve one- and 2-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

Add and subtract within 20.

2. Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.

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

3. Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.
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.

Description

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- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

Mathematics Standards: Grades K – 2
Domain: Operations and Algebraic Thinking
Extended Standards

Essence of the Standards:

- *Solve problems involving addition and subtraction.*
- *Add and subtract.*
- *Pair objects to determine odd or even.*
- *Find the total number of objects using repeated addition.*

Most Complex ← → Least Complex

Represent and solve problems involving addition and subtraction.		
OA.K2.1a Solve addition and subtraction word problems within 20, involving situations where one is "adding to," "taking from," "putting together" and "taking apart," using models or objects.	**OA.K2.1b** Solve addition and subtraction word problems within 10 involving situations where one is "adding to," "taking from," "putting together" and "taking apart," using models or objects.	**OA.K2.1c** Solve addition and subtraction word problems within 5, involving situations where one is "adding to," "taking from," "putting together" and "taking apart," using models or objects.
Add and subtract within 20.		
OA.K2.2a Add and subtract up to a sum of 20.	**OA.K2.2b** Add or subtract up to a sum of 10, with or without models or objects.	**OA.K2.2c** Demonstrate addition as "putting together" and subtraction as "taking away," using models or objects up to a sum of 5.
Work with addition and subtraction equations.		
OA.K2.3a Determine whether equations involving addition and subtraction within 20 are true or false (e.g., 2 + 3 = 4 + 1).	**OA.K2.3b** Determine whether an equality statement is true or false using objects and/or numerals.	**OA.K2.3c** Determine whether one set is equal to another set.
OA.K2.4a Determine the unknown number that makes an addition and subtraction equation true up to a sum of 20.	**OA.K2.4b** Determine the unknown number that makes an addition equation true up to a sum of 10.	**OA.K2.4c** Determine how many should be added to or taken from a set to reach a certain amount up to a sum of 5.
Work with equal groups of objects to gain foundations for multiplication.		
OA.K2.5a Identify the number of objects in a group (of up to 20) as odd or even.	**OA.K2.5b** Identify the number of objects in a group (of up to 10) as odd or even.	**OA.K2.5c** Participate in grouping objects together by 2s.
OA.K2.6a Add the number of objects in an array with up to 5 rows and 4 columns, and represent in an equation.	**OA.K2.6b** Add the number of objects in an array with up to 3 rows and 3 columns.	**OA.K2.6c** Arrange objects into like groups to show repeated addition.

Mathematics Standards: Grades 3 – 5

Domain: Operations and Algebraic Thinking

Grade 3

Represent and solve problems involving multiplication and division.

1. Interpret products of whole numbers, e.g., interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5 × 7.*
2. Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as number of shares when 56 objects are partitioned into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8.*
3. Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
4. Determine the unknown whole number in a multiplication or division equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 × ? = 48, 5 = □ ÷ 3, 6 × 6 = ?.*

Understand properties of multiplication and the relationship between multiplication and division.

5. Apply properties of operations as strategies to multiply and divide. *Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.)*
6. Understand division as an unknown-factor problem. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.*

Multiply and divide within 100.

7. Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

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

8. Solve 2-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
9. Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.*

Grade 4

Use the four operations with whole numbers to solve problems.

1. Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.
2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.1
3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

Gain familiarity with factors and multiples.

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.

Generate and analyze patterns.

5. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.*

Grade 5

Write and interpret numerical expressions.

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

Analyze patterns and relationships.

3. Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.*

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to the Common Core State Standards through appropriate instructional tasks.*

Mathematics Standards: Grades 3 – 5
Domain: Operations and Algebraic Thinking
Extended Standards

Essence of the Standards:

- *Use grouping symbols to evaluate expressions.*
- *Interpret numerical expressions using grouping symbols.*
- *Generate patterns.*

Most Complex ⟵ ⟶ Least Complex

Represent and solve problems involving multiplication and division.		
OA.35.1a Represent products of whole numbers up to 10 × 10 using arrays (e.g., interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each).	**OA.35.1b** Represent products of whole numbers up to 5 × 5 using arrays.	**OA.35.1c** Represent products of 1s and 2s using arrays (e.g., 1 group of 6 objects to represent 1 × 6 = 6).
OA.35.2a Represent quotients of whole numbers up to 100 using partitions (groupings) (e.g., divide a set of objects into equal groups).	**OA.35.2b** Represent quotients of whole numbers up to 50 using partitions (groupings) (e.g., divide a set of objects into equal groups).	**OA.35.2c** Represent quotients of 1s and 2s using partitions (groupings) (e.g., set of 4 objects grouped into 2 equal groups to represent 4 ÷ 2 = 2) up to 20.
OA.35.3a Solve word problems in situations involving equal groups, arrays and measurement quantities involving quantities up to 100.	**OA.35.3b** Solve word problems in situations involving equal groups, arrays and measurement quantities involving quantities up to 50.	**OA.35.3c** Solve word problems in situations involving equal groups, arrays and measurement quantities up to 20 involving multiples of 1s and 2s.
Understand properties of multiplication and the relationship between multiplication and division.		
OA.35.4a Apply the commutative, associative, and distributive properties as strategies to multiply and divide.	**OA.35.4b** Apply the commutative and associative properties as strategies to multiply.	**OA.35.4c** Apply the commutative property using arrays involving multiples of 1s and 2s (e.g., understand that 2 groups of 4 objects is equal to 4 groups of 2 objects).
Multiply and divide within 100.		
OA.35.5a Solve multiplication and division number sentences within 100 (e.g., solve: 9 × 6 = ?).	**OA.35.5b** Solve multiplication and division number sentences within 50 (e.g., solve: 8 × 5 = ?).	**OA.35.5c** Match multiplication and division number sentences of multiples of 1s and 2s to array and partition models (e.g., match the expression 1 × 5 = ? to the array 1 group of 5 objects).
OA.35.6a Fluently solve for products of 2 one digit numbers up to 100.	**OA.35.6b** Know from memory all products up to 7 × 7.	**OA.35.6c** Solve multiplication number sentences of multiples of 1s and 2s.
OA.35.7a Solve for the unknown whole number in multiplication and division number sentences within 100 (e.g., identify the unknown number that makes the number sentence true in 6 × ? = 56).	**OA.35.7b** Solve for the unknown whole number in multiplication and division number sentences within 50 (e.g., identify the unknown number that makes the number sentence true in 4 × ? = 20).	**OA.35.7c** Identify the array that solves for the unknown whole number in a multiplication number sentence of multiples of 1s and 2s up to 20 (e.g., given 2 × ? = 8, the student identify the array 2 groups of 4 objects).
Solve problems involving the four operations and identify and explain patterns in arithmetic.		
OA.35.8a Represent a multi-step word problem using an equation with a letter standing for the unknown, and solve.	**OA.35.8b** Represent a 2-step problem using an equation with a letter standing for the unknown and solve.	**OA.35.8c** Identify the number sentence that represents a 1-step word problem.
OA.35.9a Identify and explain arithmetic patterns in number charts and addition and multiplication tables.	**OA.35.9b** Identify arithmetic patterns in number chart, and addition and multiplication tables.	**OA.35.9c** Use odd or even numbers to make a pattern.

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Use order of operations to solve expressions.		
OA.35.10a Use order of operations to solve expressions, including the use of grouping symbols (e.g., solve: 2 + (3 – 1) × 4 = 2 + 2 × 4 = 2 + 8 = 10).	**OA.35.10b** Use order of operations to solve expressions.	**OA.35.10c** Use order of operations to solve addition and subtraction expressions.
Generate and analyze patterns; Analyze patterns and relationships.		
OA.35.11a Generate and extend a sequence (numeric pattern) (e.g., for generate: give the next 4 terms of a pattern when given the rule).	**OA.35.11b** Extend a sequence (numeric pattern) and generate a shape pattern (e.g., for generate a shape pattern: Ed is making a pattern. It goes square, square, triangle and then repeats itself. What are the next 6 shapes?).	**OA.35.11c** Extend a shape or visual pattern (e.g., abcabcabca__).

Mathematics Standards: Grades K – 2

Domain: Numbers and Operations in Base Ten

Kindergarten

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

1. Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones.

Grade 1

Extend the counting sequence.

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

Understand place value.

2. Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases:
   a. 10 can be thought of as a bundle of ten ones — called a "ten."
   b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.
   c. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones).
3. Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <.

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

4. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.
5. Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.
6. Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Grade 2

Understand place value.

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

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

5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
6. Add up to four two-digit numbers using strategies based on place value and properties of operations.
7. Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.
8. Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.
9. Explain why addition and subtraction strategies work, using place value and the properties of operations.

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

Mathematics Standards: Grades K – 2
Domain: Numbers and Operations in Base Ten
Extended Standards

Essence of the Standards:

- *Place value*
- *Skip counting*
- *Number representations*
- *Compare number values.*
- *Add and subtract.*
- *Add two-digit numbers.*
- *Line up digits according to place value to add or subtract.*
- *Mentally add or subtract 10 or 100 to/from a given number.*
- *Addition and subtraction strategies*

Most Complex ← → Least Complex

Understand place value.		
NBT.K2.1a Compose (put together) and decompose (break apart) a three-digit number (e.g., 328 = 3 hundreds, 2 tens and 8 ones).	**NBT.K2.1b** Compose (put together) and/or decompose (break apart) a two-digit number.	**NBT.K2.1c** Identify a model or object representation for a two-digit number up to 20.
NBT.K2.2a Count by 5s and 10s to 100.	**NBT.K2.2b** Count by 10s to 100.	**NBT.K2.2c** Count by 10s to 50.
NBT.K2.3a Identify the correct, expanded form or number name given a three-digit number written in standard form (e.g., 164 = 100 + 60 + 4 = one hundred sixty-four).	**NBT.K2.3b** Identify the correct, expanded form given a model or object representation of a two-digit number.	**NBT.K2.3c** Identify a number up to 20 when given model or object representation.
NBT.K2.4a Compare 2 three-digit numbers using "more than," "less than" or the "same as" based on their place value.	**NBT.K2.4b** Compare 2 two-digit numbers using "more than," "less than" or the "same as" based on their place value.	**NBT.K2.4c** Compare quantities (e.g., objects) up to 10 using "more than," "less than" or the "same as."
Use place value understanding and properties of operations to add and subtract.		
NBT.K2.5a Add and subtract up to the sum of 50 using strategies based on place value (e.g., collecting the tens, collecting the ones, and composing ten ones to make a ten).	**NBT.K2.5b** Add and subtract up to the sum of 20 using strategies based on place value.	**NBT.K2.5c** Add and subtract up to the sum of 10 using models and concrete objects.
NBT.K2.6a Add 2 two-digit numbers using at least one strategy (e.g., concrete models or drawings, decomposing numbers, or strategies based on place value, properties of operations, and/ or relationships between addition and subtraction).	**NBT.K2.6b** Add and subtract 2 two-digit numbers (multiples of 10) using at least one strategy (e.g., concrete models or drawings decomposing numbers, or strategies based on place value, properties of operations, and/ or relationships between addition and subtraction).	**NBT.K2.6c** Add and subtract 1 two-digit number and 1 one-digit number, using models and concrete objects. .
NBT.K2.7a Add and subtract 10 to or from a given number up to 100.	**NBT.K2.7b** Add 10 to a given number up to 100.	**NBT.K2.7c** Add 1 more to a given set up to 20 using models or objects.
NBT.K2.8a Identify or create a model that can be used to solve either an addition or a subtraction problem.	**NBT.K2.8b** Identify or create a model that can be used to solve an addition problem.	**NBT.K2.8c** Identify which model represents an addition problem, given a choice of two models.

Mathematics Standards: Grades 3 – 5

Domain: Numbers and Operations in Base Ten

Grade 3	Grade 4	Grade 5
Use place value understanding and properties of operations to perform multi-digit arithmetic. 1. Use place value understanding to round whole numbers to the nearest 10 or 100. 2. Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. 3. Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations.	**Generalize place value understanding for multi-digit whole numbers.** 1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.* 2. Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. 3. Use place value understanding to round multi-digit whole numbers to any place. **Use place value understanding and properties of operations to perform multi-digit arithmetic.** 4. Fluently add and subtract multi-digit whole numbers using the standard algorithm. 5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 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.	**Understand the place value system.** 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. 2. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. 3. Read, write, and compare decimals to thousandths. a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 × 100 + 4 × 10 + 7 × 1 + 3 × (1/10) + 9 × (1/100) + 2 × (1/1000). b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. 4. Use place value understanding to round decimals to any place. **Perform operations with multi-digit whole numbers and with decimals to hundredths.** 5. Fluently multiply multi-digit whole numbers using the standard algorithm. 6. Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 7. Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

Mathematics Standards: Grades 3 – 5
Domain: Numbers and Operations in Base Ten
Extended Standards

Essence of the Standards:

- *Place value*
  - *Decimal place value*
  - *Rounding decimals*
  - *Multiply whole numbers*
  - *Divide whole numbers*
  - *Decimal operations*

Most Complex ⟷ Least Complex

Use place value understanding and properties of operations to perform multi-digit arithmetic.		
NBT.35.1a Use place value understanding to round multi-digit whole numbers to the nearest 10s or 100s.	**NBT.35.1b** Identify whether a number is closer to 0 or 10.	**NBT.35.1c** Identify whether a number is closer to 0 or 10 using a model (e.g., number line or 1s and 10s cubes).
NBT.35.2a Multiply one-digit whole numbers by 10 (e.g., 3 × 10 = 30).	**NBT.35.2b** Multiply one-digit whole numbers by 5.	**NBT.35.2c** Multiply one-digit whole numbers by 2 using concrete objects.
Generalize place value understanding for multi-digit whole numbers.		
NBT.35.3a Decompose multi-digit whole numbers by their place values and expanded form up to 1000 (e.g., 457: 4 hundreds, 5 tens, 7 ones; four hundred fifty-seven; 400 + 50 + 7).	**NBT.35.3b** Decompose multi-digit whole numbers by their place values and expanded form using 1s, 10s, and 100s cubes (e.g., 57; 5 tens, 7 ones; fifty-seven; 50 + 7).	**NBT.35.3c** Decompose multi-digit whole numbers by their place values and expanded form using 1s, 10s, and 100s up to 100.
NBT.35.4a Translate between multi-digit whole number numerals and words.	**NBT.35.4b** Translate between two-digit whole number numerals and words.	**NBT.35.4c** Match two-digit whole number numerals and words to model (e.g., match "25" or the word "twenty-five" to a set of 25 objects or 2 10s and 5 1s cubes).
NBT.35.5a Compare two-digit numbers based on values of the digits in each place, using >, =, and < symbols *(e.g., 56 >52; 45<56).*	**NBT.35.5b** Compare two-digit numbers using >, =, and < symbols and concrete objects.	**NBT.35.5c** Identify whether a set of objects is "more than," "less than" or "same as" another set of objects.
Use place value understanding and properties of operations to perform multi-digit arithmetic.		
NBT.35.6a Add and subtract within 100 with ease using strategies and algorithms based on place value, the properties of operations, and/or the relationship between addition and subtraction (no calculator).	**NBT.35.6b** Add and subtract within 50 with ease using strategies and algorithms based on place value, the properties of operations, and/or the relationship between addition and subtraction (the focus is on the use of strategies - (no calculator)).	**NBT.35.6c** Add and subtract within 20 with ease using strategies and algorithms based on place value, the properties of operations, and/or the relationship between addition and subtraction (no calculator, but could include concrete objects).
NBT.35.7a Multiply multiples of 100 by a one-digit whole number, using strategies based on place value and the properties of operations.	**NBT.35.7b** Multiply multiples of 10 by a one-digit whole number, using strategies based on place value and the properties of operations.	**NBT.35.7c** Multiply numbers up to 10 by 1 using concrete objects or models.
NBT.35.8a Divide a whole number of up to two digits by a one-digit whole number using strategies based on place value, the relationship between multiplication and division and the properties of operations (no remainders).	**NBT.35.8b** Divide multiples of ten by a one-digit whole number using strategies based on place value, relationship between multiplication and division and the properties of operations (no remainders) (e.g., 60 divided by 5 = 12).	**NBT.35.8c** Determine whether a number is divisible by 2.

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Understand the place value system.		
NBT.35.9a Decompose multi-digit decimals by their place values (e.g., 3.58 is 3 ones, 5 tenths, and 8 hundredths: *13 out of 100 can be written as 0.13, 13/100 or one dime and three pennies*).	**NBT.35.9b** Match visual or tactile representations of tenths and hundredths to their equivalent decimal numeral (e.g., 13 out of 100 can be written as 0.13, 13/100, or 1 dime and 3 pennies: 10 out of 100 = 0.10 = 1/10 = one dime).	**NBT.35.9c** Match visual or tactile representation of tenths to equivalent decimal numeral (e.g., 1 out of 10 can be written as 0.1 or 1 dime).
NBT.35.10a Compare two decimal numerals written up to the hundredths place using >, = and < symbols.	**NBT.35.10b** Compare two decimal models to the tenths place using >, = and < symbols.	**NBT.35.10c** Compare visual or tactile representations or models of tenths and determine which is "more than" or "same as".
NBT.35.11a Round decimals in hundredths to the nearest tenths.	**NBT.35.11b** Round decimals in tenths to the nearest whole number.	**NBT.35.11c** Identify whether a decimal is closer to 0 or 1 using models (e.g., number line or visual representations).
Perform operations with multi-digit whole numbers and with decimals to hundredths.		
NBT.35.12a Multiply and divide multi-digit whole numbers up to three-digit whole numbers (e.g., 50 ÷ 25 = 2, 125 ÷ 25 = 5).	**NBT.35.12b** Multiply 2-digit by 2-digit whole numbers and divide 2-digit by 1-digit whole numbers. (e.g., 15 × 10 = 150).	**NBT.35.12c** Multiply and divide 2-digit by 1-digit whole numbers using models (e.g., 10 apples shared equally among 5 friends).
NBT.35.13a Add and subtract decimals to hundredths.	**NBT.35.13b** Add and subtract decimals to hundredths using concrete models or drawings.	**NBT.35.13c** Add and subtract decimals to tenths using concrete models or drawings.

Mathematics Standards: Grades K – 2
Domain: Measurement and Data

Kindergarten	Grade 1	Grade 2
Describe and compare measurable attributes. 1. Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. 2. Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.* **Classify objects and count the number of objects in each category.** 3. Classify objects into given categories; count the numbers of objects in each category and sort the categories by count.	**Measure lengths indirectly and by iterating length units.** 1. Order three objects by length; compare the lengths of two objects indirectly by using a third object. 2. Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.* **Tell and write time.** 3. Tell and write time in hours and half-hours using analog and digital clocks. **Represent and interpret data.** 4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.	**Measure and estimate lengths in standard units.** 1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes. 2. Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen. 3. Estimate lengths using units of inches, feet, centimeters, and meters. 4. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. **Relate addition and subtraction to length.** 5. Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. 6. Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram. **Work with time and money.** 7. Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m. 8. Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. *Example: If you have 2 dimes and 3 pennies, how many cents do you have?* **Represent and interpret data.** 9. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units. 10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put together, take-apart, and compare problems using information presented in a bar graph.

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

Mathematics Standards: Grades K – 2
Domain: Measurement and Data
Extended Standards

Essence of the Standards:

- *Measure length with an appropriate tool.*
- *Compare different units of measure.*
- *Estimate length.*
- *Compare length of objects.*
- *Solve for an unknown length in a word problem.*
- *Represent whole numbers on a number line and use to add or subtract.*
- *Tell time.*
- *Solve word problems involving money.*
- *Gather and represent measurement data using a line plot.*

Most Complex ⟷ Least Complex

Measure and estimate lengths in standard units; Measure lengths indirectly and by iterating length units; Describe and compare measurable attributes.		
MD.K2.1a Measure an object with a given tool such as a ruler, yardstick, meter stick or measuring tape.	**MD.K2.1b** Measure an object using non-standards units. (e.g., same length pencils, paperclips).	**MD.K2.1c** Order objects by length.
MD.K2.2a Measure and compare the length of an object with two different standard or nonstandard tools.	**MD.K2.2b** Measure and compare two objects with a standard or non-standard tool.	**MD.K2.2c** Compare two objects and identify as longer, shorter, taller or same length.
MD.K2.3a Estimate length using inches, feet, centimeters or meters.	**MD.K2.3b** Estimate length using non-standard units.	**MD.K2.3c** Identify which measurement tool to use (e.g., use a ruler to measure length; use a scale to find weight).
MD.K2.4a Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.	**MD.K2.4b** Measure to determine how much longer one object is than another using a non-standard unit.	**MD.K2.4c** Measure an object using non-standard units (e.g., cubes, paper clips).
Relate addition and subtraction to length.		
MD.K2.5a Solve addition and subtraction word problems involving lengths.	**MD.K2.5b** Solve addition word problems involving length.	**MD.K2.5c** Measure the length of two objects using non-standard units to determine the total length of the two objects combined.
MD.K2.6a Add or subtract using a number line.	**MD.K2.6b** Demonstrate that moving forward is addition and moving backwards is subtraction on a number line.	**MD.K2.6c** Identify numbers on a number line.
Work with time and money.		
MD.K2.7a Tell time to the nearest hour and half-hour intervals on digital and analog clocks.	**MD.K2.7b** Tell time to the nearest hour on digital and analog clocks.	**MD.K2.7c** Identify events that happen in the morning (a.m.) or afternoon/evening (p.m.).
MD.K2.8a Identify the value of a combination of coins up to one dollar.	**MD.K2.8b** Identify coins/bills and match to their values and corresponding symbol ($, ¢).	**MD.K2.8c** Match like coins and one dollar bills.
MD.K2.9a Solve problems involving a combination of coins and dollar bills within a word problem.	**MD.K2.9b** Select the correct coins and/or bills to match a given amount.	**MD.K2.9c** Identify coins (quarters, dimes, nickels, pennies).

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Represent and interpret data.		
MD.K2.10a Gather data (e.g., measure the length of an object) and graph the data on a line plot.	**MD.K2.10b** Graph given measurement data on a line plot.	**MD.K2.10c** Identify numbers on a number line.
MD.K2.11a Create a bar or picture graph, with given data and answer questions about the graph using a single unit scale.	**MD.K2.11b** Create a picture graph, given data and answer questions about the graph.	**MD.K2.11c** Classify and count objects in categories of a data set (e.g., given a set of colored cubes: identify if any are red, count how many are red, etc.).

Mathematics Standards: Grades 3 – 5

Domain: Measurement and Data

Grade 3

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

1. Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.
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 1-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.

Represent and interpret data.

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

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

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

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

8. Solve real world and mathematical problems

Grade 4

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

1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb., oz.; l, ml; hr., min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *For example, know that 1 ft. is 12 times as long as 1 in. Express the length of a 4 ft. snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...*
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. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.*

Represent and interpret data.

4. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

Geometric measurement: understand concepts of angle and measure angles.

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

Grade 5

Convert like measurement units within a given measurement system.

1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

Represent and interpret data.

2. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.*

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

3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
   a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.
   b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.
4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft., and improvised units.
5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.

- Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.
- Apply the formulas $V = l \times w \times h$ and $V = b \times h$ 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.
- 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.

involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.		

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

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Mathematics Standards: Grades 3 – 5
Domain: Measurement and Data
Extended Standards

Essence of the Standards:

- *Tell time.*
- *Solve real world problems involving time and money.*
- *Equivalent measurement*
- *Organize and represent data.*
- *Properties of volume*
- *Measure volume.*
- *Relate volume to addition and multiplication.*

Most Complex ⟷ Least Complex

Solve problems involving measurement and estimation of intervals of time, liquid volume and masses of objects.		
MD.35.1a Tell time to the nearest 15 minutes.	**MD.35.1b** Tell time to the nearest 30 minutes.	**MD.35.1c** Use a schedule to determine the order of events.
MD.35.2a Solve word problems involving addition and subtraction of time intervals in 15 minutes.	**MD.35.2b** Solve word problems involving addition of time intervals in 30 minutes.	**MD.35.2c** Identify whether an event happened in the morning, afternoon or evening.
MD.35.3a Measure and estimate liquid volumes and masses of objects using standard units of measure (e.g., measuring cup, scale).	**MD.35.3b** Measure liquid volumes and masses of objects using standard units of measure (e.g., measuring cup, scale).	**MD.35.3c** Select the appropriate tool to measure volume and mass (e.g., measuring cup, scale).
MD.35.4a Solve 1-step, real-world word problems involving mass, volume or money using the appropriate operation (multiplication, addition, subtraction).	**MD.35.4b** Solve addition and subtraction 1-step, real-world word problems involving mass, volume or money (e.g., making change, weight of a book bag after library book is removed).	**MD.35.4c** Solve addition 1-step, real-world word problems involving mass, volume or money (e.g., following a recipe, paying for groceries).
Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.		
MD.35.5a Solve measurement word problems using the four operations involving distances, mass, and money, including problems involving simple fractions or decimals.	**MD.35.5b** Solve measurement word problems using the four operations involving distances, mass and money.	**MD.35.5c** Solve addition and subtraction measurement word problems involving distances, mass and money (e.g., The park is 6 miles away. I have walked 5 miles, how much farther do I need to walk?).
Convert like measurement units within a given measurement system.		
MD.35.6a Convert within one system of units (e.g., convert between km, m, cm; kg, g; lb., oz.; L, mL; hr., min, sec).	**MD.35.6b** Identify whether a measurement is "larger than," "less than" or "same as" another measurement within the same system of units (e.g., 1.5kg is larger than 500 g).	**MD.35.6c** Determine whether a set is "more than," "less than" or the "same as" another set.
Represent and interpret data.		
MD.35.7a Create a line plot from a given or collected data set with measurements in fractions (1/2, 1/4). Interpret the line plot, including addition and subtraction of fractions by using information presented in the line plot.	**MD.35.7b** Create scaled bar graphs from given or collected data sets and interpret the graph, including solving 1-step and 2-step "how many more" and "how many less" problems.	**MD.35.7c** Interpret by solving 1-step "how many more" and "how many less" problems (e.g., record the amount of rain for a week, determine how much more rain fell on one day than another).
Geometric measurement: understand concepts of area and relate area to multiplication and to addition.		
MD.35.8a Multiply side lengths to find area of rectangles with whole-number side lengths and understand that the area of all rectangles is length × width.	**MD.35.8b** Find the area of rectangles and triangles by counting unit squares and understand that a square with a side length of 1 unit is called a "unit square."	**MD.35.8c** Find the area of rectangles with whole-number side lengths by counting unit squares.

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Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.		
MD.35.9a Solve word problems involving perimeter when given the lengths of the sides (e.g., given the perimeter and the length of three sides, find the length of the missing side).	**MD.35.9b** Find the perimeter of polygons drawn on graphing paper by counting the length of the sides.	**MD.35.9c** Find the perimeter of polygons by counting the number of unit squares that fit around the shape.
Geometric measurement: understand concepts of angle and measure angles.		
MD.35.10a Explain the parts of an angle (two rays, common endpoint) and identify 30, 45, 60, 90, 180, 270 and 360 degree angles.	**MD.35.10b** Identify 30, 45, 60 and 90 degree angles.	**MD.35.10c** Identify whether an angle is "more than," "less than" or the "same as" a 90-degree angle.

Mathematics Standards: Grades K – 2
Domain: Geometry

Kindergarten	Grade 1	Grade 2
Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres). 1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as *above*, *below*, *beside*, *in front of*, *behind*, and *next to*. 2. Correctly name shapes regardless of their orientations or overall size. 3. Identify shapes as two-dimensional (lying in a plane, "flat") or three-dimensional ("solid"). **Analyze, compare, create, and compose shapes.** 1. Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/"corners") and other attributes (e.g., having sides of equal length). 2. Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes. *3.* Compose simple shapes to form larger shapes. *For example, "Can you join these two triangles with full sides touching to make a rectangle?"*	**Reason with shapes and their attributes.** 1. Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes. 2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. 3. Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters*, and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.	**Reason with shapes and their attributes.** 1. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes. 2. Partition a rectangle into rows and columns of same-size squares and count to find the total number of them. 3. Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves*, *thirds*, *half of*, *a third of*, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
- *The complexity options for these standards assure that all students, including those with the significant cognitive disabilities, have access to these core standards through appropriate instructional tasks.*

Mathematics Standards: Grades K – 2
Domain: Geometry
Extended Standards

Essence of the Standards:

- *Identify shapes.*
- *A rectangle can be partitioned into same-size squares.*
- *A whole can be partitioned into sets of equal parts.*

Most Complex ← → Least Complex

Identify and describe shapes; Analyze, compare, create and compose shapes; Reason with shapes and their attributes.

G.K2.1a Classify shapes by their defining attributes (e.g., quadrilaterals, triangles, number of sides and angles).	**G.K2.1b** Sort shapes by non-defining attributes (size, color, orientation).	**G.K2.1c** Identify squares, triangles, circles and rectangles.
G.K2.2a Compose simple shapes from other basic shapes (e.g., a rectangle can be composed from two right triangles).	**G.K2.2b** Sort objects in the environment by their shape.	**G.K2.2c** Match objects in the environment to their shape.
G.K2.3a Describe the relative positions of objects using terms such as "above," "below", "beside," "in front," "behind" and "next to."	**G.K2.3b** Describe the relative positions of objects using terms such as "above", "below", "beside", and "next to".	**G.K2.3c** Describe the relative positions of objects using terms such as "above" and "below."
G.K2.4a Identify cubes, rectangular prisms, cones, cylinders and spheres.	**G.K2.4b** Identify three-dimensional shapes in the environment.	**G.K2.4c** Identify shapes as two-dimensional or three-dimensional (i.e., flat vs. solid).
G.K2.5a Partition circles and rectangles into two, three or four equal parts; identify the parts as "halves," "thirds," "quarters," "half of," "a third of," or "a quarter of;" and identify the whole as "two halves," "three thirds," "four fourths" or "four quarters."	**G.K2.5b** Partition circles into two or four equal parts; identify the parts as "halves," "quarters," "half of," "a third of" or "a quarter of;" and identify the whole as "two halves," "three thirds," "four fourths" or "four quarters."	**G.K2.5c** Count the number of sections in a circle that has been divided into equal parts (e.g., half, quarter, third).

Mathematics Standards: Grades 3 – 5
Domain: Geometry

Grade 3	Grade 4	Grade 5
Reason with shapes and their attributes. 1. Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories. 2. Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.*	**Draw and identify lines and angles, and classify shapes by properties of their lines and angles.** 1. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. 2. Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles. 3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.	**Graph points on the coordinate plane to solve real-world and mathematical problems.** 1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate). 2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. **Classify two-dimensional figures into categories based on their properties.** 3. Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.* 4. Classify two-dimensional figures in a hierarchy based on properties.

Description

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Mathematics Standards: Grades 3 – 5
Domain: Geometry
Extended Standards

Essence of the Standards:

- *Plot coordinates on a graph.*
- *Categories of shapes have similar attributes.*
- *Classify shapes.*

Most Complex ⟵ ⟶ Least Complex

Graph points on the coordinate plane to solve real-world and mathematical problems.		
G.35.1a Solve problems involving graphing (limit to first quadrant).	**G.35.1b** Identify and plot points on a coordinate plane (all quadrants).	**G.35.1c** Identify and plot points in the first quadrant of a coordinate plane. (e.g., place a marker on (2, 3)).
Reason with shapes and their attributes; Draw and identify lines and angles, and classify shapes by properties of their lines and angles; Classify two-dimensional figures into categories based on their properties.		
G.35.2a Classify shapes by their defining attributes (e.g., quadrilaterals, triangles, number of sides and angles).	**G.35.2b** Sort quadrilaterals and triangles.	**G.35.2c** Identify quadrilaterals and triangles (right, scalene, isosceles).
G.35.3a Identify perpendicular and parallel lines, and angles (right, acute, obtuse) in two-dimensional figures.	**G.35.3b** Identify points, lines, line segments and rays.	**G.35.3c** Identify points, lines and line segments.
G.35.4a Partition circles and rectangles into two, three or four equal parts; identify the parts as "halves," "thirds," "quarters," "half of," "a third of" or "a quarter of," and identify the whole as "two halves," "three thirds," "four fourths" or "four quarters."	**G.35.4b** Partition circles into two or four equal parts, identify the parts as "halves," "quarters," "half of," "a third of" or "a quarter of," and identify the whole as "two halves," "three thirds," "four fourths" or "four quarters."	**G.35.4c** Count the number of sections in a circle that has been divided into equal parts (e.g., half, quarter, third).
G.35.5a Determine whether a figure has a line of symmetry.	**G.35.5b** Identify the line of symmetry of a figure.	**G.35.5c** Identify whether the line on a figure shows the line of symmetry.
G.35.6a Compose simple shapes from other basic shapes (e.g., a rectangle can be composed from two right triangles).	**G.35.6b** Sort objects in the environment by their shape.	**G.35.6c** Match objects in the environment to their shape.
G.35.7a Describe the relative positions of objects using terms such as "above," "below," "beside," "in front," "behind," and "next to."	**G.35.7b** Describe the relative positions of objects using terms such as "above," "below," "beside" and "next to."	**G.35.7c** Describe the relative positions of objects using terms such as "above" and "below."
G.35.8a Identify cubes, rectangular prisms, cones, cylinders and spheres.	**G.35.8b** Identify three-dimensional shapes in the environment.	**G.35.8c** Identify shapes as two-dimensional or three-dimensional (i.e., flat vs. solid).

Mathematics Standards: Grades 6 – 8
Domain: Geometry

Grade 6

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

1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l\ w\ h$ and $V = b\ h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
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.
4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

Grade 7

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

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.
2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

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

4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.
5. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Grade 8

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

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

Understand and apply the Pythagorean Theorem.

6. Explain a proof of the Pythagorean Theorem and its converse.
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. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

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

9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Description

- These Standards define what students should understand and be able to do in their study of mathematics. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations.
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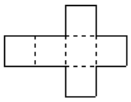
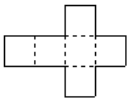
Mathematics Standards: Grades 6 – 8
Domain: Geometry
Extended Standards

Essence of the Standards:

- *Demonstrate rotations (turns), reflections (flips, and translations (slides).*
- *Properties of shapes stay the same regardless of orientation.*
- *Describe the manipulation or resizing of geometric figures.*
- *Properties of shapes stay the same regardless of orientation or size.*
- *Properties of angles*
- *Pythagorean Theorem is a formula that only applies to right triangles.*
- *Pythagorean Theorem*
- *Volume of cones, cylinders and spheres*

Most Complex ⟷ Least Complex

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

G.68.1a Demonstrate that the area of a right triangle is 1/2 × length × height (e.g., two same right triangles combined make a rectangle and the area of a triangle is half the area of the rectangle it can be composed into).	**G.68.1b** Demonstrate that the area of all rectangles is length × width (e.g., multiply side lengths to find the area of rectangles with whole-number side lengths).	**G.68.1c** Find the area of rectangles and triangles with whole-number side lengths by counting unit squares.
G.68.2a Find the area of triangles, quadrilaterals and polygons by decomposing into triangles and rectangles (e.g., the area of a trapezoid can be found by decomposing into a rectangle and triangles).	**G.68.2b** Find the area of rectilinear figures by decomposing them into non-overlapping parts and using the length × width formula to find the areas and then sum together to find the total area of the figure. 	**G.68.2c** Find the area of figures by counting unit squares.
G.68.3a Identify the side length(s) of a polygon drawn on a coordinate plane.	**G.68.3b** Identify the polygon in a coordinate plane when given the coordinates of the vertices.	**G.68.3c** Identify and plot points on a coordinate plane (all quadrants).
G.68.4a Find the surface area of prisms and cubes by using the nets of these three-dimensional figures. 	**G.68.4b** Represent three-dimensional figures using nets. 	**G.68.4c** Identify cubes, rectangular prisms, cones, cylinders and spheres (e.g., cubes, rubber eraser, funnel, paper towel roll, ball).
G.68.5a Recognize that the volume of a right rectangular prism can be found by multiplying the height by the area of the base (i.e., show that volume = length × width × height or base × height).	**G.68.5b** Demonstrate that unit cubes can be used to build figures that have volume and determine the volume of a figure.	**G.68.5c** Find the volume of a right rectangular prism (e.g., count the number of unit cubes it takes to fill a rectangular prism).

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

G.68.6a Solve problems involving scaled drawings of figures (e.g., if a triangle is drawn on a coordinate plane, what will be the length of one of the sides if the triangle is increased by a factor of 2?).	**G.68.6b** Identify the scaled drawing of a geometric figure (e.g., which shape is twice the size of another shape).	**G.68.6c** Identify polygons drawn on a coordinate plane (e.g., square, rectangles, quadrilaterals, triangles (isosceles, right, scalene, obtuse)).

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Solve real-life and mathematical problems involving angle measure, area, surface area and volume.		
G.68.7a Solve real-world problems involving the area of two-dimensional figures (rectangles, right triangles, trapezoids, parallelograms, rectilinear shapes).	**G.68.7b** Solve real-world problems involving the area of figures involving rectangles and right triangles.	**G.68.7c** Solve real-world problems involving perimeter.
G.68.8a Identify unknown angles and solve problems using facts about supplementary, complementary and adjacent angles and parallel and perpendicular lines.	**G.68.8b** Sort angles by type (right, acute, obtuse, straight, reflex).	**G.68.8c** Order angles by size.
G.68.9a Identify the attributes of a circle (radius, diameter, circumference, chord, and center).	**G.68.9b** Identify the radius, diameter and center of a circle.	**G.68.9c** Identify circles in three-dimensional objects and in the environment.
Understand congruence and similarity using physical models, transparencies or geometry software.		
G.68.10a Determine the sequence of transformations (rotation, reflection, translation) that will make a figure congruent to another.	**G.68.10b** Determine whether a rotation, a reflection or a translation is needed to make a figure congruent to another.	**G.68.10c** Determine the direction and how many units a figure must be shifted to be congruent to another on a coordinate plane (e.g., 3 units to the right).
G.68.11a Demonstrate the effects of dilations, translations, rotations and reflections.	**G.68.11b** Describe the effect of rotation (turn), reflection (flip) and translation.	**G.68.11c** Demonstrate concepts of translation (top, bottom right, left).
G.68.12a Identify congruent (same shape and size) shapes.	**G.68.12b** Match shapes in different orientations and sizes.	**G.68.12c** Match similar shapes.
Understand and apply the Pythagorean Theorem.		
G.68.13a Use visual models to demonstrate the relationship of the three side lengths of any right triangle.	**G.68.13b** Identify the parts of a right triangle (right angle, legs, hypotenuse).	**G.68.13c** Identify right triangles in the environment.
G.68.14a Determine whether the points create a right triangle, given three points on a coordinate plane.	**G.68.14b** Identify a right triangle when drawn on a coordinate plane.	**G.68.14c** Identify right triangles from a group of a variety of triangles.
Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.		
G.68.15a Label the parts of cones, cylinders and spheres.	**G.68.15b** Find cones, cylinders and spheres in the environment.	**G.68.15c** Sort three-dimensional shapes (cubes, cones, cylinders, rectangular prisms, spheres).

Mathematics Standards: Grades 3 – 5

Domain: Numbers and Operations – Fractions

Grade 3

Develop understanding of fractions as numbers.

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*.
2. Understand a fraction as a number on the number line; represent fractions on a number line diagram.
   a. Represent a fraction 1/*b* on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each part has size 1/*b* and that the endpoint of the part based at 0 locates the number 1/*b* on the number line.
   b. Represent a fraction *a*/*b* on a number line diagram by marking off *a* lengths 1/*b* from 0. Recognize that the resulting interval has size *a*/*b* and that its endpoint locates the number *a*/*b* on the number line.
3. Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.
   a. Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.
   b. Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3). Explain why the fractions are equivalent, e.g., by using a visual fraction model.
   c. Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.*
   d. Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

Grade 4

Extend understanding of fraction equivalence and ordering.

1. Explain why a fraction *a*/*b* is equivalent to a fraction (*n* × *a*)/(*n* × *b*) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.
2. Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

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

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

Grade 5

Use equivalent fractions as a strategy to add and subtract fractions.

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

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

3. Interpret a fraction as division of the numerator by the denominator (*a*/*b* = *a* ÷ *b*). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?*
4. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.
   a. Interpret the product (*a*/*b*) × *q* as *a* parts of a partition of *q* into *b* equal parts; equivalently, as the result of a sequence of operations *a* × *q* ÷ *b*. *For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = ac/bd.)*
   b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.
5. Interpret multiplication as scaling (resizing), by:
   a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.
   b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence *a*/*b* = (*n*×*a*)/(*n*×*b*) to the effect of multiplying *a*/*b* by 1.
6. Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.
7. Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.
   a. Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. *For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3.*
   b. Interpret division of a whole number by a unit fraction, and compute such quotients. *For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4.*
   c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb. of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?*

	Understand decimal notation for fractions, and compare decimal fractions. 5. Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100.4 *For example, express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.* 6. Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.* 7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model.	

Description

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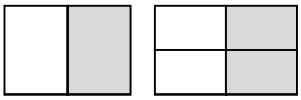
Mathematics Standards: Grades 3 – 5
Domain: Numbers and Operations – Fractions
Extended Standards

Essence of the Standards:

- *Add and subtract fractions.*
- *Fraction word problems*
- *Fractions represent division problems.*
- *Multiply fractions.*
- *Multiplying by a whole number produces a bigger product; multiplying by a fraction produces a smaller product.*
- *Multiplication word problems involving fractions.*
- *Divide whole numbers by fractions.*

Most Complex ← → Least Complex

Develop understanding of fractions as numbers.		
NF.35.1a Identify a/b on a number line running from 0 to 1 that is partitioned into b equal parts, up to 10 (e.g., when a = 2 and b = 3, 2/3 means dividing the whole into 3 equal parts and adding 2 parts together).	**NF.35.1b** Recognize that 1/b is the unit fraction created when a number line running from 0 to 1 is partitioned into b equal parts, up to 10 (e.g., when b = 3, 1/3 means dividing the whole into 3 equal parts with each part representing 1/3).	**NF.35.1c** Recognize that 1/b is the unit fraction created when a rectangle is divided into b equal parts, up to 10 (e.g., when b = 2, 1/2 means dividing the whole into 2 equal parts).
NF.35.2a Generate simple equivalent fractions (e.g., 1/2 = 2/4, 4/6 = 2/3, 5/5 = 1 = 3/3; identify which is equivalent to 1/2).	**NF.35.2b** Identify equivalent fractions by comparing their relative size using a number line (e.g., 2/5 on a number line partitioned into 5 equal parts is equivalent to (at the same point on) 4/10 on a number line partitioned into 10 equal parts).	**NF.35.2c** Identify equivalent fractions by comparing their relative size using models. 
NF.35.3a Compare two fractions with different denominators using >, < or = symbols.	**NF.35.3b** Compare two fractions with same denominator using >, < or = symbols.	**NF.35.3c** Compare two fractions with the same denominator by comparing their relative size using models (e.g., more than, less than, greater than).
NF.35.4a Add and subtract fractions without models, excluding mixed fractions.	**NF.35.4b** Add and subtract fractions with different denominators using models.	**NF.35.4c** Add and subtract fractions with the same denominator using models (e.g., use a rectangle divided into 10 equal parts to solve 2/10 + 4/10 by shading 2 parts and 4 parts and then counting the number of shaded parts).
NF.35.5a Solve addition and subtraction fraction word problems without models, excluding mixed fractions.	**NF.35.5b** Solve addition and subtraction word problems involving fractions with different denominators using models.	**NF.35.5c** Solve addition and subtraction word problems involving fractions with the same denominator using models.
Apply and extend previous understandings of multiplication and division to multiply and divide fractions.		
NF.35.6a Solve problems involving multiplication of a fraction by a whole number.	**NF.35.6b** Recognize that multiplying a fraction by a whole number is similar to taking a fraction of each whole piece and summing them together (e.g., 4 × 1/5 = 1/5 + 1/5 + 1/5 + 1/5 = 4/5).	**NF.35.6c** Recognize a fraction as the division of the numerator by the denominator using unit fractions (e.g., show that 1/3 means dividing a whole into 3 equal parts).
NF.35.7a Recognize that multiplying a fraction by a fraction is simply multiplying the numerator by the numerator and the denominator by the denominator to create a new fraction (e.g., 1/4 × 1/3 = (1 × 1) / (4 × 3) = 1/ 12).	**NF.35.7b** Recognize that multiplying a fraction by a fraction is similar to creating a model of the first fraction then scaling each part by the other fraction (e.g., 1/2 × 1/3 is similar to dividing a whole rectangle into two equal parts and then dividing each equal part into three equal parts to arrive at 1/6).	**NF.35.7c** Represent multiplying a fraction with a fraction using models to perform skip counting with the numerators and denominators.

Mathematics Standards: Grades 6 – 8

Domain: Ratios and Proportional Relationships

Grade 6	Grade 7	Grade 8
Understand ratio concepts and use ratio reasoning to solve problems. 1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."* 2. Understand the concept of a unit rate *a*/*b* associated with a ratio *a*:*b* with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."* 3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?* c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	**Analyze proportional relationships and use them to solve real-world and mathematical problems.** 1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.* 2. Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r)* where *r* is the unit rate. 3. Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*	***N/A***

Description

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Mathematics Standards: Grades 6 – 8
Domain: Ratios and Proportional Relationships
Extended Standards

Essence of the Standards:

- *Create and solve ratios.*
- *Represent proportional relationships.*
- *Use ratios to solve real-world problems.*
- *Ratios and proportional relationships can be used to determine unknown quantities.*

Most Complex ← → Least Complex

Understand ratio concepts and use ratio reasoning to solve problems.

Limit to ratios of denominators of 2, 3, 4,5, 6, 8, 10	**Limit to ratios of denominators of 2, 3, 4,5, 6, 8, 10**	**Limit to ratios of numerators of one and denominators of 2 and 4**
RP.68.1a Identify unit rate and solve problems that describe a relationship between quantities (e.g., for every vote candidate A received, candidate C received nearly three votes.).	**RP.68.1b** Identify the ratio that describes a relationship between quantities (e.g., for every vote candidate A received, candidate C received nearly three votes.).	**RP.68.1c** Identify the model that represents the ratio that describes a relationship between two quantities (e.g., a bag has 4 red and 6 yellow marbles, which model shows the ratio of red to yellow marbles: a visual of 4 red marbles: a visual of 6 yellow marbles).
RP.68.2a Solve problems involving unit rates (e.g., if it took 2 hours to mow 6 lawns, then at that rate, how many lawns could be mowed in 8 hours? At what rate were lawns being mowed?).	**RP.68.2b** Solve for unit rate (e.g., It took James 2 hours to drive 40 miles, on average. How fast did he drive?).	**RP.68.2c** Identify a unit rate in a word problem.
RP.68.3a Write a percent as a rate per one-hundred (e.g., 30 out of 100 is 30% is 30/100).	**RP.68.3b** Write a percent as a rate per one-hundred (e.g., 30 out of 100 is 30% is 30/100). Use proportional reasoning to find the whole when given both the part and the percent. (50% = 20 out of x)	**RP.68.3c** Identify a percent as a rate per one hundred.
RP.68.4a Use proportional reasoning to find the whole when given both the part and the percent. (50% = 20 out of x)	**RP.68.4b** Recognize the part as a whole when given both the part and the percent.	**RP.68.4c** Identify parts of the whole.
RP.68.5a Given a visual model, identify ratios involving fractions.	**RP.68.5b** Given a visual model or manipulative, identify ratios involving whole numbers.	**RP.68.5c** Given a manipulative, identify the units to be compared.
RP.68.6a Identify if a graph represents a proportional relationship.	**RP.68.6b** Given coordinate pairs involving whole numbers, identify the rule.	**RP.68.6c** Given a rule, continue a sequence of whole numbers.
RP.68.7a Given a ratio table involving whole numbers, identify the rule and fill in a missing value.	**RP.68.7b** Given a ratio table involving whole numbers, identify the rule**.**	**RP.68.7c** Given a rule, continue a sequence of whole numbers.

Mathematics Standards: Grades 6 – 8
Domain: The Number System

Grade 6

Apply and extend previous understandings of multiplication and division to divide fractions by fractions.

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

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

2. Fluently divide multi-digit numbers using the standard algorithm.
3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4 (9 + 2).*

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

5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
6. Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.
   a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite.
   b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.
   c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.
7. Understand ordering and absolute value of rational numbers.
   a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret –3 > –7 as a statement*

Grade 7

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

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

Grade 8

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

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

that –3 is located to the right of –7 on a number line oriented from left to right. b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –3 °C > –7 °C to express the fact that –3 °C is warmer than –7 °C.* c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.* d. Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.* 8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.		

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Mathematics Standards: Grades 6 – 8
Domain: The Number System
Extended Standards

Essence of the Standards:

- *Identify rational and irrational numbers.*
- *Estimate the values of numbers.*
- *Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers.*

Most Complex ⟷ Least Complex

Apply and extend previous understandings of multiplication and division to divide fractions by fractions.		
NS.68.1a Recognize that dividing a whole number by a fraction is to invert the fraction and then multiply (e.g., 2 divided by 1/3 = 2 × 3/1 = 6).	**NS.68.1b** Recognize that dividing a whole number by a fraction is separating the whole into the required fractional parts and counting how many parts are in the total (e.g., 1 divided by 1/3 means divide the whole into 3 equal pieces and count the parts to arrive at 3).	**NS.68.1c** Recognize a fraction as the division of the numerator by the denominator using unit fractions (e.g., use a model to show that 1/3 means dividing a whole into 3 equal parts).
Compute fluently with multi-digit numbers and find common factors and multiples.		
NS.68.2a Fluently divide multi-digit whole numbers.	**NS.68.2b** Divide multi-digit whole numbers up to three-digit whole numbers by one or two digit numbers.	**NS.68.2c** Divide a two-digit number by a one-digit number using models.
NS.68.3a Fluently add, subtract, multiply and divide multi-digit decimals.	**NS.68.3b** Add, subtract and multiply multi-digit decimals using models.	**NS.68.3c** Add and subtract multi-digit decimals using models.
Apply and extend previous understandings of numbers to the system of rational numbers.		
NS.68.4a Solve real-world problems involving positive and negative numbers (e.g., temperatures, elevations, distance from a fixed point (map reading)).	**NS.68.4b** Solve problems involving positive and negative numbers using a number line (e.g., temperatures, distances from a fixed point).	**NS.68.4c** Locate a given positive or negative number on a number line.
NS.68.5a Recognize the effects of multiplying and dividing with negative numbers (e.g., -2 × -4 = 8).	**NS.68.5b** Recognize that the absolute value of a rational number is how far it is from 0 on the number line (i.e., plot a number and its opposite on a number line and recognize that they are equidistant from zero).	**NS.68.5c** Recognize that addition means move to the right and subtraction means move to the left on a number line.

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Apply and extend previous understandings of operations with fractions to add, subtract, multiply and divide rational numbers.		
NS.68.6a Add and subtract fractions without models, excluding mixed fractions.	**NS.68.6b** Add and subtract fractions with different denominators using models.	**NS.68.6c** Add and subtract fractions with the same denominator using models (e.g., use a rectangle divided into 10 equal parts to solve 2/10 + 4/10 by shading 2 parts and 4 parts and then counting the number of shaded parts).
NS.68.7a Solve addition and subtraction fraction word problems without models, excluding mixed fractions.	**NS.68.7b** Solve addition and subtraction word problems involving fractions with different denominators using models.	**NS.68.7c** Solve addition and subtraction word problems involving fractions with the same denominator using models.
NS.68.8a Solve problems involving the multiplication of a fraction by a whole number.	**NS.68.8b** Recognize that multiplying a fraction by a whole number is similar to taking a fraction of each whole piece and summing them together (e.g., 4 × 1/5 = 1/5 + 1/5 + 1/5 + 1/5 = 4/5).	**NS.68.8c** Recognize a fraction as the division of the numerator by the denominator using unit fractions (e.g., show that 1/3 means dividing a whole into 3 equal parts).
NS.68.9a Recognize that multiplying a fraction by a fraction is simply multiplying the numerator by the numerator and the denominator by the denominator to create a new fraction (e.g., 1/4 × 1/3 = (1 × 1) / (4 × 3) = 1/ 12).	**NS.68.9b** Recognize that multiplying a fraction by a fraction is similar to creating a model of the first fraction and then scaling each part by the other fraction (e.g., 1/2 × 1/3 is similar to dividing a whole rectangle into 2 equal parts and then dividing each equal part into 3 equal parts to arrive at 1/6).	**NS.68.9c** Identify that multiplying two fractions together can be performed simply by multiplying the two numerators together and the two denominators together.
Know that there are numbers that are not rational, and approximate them by rational numbers.		
NS.68.10a Estimate which point on a number line a decimal (up to hundredths) is closest to (e.g., given a number line running from 3 to 5 in increments of 1/10, identify at which point the decimal 4.13 would be).	**NS.68.10b** Round decimals to the nearest whole number or tenths and identify the corresponding points on a number line.	**NS.68.10c** Identify the whole-number points on a number line.

Mathematics Standards: Grades 6 – 8
Domain: Expressions and Equations

Grade 6

Apply and extend previous understandings of arithmetic to algebraic expressions.

1. Write and evaluate numerical expressions involving whole-number exponents.
2. Write, read, and evaluate expressions in which letters stand for numbers.
   a. Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.*
   b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.*
   c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems.

Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas V = s3 and A = 6 s2 to find the volume and surface area of a cube with sides of length s = 1/2.*

3. Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.*
4. Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.*

Reason about and solve one-variable equations and inequalities.

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.
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.
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.
8. Write an inequality of the form x > *c* or x < *c* to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form x > *c* or x < *c* have infinitely many solutions; represent solutions of such inequalities on number line diagrams.

Represent and analyze quantitative relationships between dependent and independent variables.

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

Grade 7

Use properties of operations to generate equivalent expressions.

1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*

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

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

Grade 8

Work with radicals and integer exponents.

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where *p* is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.*
4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

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

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*
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*.

Analyze and solve linear equations and pairs of simultaneous linear equations.

7. Solve linear equations in one variable.
   a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = *a*, *a* = *a*, or *a* = *b* results (where *a* and *b* are different numbers).
   b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
8. Analyze and solve pairs of simultaneous linear equations.
   a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
   b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.*
   c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*

quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.*		

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Mathematics Standards: Grades 6 – 8
Domain: Expressions and Equations
Extended Standards

Essence of the Standards:

- *Know how to evaluate numerical expressions that contain exponents.*
- *Evaluate square root and cube root of perfect squares and cubes.*
- *Understand the powers of 10.*
- *Scientific notation*
- *Graph and compare slope.*

Most Complex ⟵ ⟶ Least Complex

Apply and extend previous understanding of arithmetic to algebraic expressions.		
EE.68.1a Write and evaluate numerical expressions involving whole-number exponents (e.g., 3^2 = 3 × 3; 2^3 = 2 × 2 × 2).	**EE.68.1b** Apply properties of operations to generate equivalent expressions (e.g., 3(2 + x) = 6 + 3x; *y* + *y* + *y* = 3y).	**EE.68.1c** Write and/or evaluate expressions in which letters stand for unknown numbers (e.g., a model of 10 apples and giving some away).
Reason about and solve one-variable equations and inequalities.		
EE.68.2a Represent a real-world situation using an algebraic expression or inequality involving a variable (e.g., 45 - a = 35 models; I start with 45 apples and now have 35). **EE.68.3a** Solve an algebraic expression or inequality involving variables.	**EE.68.2b** Represent a real-world situation using an algebraic expression involving a variable (e.g., 8 + a = 10 models; I start with 8 apples and now have 10). **EE.68.3b** Solve an algebraic expression involving variables.	**EE.68.2c** Represent an algebraic expression that simulates a real-world situation when a specific number is unknown using concrete objects. **EE.68.3c** Solve an algebraic expression using concrete objects.
Work with radicals and integer exponents.		
EE.68.4a Recognize perfect squares up to 25 (e.g., 5 squared is 25).	**EE.68.4b** Create a representation of a perfect square.	**EE.68.4c** Select the perfect square, given a model.
Understand the connections between proportional relationships, lines and linear equations.		
EE.68.5a Identify the slope of a line.	**EE.68.5b** Determine whether a line has a positive, a negative or no slope.	**EE.68.5c** Determine whether the line is increasing (going up), decreasing (going down) or flat.
Analyze and solve linear equations and pairs of simultaneous linear equations.		
EE.68.6a Solve a 1-step linear equation (e.g., *y* + 3 = 5). **EE.68.7a** Locate the coordinate at which two lines intersect.	**EE.68.6b** Identify the operation needed to solve a given 1-step linear equation (the inverse operation). **EE.68.7b** Locate the point where two lines intersect.	**EE.68.6c** Solve for an unknown number within a number sentence (e.g., 5 + *x* = 8). **EE.68.7c** Determine whether two lines intersect.

Mathematics Standards: Grades 6 – 8
Domain: Functions

Grade 6	Grade 7	Grade 8
N/A	***N/A***	**Define, evaluate, and compare functions.** 1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. 2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* 3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* **Use functions to model relationships between quantities.** 4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. 6. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

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Mathematics Standards: Grades 6 – 8
Domain: Functions
Extended Standards

Essence of the Standards:

- *Specific input will yield specific output.*
- *Compare/contrast two different input/output relationships.*
- *Equations of linear and non-linear functions*
- *Construct a linear graph using a table or equation.*
- *Construct a linear graph as described verbally.*

Most Complex ⟷ Least Complex

Define, evaluate and compare functions; Use functions to model relationships between quantities.

F.68.1a Determine whether an ordered pair is a viable solution to a given linear function. .	**F.68.1b** Classify graphs of functions as linear or non-linear. 	**F.68.1c** Determine whether the line is increasing (going up), decreasing (going down) or flat.
F.68.2a Determine whether a function is linear or non-linear given the equation.	**F.68.2b** Match a function to its graph.	**F.68.2c** Determine whether the slope of the function is positive, negative or flat.
F.68.3a Graph a linear function.	**F.68.3b** Determine the x and y intercept points for a linear graph.	**F.68.3c** Identify two points on a linear graph.

Mathematics Standards: Grades 6 – 8

Domain: Statistics and Probability

Grade 6

Develop understanding of statistical variability.

1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.*
2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

Summarize and describe distributions.

4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
5. Summarize numerical data sets in relation to their context, such as by:
   a. Reporting the number of observations.
   b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
   c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
   d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

Grade 7

Use random sampling to draw inferences about a population.

1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*

Draw informal comparative inferences about two populations.

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

Investigate chance processes and develop, use, and evaluate probability models.

5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.
6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*
7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.
   a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a*

Grade 8

Investigate patterns of association in bivariate data.

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.
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.
3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr. as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*
4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

	student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected. b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* 8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event. c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*	

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Mathematics Standards: Grades 6 – 8
Domain: Statistics and Probability
Extended Standards

Essence of the Standards:

- *Describe patterns on a graph.*
- *Describe patterns on a graph using a line of best fit.*
- *Describe patterns on a graph using slope and intercept.*
- *Construct a two-way table and interpret association between the two variables.*

Most Complex ← → Least Complex

Develop understanding of statistical variability.		
SP.68.1a Compute the mean, the median and the mode of a data set involving numbers less than 50 (e.g., number of rainy days in a month).	**SP.68.1b** Compute the median and the mode of a data set involving numbers less than 50 (e.g., summer days over 90 degrees).	**SP.68.1c** Interpret information from a given or collected data set (e.g., given a tally chart showing the favorite colors of the students in Joe's math class, determine which color was the most/least favorite).
Summarize and describe distributions.		
SP.68.2a Construct and interpret a histogram from a given or collected data set.	**SP.68.2b** Construct and analyze a line plot from a given or collected data set.	**SP.68.2c** Construct and analyze a bar graph from a given or collected data set.
Investigate chance processes and develop, use and evaluate probability models.		
SP.68.3a Understand a probability of 0 as impossible, 1 as certain, near 0 as unlikely, near 1 as likely and near 1/2 as equally likely.	**SP.68.3b** Determine the probability of an event occurring as likely, unlikely, certain or impossible.	**SP.68.3c** Determine the probability of an event occurring as likely or unlikely.
Investigate patterns of association in bivariate data.		
SP.68.4a Determine which line most closely represents the line of best fit for a given scatterplot.	**SP.68.4b** Determine whether patterns on a scatter plot are positive, negative or have no correlation.	**SP.68.4c** Determine whether linear graph is increasing, decreasing or flat.

Mathematics Standards: Grades 9 – 12
Algebra – Seeing Structure in Expressions

Grades 9 – 12

Interpret the structure of expressions

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

Write expressions in equivalent forms to solve problems

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
   a. Factor a quadratic expression to reveal the zeros of the function it defines.
   b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
   c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*

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Mathematics Standards: Grades 9 – 12
Algebra – Seeing Structure in Expressions
Extended Standards

Essence of the Standards:

- *Interpret expressions.*
- *Use factoring to create equivalent expressions.*

Most Complex ← → Least Complex

Interpret the structure of expressions.		
A.SSE.912.1a Represent a real-world situation with an expression, both numeric and variable.	**A.SSE.912.1b** Represent a real-world situation with a numeric expression.	**A.SSE.912.1c** Represent a real-world situation with an expression using concrete objects.
Write expressions in equivalent forms to solve problems.		
A.SSE.912.2a Simplify and factor expressions involving variables (e.g., $(2(x + 4) = 2x + 8)$.	**A.SSE.912.2b** Identify the equivalent numeric expression (e.g., $7 + 5 = 5 + 7$).	**A.SSE.912.2c** Identify equivalent expressions with whole numbers less than 10 using concrete objects.

Mathematics Standards: Grades 9 – 12
Algebra – Creating Equations

Grades 9 – 12

Create equations that describe numbers or relationships

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.*
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

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Mathematics Standards: Grades 9 – 12
Algebra – Creating Equations
Extended Standards

Essence of the Standards:

- *Create equations to solve problems with one variable.*
- *Graph equations on a coordinate plane.*

Most Complex ⟵ ⟶ Least Complex

Create equations that describe numbers or relationships.		
A.CE.912.1a Represent a real-world situation with a linear equation or inequality.	**A.CE.912.1b** Represent a real-world situation with a linear equation.	**A.CE.912.1c** Represent a real-world situation using concrete objects, models and pictures.
A.CE.912.2a Graph a given equation or inequality on a coordinate plane.	**A.CE.912.2b** Graph a given equation on a coordinate plane.	**A.CE.912.2c** Identify whether a line is increasing or decreasing on a coordinate plane.

Mathematics Standards: Grades 9 – 12
Algebra – Reasoning with Equations and Inequalities

Grades 9 – 12

Understand solving equations as a process of reasoning and explain the reasoning

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Solve equations and inequalities in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
4. Solve quadratic equations in one variable.
   a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
   b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Solve systems of equations

5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line $y = –3x$ and the circle $x^2 + y^2 = 3$.*
8. (+) Represent a system of linear equations as a single matrix equation in a vector variable.
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).

Represent and solve equations and inequalities graphically

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
12. Graph the solutions to a linear inequality in two variables as a half-plane excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

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Math Standards: Grades 9 – 12
Algebra – Reasoning with Equations and Inequalities
Extended Standards

Essence of the Standards:

- *Justify a solution method.*
- *Solve linear equations and inequalities.*
- *Solve a system of linear equations with graphs.*
- *Graph and solve a system with a linear relationship and a quadratic relationship.*

Most Complex ⟷ Least Complex

Understand solving equations as a process of reasoning and explain the reasoning.		
A.REI.912.1a Order a given sequence of steps to solve an equation.	**A.REI.912.1b** Identify the operation performed to get to the next step of a given sequence of steps used to solve an equation.	**A.REI.912.1c** Identify how many should be added or taken away from a set to get a given total.
Solve equations and inequalities in one variable.		
A.REI.912.2a Solve linear equations.	**A.REI.912.2b** Solve 1-step linear equations.	**A.REI.912.2c** Solve for the missing number within a given number sentence involving addition or subtraction of numbers less than 10.
A.REI.912.3a Solve for viable solutions to real-world, 1-step inequality situations.	**A.REI.912.3b** Identify whether a given value is a viable solution to a 1-step inequality.	**A.REI.912.3c** Identify viable answer when given a real world context involving an inequality (e.g., Jane has a bag of 20 marbles, she gives at least 8 away, how many could she have left at the end of the day?).
Solve systems of equations.		
A.REI.912.4a Locate the coordinate at which two lines intersect.	**A.REI.912.4b** Locate the point on the graph at which two lines intersect.	**A.REI.912.4c** Identify whether two lines intersect.
A.REI.912.5a Locate the coordinate of the point(s) at which a line intersects a quadratic function (e.g., at which two coordinates does the line intersect the parabola?).	**A.REI.912.5b** Locate the point(s) on the graph at which a line intersects a quadratic function (e.g., identify on the graph where the line intersects the parabola).	**A.REI.912.5c** Identify whether a line intersects a quadratic function (e.g., does the line intersect the parabola at one or two points? Does the line intersect the parabola?).

Mathematics Standards: *Geometry - Congruence* Grades 9 – 12

Grades 9 – 12

Experiment with transformations in the plane

1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
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.

Understand congruence in terms of rigid motions

6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
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.
8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

9. Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.*
10. Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*
11. Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*

Make geometric constructions

12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.*
13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

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Mathematics Standards: *Geometry - Congruence* Extended Standards Grades 9 – 12

Essence of the Standards:

- *Define points, lines, line segments, angles, and perpendicular and parallel lines.*
- *Understand rigid motions such as rotations (turns), reflections (flips), and translations (slides) and congruency.*

Most Complex ← → Least Complex

Experiment with transformations in the plane.

G.CO.912.1a Identify points, lines, line segments, angles (right, acute, obtuse, and order by size), and perpendicular and parallel lines.	**G.CO.912.1b** Identify points, lines, line segments and angles (right, acute, obtuse, and order by size).	**G.CO.912.1c** Identify points, lines and line segments, and order angles by size.
G.CO.912.2a Identify whether a rotation (turn), a reflection (flip) or a translation (slide) is required to make a shape congruent to another on a coordinate plane.	**G.CO.912.2b** Identify whether a rotation (turn), a reflection (flip) or a translation (slide) is required to make a shape congruent to another.	**G.CO.912.2c** Match shapes in different orientations.

Mathematics Standards: Grades 9 – 12
Geometry – Similarity, Right Triangles and Trigonometry

Grades 9 – 12

Understand similarity in terms of similarity transformations

1. Verify experimentally the properties of dilations given by a center and a scale factor:
   a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
   b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Prove theorems involving similarity

4. Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.*
5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Define trigonometric ratios and solve problems involving right triangles

6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
7. Explain and use the relationship between the sine and cosine of complementary angles.
8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Apply trigonometry to general triangles

9. (+) Derive the formula $A = 1/2\ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.
11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

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Mathematics Standards: Grades 9 – 12
Geometry – Similarity, Right Triangles and Trigonometry
Extended Standards

Essence of the Standards:

- *Identify similar figures.*
- *Understand attributes of a right triangle.*

Most Complex ← → Least Complex

Understand similarity in terms of similarity transformations.		
G.SRT.912.1a Verify that two shapes are similar on a coordinate plane.	**G.SRT.912.1b** Identify which shape is similar on a coordinate plane or using concrete objects.	**G.SRT.912.1c** Identify which shape is bigger, smaller, or same size as another.
G.SRT.912.2a Construct a right triangle on a coordinate plane and label the parts.	**G.SRT.912.2b** Identify the parts of a right triangle (right angle, legs, hypotenuse).	**G.SRT.912.2c** Given an assortment of triangles, identify right triangles.

Mathematics Standards: *Geometry - Circles* — Grades 9 – 12

Grades 9 – 12

Understand and apply theorems about circles

1. Prove that all circles are similar.
2. Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.*
3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
4. (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles

5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

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Mathematics Standards: *Geometry – Circles* Extended Standards — Grades 9 – 12

Essence of the Standards:

- Understand properties of circles.

Most Complex ⟵ ⟶ Least Complex

Understand and apply theorems about circles.		
G.C.912.1a Use the radius of a circle to determine the diameter and vice versa.	**G.C.912.1b** Identify parts of a circle (radius, diameter, circumference, chord, arc).	**G.C.912.1c** Identify three-dimensional shapes with a circle as a cross-section and/or identify shapes or objects that have a circular base.

Mathematics Standards: Grades 9 – 12
Geometry - Geometric Measurement and Dimension

Grades 9 – 12

Explain volume formulas and use them to solve problems

1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.*
2. (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Visualize relationships between two-dimensional and three-dimensional objects

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.

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Mathematics Standards: Grades 9 – 12
Geometry - Geometric Measurement and Dimension
Extended Standards

Essence of the Standards:

- *Understand that three-dimensional objects have volume.*

Most Complex ⟷ Least Complex

Visualize relationships between two-dimensional and three-dimensional objects.

G.GMD.912.1a Compare the volume of two objects with the same base but different heights and vice versa (e.g., which cup can hold more water: the shorter or the taller cup; given the choice different sized cubes, identify which would hold more).	**G.GMD.912.1b** Distinguish between objects that do and do not have volume.	**G.GMD.912.1c** Sort three-dimensional objects (cones, cylinders, spheres).

Mathematics Standards: Grades 9 – 12
Geometry - Modeling with Geometry

Grades 9 – 12

Apply geometric concepts in modeling situations

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).
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
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).

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Mathematics Standards: Grades 9 – 12
Geometry - Modeling with Geometry

Essence of the Standards:

- *Identify geometric shapes in the real world.*

Most Complex ⟷ Least Complex

Apply geometric concepts in modeling situations.		
G.MG.912.1a Match the shape of real-world objects to two-dimensional and three-dimensional shapes (e.g., the trunk of a tree is cylindrical in shape; a car is cube in shape; the flower of a sunflower is circular in shape; a bookshelf is rectangular prism in shape).	**G.MG.912.1b** Match the shape of real-world objects to polygons (e.g., a window is rectangular in shape, a door is rectangular in shape, the front of a wheel is circular in shape, a table can be of many different shapes (circular, rectangular).	**G.MG.912.1c** Match cones, cylinders, or spheres with real-world objects.

Mathematics Standards: Grades 9 – 12
Statistics and Probability - Interpreting Categorical and Quantitative Data

Grades 9 – 12

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

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Summarize, represent, and interpret data on two categorical and quantitative variables

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.
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
   a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.*
   b. Informally assess the fit of a function by plotting and analyzing residuals.
   c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.

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Mathematics Standards: Grades 9 – 12
Statistics and Probability - Interpreting Categorical and Quantitative Data
Extended Standards

Essence of the Standards:

- *Represent data with bar graphs and dot plots.*
- *Use measures of center to compare data.*
- *Interpret data on a scatter plot.*
- *Interpret the slope and intercept on a graph.*

Most Complex ⟵ ⟶ Least Complex

Summarize, represent and interpret data on a single count or measurement variable.		
SP.ID.912.1a Create a bar graph to represent given or collected data.	**SP.ID.912.1b** Create a dot plot to represent given or collected data.	**SP.ID.912.1c** Match a dot plot with a given data set.
SD.ID.912.2a Compute mean, median and mode of a given or collected data set.	**SP.ID.912.2b** Compute mean (average), median or mode of a given or collected data set involving numbers less than 100.	**SP.ID.912.2c** Identify the median and mode of a given data set involving numbers less than 100.
SP.ID.912.3a Interpret a bar graph.	**SP.ID.912.3b** Interpret a dot plot.	**SP.ID.912.3c** Complete an incomplete dot plot (e.g., adding missing labels and missing data points).
Summarize, represent and interpret data on two categorical and quantitative variables.		
SP.ID.912.4a Create a scatter plot to represent given or collected data and interpret the relation between the two variables as positive, negative or no correlation.	**SP.ID.912.4b** Interpret the relation between two variables in a scatter plot as positive, negative or no correlation.	**SP.ID.912.4c** Match a scatter plot with a given data set.
Interpret linear models.		
SP.ID.912.5a Graph a line with a given slope and *y*-intercept.	**SP.ID.912.5b** Identify the slope of a line.	**SP.ID.912.5c** Match a line graph with a given data set.

Mathematics Standards: Grades 9 – 12
Statistics and Probability - Making Inferences and Justifying Conclusions

Grades 9 – 12

Understand and evaluate random processes underlying statistical experiments

1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

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

3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
6. Evaluate reports based on data.

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Mathematics Standards: Grades 9 – 12
Statistics and Probability - Making Inferences and Justifying Conclusions
Extended Standards

Essence of the Standards:

- *Evaluate whether a data set is consistent with a data-generating process.*

Most Complex ← → Least Complex

Understand and evaluate random processes underlying statistical experiments

SP.IC.912.1a Determine whether the data could come from a data-generating device (spinner, coin, number cube).	**SP.IC.912.1b** Determine the likelihood (likely, impossible, unlikely, certain) of outcomes from a data-generating device.	**SP.IC.912.1c** Determine the likelihood (likely or unlikely) of an outcome from a data-generating device.
SP.IC.912.2a Understand a probability of 0 as impossible, probability of 1 as certain, probability near 0 as unlikely, near 1 as likely, and near 1/2 as equally likely.	**SP.IC.912.2b** Understand a probability near 0 as unlikely and near 1 as likely.	**SP.IC.912.2c** Understand a probability near 0 as unlikely and near 1 as likely using a number line.