Understanding Number

Kindergarten

NY-K.CC.1 Count to 100 by ones and by tens.

NY-K.CC.2 Count to 100 by ones beginning from any given number (instead of beginning at 1).

NY-K.CC.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).

NY-K.CC.4 Understand the relationship between numbers and quantities up to 20; connect counting to cardinality.
NY-K.CC.4a 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. (1:1 correspondence)
NY-K.CC.4b Understand that the last number name said tells the number of objects counted, (cardinality). The number of objects is the same regardless of their arrangement or the order in which they were counted.
NY-K.CC.4c Understand the concept that each successive number name refers to a quantity that is one larger.
NY-K.CC.4d Understand the concept of ordinal numbers (first through tenth) to describe the relative position and magnitude of whole numbers.

NY-K.CC.5a Answer counting questions using as many as 20 objects arranged in a line, a rectangular array, and a circle. Answer counting questions using as many as 10 objects in a scattered configuration. e.g., "How many _____ are there?"
NY-K.CC.5b Given a number from 1–20, count out that many objects.

NY-K.CC.6 Identify whether the number of objects in one group is greater than (more than), less than (fewer than), or equal to (the same as) the number of objects in another group. e.g., using matching and counting strategies. Note: Include groups with up to ten objects.

NY-K.CC.7 Compare two numbers between 1 and 10 presented as written numerals. e.g., 6 is greater than 2.

NY-K.NBT.1 Compose and decompose the numbers from 11 to 19 into ten ones and one, two, three, four, five, six, seven, eight, or nine ones. e.g., using objects or drawings.

First Grade

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

NY-1.NBT.2 Understand that the two digits of a two-digit number represent amounts of tens and ones.
NY-1.NBT.2a Understand 10 can be thought of as a bundle of ten ones, called a "ten".
NY-1.NBT.2b Understand that the numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.
NY-1.NBT.2c Understand that 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).

NY-1.NBT.3 Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <

Second Grade

NY-2.NBT.1 Understand that the digits of a three-digit number represent amounts of hundreds, tens, and ones.
e.g., 706 equals 7 hundreds, 0 tens, and 6 ones.
NY-2.NBT.1a Understand 100 can be thought of as a bundle of ten tens, called a "hundred."

NY-2.NBT.1b Understand 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).

NY-2.NBT.2 Count within 1000; skip-count by 5's, 10's, and 100's.

NY-2.NBT.3 Read and write numbers to 1000 using base ten numerals, number names, and expanded form. e.g., expanded form: 237 = 200 + 30 + 7

NY-2.NBT.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.

Third Grade

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

NY-3.NBT.4a Understand that the digits of a four-digit number represent amounts of thousands, hundreds, tens, and ones. e.g., 3,245 equals 3 thousands, 2 hundreds, 4 tens, and 5 ones.
NY-3.NBT.4b Read and write four-digit numbers using base-ten numerals, number names, and expanded form. e.g., The number 3,245 in expanded form can be written as 3,245= 3,000 + 200 + 40 + 5.

Fourth Grade

NY-4.NBT.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. e.g., Recognize that 70 × 10 = 700 (and, therefore, 700 ÷ 10 = 70) by applying concepts of place value, multiplication, and division. Note: Grade 4 expectations are limited to whole numbers less than or equal to 1,000,000.

NY-4.NBT.2a. Read and write multi-digit whole numbers using base ten numerals, number names, and expanded form. e.g., 50,327 = 50,000 + 300 + 20 + 7
NY-4.NBT.2b Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. Note: Grade 4 expectations are limited to whole numbers less than or equal to 1,000,000.

NY-4.NBT.3 Use place value understanding to round multi-digit whole numbers to any place. Note: Grade 4 expectations are limited to whole numbers less than or equal to 1,000,000.

NY-4.NF.6 Use decimal notation for fractions with denominators 10 or 100. e.g.,
-    Rewrite 0.62 as 62 100 or 62 100 as 0.62.
-    Describe a length as 0.62 meters.
-    Locate 0.62 on a number line.
Note: Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

NY-4.NF.7 Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions.
e.g., using a visual model.
Note: Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

Fifth Grade

NY-5.NBT. 1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

NY-5.NBT.2 Use whole-number exponents to denote powers of 10. 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.

NY-5.NBT.3 Read, write, and compare decimals to thousandths.
NY-5.NBT.3a Read and write decimals to thousandths using base-ten numerals, number names, and expanded form.
e.g.,

- $47.392 = 4 \times 10 + 7 \times 1 + 3 \times \frac{1}{10} + 9 \times \frac{1}{100} + 2 \times \frac{1}{1000}$

- $47.392 = (4 \times 10) + (7 \times 1) + (3 \times \frac{1}{10}) + (9 \times \frac{1}{100}) + (2 \times \frac{1}{1000})$

- $47.392 = (4 \times 10) + (7 \times 1) + (3 \times 0.1) + (9 \times 0.01) + (2 \times 0.001)$

NY-5.NBT.3b Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

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

Negative Numbers/Rational Numbers
NY-5.G.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond. e.g., x-axis and x-coordinate, y-axis and y-coordinate.

6th Grade

NY-6.EE.1 Write and evaluate numerical expressions involving whole number exponents.

Negative Numbers/Rational Numbers
NY-6.NS.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or

values. Use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge.

NY-6.NS.6 Understand a rational number as a point on the number line. Use number lines and coordinate axes to represent points on a number line and in the coordinate plane with negative number coordinates.
NY-6.NS.6a 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, and that 0 is its own opposite. e.g., With the number 3, $-(-3) = 3$
NY-6.NS.6b 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.
NY-6.NS.6c Find and position integers and other rational numbers on a horizontal or **vertical number line**. Find and position pairs of integers and other rational numbers on a coordinate plane.

NY-6.NS.7 Understand ordering and absolute value of rational numbers.
NY-6.NS.7a Interpret statements of inequality as statements about the relative position of two numbers on a number line.
e.g., Interpret $-3 > -7$ as a statement that -3 is located to the right of -7 on a number line oriented from left to right.
NY-6.NS.7b Write, interpret, and explain statements of order for rational numbers in real-world contexts.
e.g., Write $-3°C > -7°C$ to express the fact that $-3°C$ is warmer than $-7°C$.
NY-6.NS.7c 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.
e.g., For an account balance of -30 dollars, write $|-30| = 30$ to describe the size of the debt in dollars.
NY-6.NS.7d Distinguish comparisons of absolute value from statements about order.
e.g., Someone with a balance of $100 in their bank account has more money than someone with a balance of $-$1000$, because $100 > -1000$. But, the second person's debt balance is much greater than the first person's credit balance because $|-1000| > |100|$.

7th Grade

NY-7.NS.2d Convert a fraction to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats

8th Grade

NY-8.NS.1 Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion eventually repeats. Know that other numbers that are not rational are called irrational.
NY-8.NS.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line, and estimate the value of expressions.

NY-8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form $x2 = p$ and $x3 = p$, where p is a positive rational number. Know square roots of perfect squares up to 225 and cube roots of perfect cubes up to 125. Know that the square root of a non-perfect square is irrational. e.g., The $\sqrt{2}$ is irrational.

NY-8.EE.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. e.g., 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.

NY-8.EE.4 Perform multiplication and division with numbers expressed in scientific notation, including problems where both standard decimal form and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Interpret scientific notation that has been generated by technology.

Algebra I

AI-N.RN.3 Use properties and operations to understand the different forms of rational and irrational numbers.
a.) Perform all four arithmetic operations and apply properties to generate equivalent forms of rational numbers and square roots.
<u>Note:</u> Tasks include rationalizing numerical denominators of the form $\square/\sqrt{\square}$ where a is an integer and b is a natural number.
b.) Categorize the sum or product of rational or irrational numbers.
- The sum and product of two rational numbers is rational.
- The sum of a rational number and an irrational number is irrational.
- The product of a nonzero rational number and an irrational number is irrational.
- The sum and product of two irrational numbers could be either rational or irrational.

Algebra II

AII-N.RN.1 Explore how the meaning of rational exponents follows from extending the properties of integer exponents.
e.g., we define $5^{\frac{1}{3}}$ to be the cube root of 5 because we want $(5^{\frac{1}{3}})^3 = 5^{(\frac{1}{3})3}$ to hold, so $(5^{\frac{1}{3}})^3$ must equal 5.

AII-N.RN.2 Convert between radical expressions and expressions with rational exponents using the properties of exponents.
<u>Note:</u> All radical expressions involving variables assume the variables are representing positive numbers. Includes expressions with

variable factors, such as $\sqrt[3]{27x^5y^3}$, being equivalent to $(27x^5y^3)^{\frac{1}{3}}$ which equals $3x^{\frac{5}{3}}y$.

AII-N.CN.1 Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.

AII-N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
Note: Tasks include simplifying powers of i.

Understanding Fractions

First Grade

NY-1. G.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.

Second Grade

NY-2.MD.6 Represent whole numbers as lengths from 0 on a number line with equally spaced points corresponding to the numbers 0, 1, 2, …, and represent whole-number sums and differences within 100 on a number line.

NY-2.G.3 Partition circles and rectangles into two, three, or four equal shares. Describe the shares using the words halves, thirds, half of, a third of, etc. Describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.

Third Grade

NY-3.NF.1 Understand a unit fraction, $\frac{1}{b}$, is the quantity formed by 1 part when a whole is partitioned into *b* equal parts. Understand a fraction $\frac{a}{b}$ is the quantity formed by *a* parts of size $\frac{1}{b}$.
Note: Fractions are limited to those with denominators 2, 3, 4, 6, and 8.

NY-3.NF.2 Understand a fraction as a number on the number line; represent fractions on a number line.
Note: Fractions are limited to those with denominators 2, 3, 4, 6, and 8.
NY-3.NF.2a Represent a fraction $\frac{1}{b}$ on a number line by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each part has size $\frac{1}{b}$ and that the endpoint of the part starting at 0 locates the number $\frac{1}{b}$ on the number line.
NY-3.NF.2b Represent a fraction $\frac{a}{b}$ on a number line by marking off a lengths $\frac{1}{b}$ from 0. Recognize that the resulting interval has size $\frac{a}{b}$ and that its endpoint locates the number $\frac{a}{b}$ on the number line.

NY-3.NF.3 Explain equivalence of fractions and compare fractions by reasoning about their size.
Note: Fractions are limited to those with denominators 2, 3, 4, 6, and 8.
NY-3.NF.3a Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.
NY-3.NF.3b Recognize and generate equivalent fractions. e.g., $\frac{1}{2} = \frac{2}{4}$; $\frac{4}{6} = \frac{2}{3}$. Explain why the fractions are equivalent. e.g., using a visual fraction model.
NY-3.NF.3c Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. e.g., Express 3 in the form $3 = \frac{3}{1}$, recognize that $\frac{6}{3} = 2$, and locate $\frac{4}{4}$ and 1 at the same point on a number line.
NY-3.NF.3d. Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons rely on the two fractions referring to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions. e.g., using a visual fraction model.

NY-3.G.2 Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.
e.g., Partition a shape into 4 parts with equal area, and describe the area of each part as $\frac{1}{4}$ of the area of the shape.

Fourth Grade

NY-4.NF.1 Explain why a fraction $\frac{a}{b}$ is equivalent to a fraction $\frac{a \times n}{b \times n}$ 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.
Note: Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

NY-4.NF.2 Compare two fractions with different numerators and different denominators. Recognize that comparisons are valid only when the two fractions refer to the same whole. e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as $\frac{1}{2}$. Record the results of comparisons with symbols >, =, or <, and justify the conclusions. e.g., using a visual fraction model.
Note: Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

NY-4.NF.3 Understand a fraction $\frac{a}{b}$ with a > 1 as a sum of fractions $\frac{1}{b}$ Note: $\frac{1}{b}$ refers to the unit fraction for $\frac{a}{b}$
NY-4.NF.3b 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 such as, but not limited to:
- 3/8 = 1/8 + 1/8 + ⅛

- 3/8 = 1/8 + 2/8
- $2\frac{1}{8}$= 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.

NY-4.NF.4a Understand a fraction $\frac{a}{b}$ as a multiple of $\frac{1}{b}$ e.g., Use a visual fraction model to represent $\frac{5}{4}$ as the product 5 × $\frac{1}{4}$, recording the conclusion with the equation $\frac{5}{4}$= 5 × $\frac{1}{4}$.

NY-4.NF.4b Understand a multiple of $\frac{a}{b}$ as a multiple of $\frac{1}{b}$, and use this understanding to multiply a whole number by a fraction.

e.g., Use a visual fraction model to express $3 \ x \ \frac{2}{5}$ as $6 \ x \ \frac{1}{5}$, recognizing this product as $\frac{6}{5}$, in general, n × $\frac{a}{b}$= $\frac{(n \ x \ a)}{b}$.

NY-4.NF.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. e.g., express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.
Notes:
- Students who can generate equivalent fractions can develop strategies for adding fractions with unlike denominators in general. But addition and subtraction with unlike denominators in general is not a requirement at this grade.
- Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

7th Grade

NY-7.NS.2d Convert a fraction to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats

8th Grade

NY-8.NS.1 Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion eventually repeats. Know that other numbers that are not rational are called irrational.

Four Operations

Whole Numbers

NY-K.OA.1 Represent addition and subtraction using objects, fingers, pennies, drawings, sounds, acting out situations, verbal explanations, expressions, equations or other strategies.
Note: Drawings need not show details, but should show the mathematics in the problem.

NY-K.OA.2a Add and subtract within 10.
NY-K.OA.2b Solve addition and subtraction word problems within 10. e.g., using objects or drawings to represent the problem.

NY-K.OA.3 Decompose numbers less than or equal to 10 into pairs in more than one way. Record each decomposition by a drawing or equation. e.g., using objects or drawings.

NY-K.OA.4 Find the number that makes 10 when given a number from 1 to 9. Record the answer with a drawing or equation. e.g., using objects or drawings.

NY-K.OA.5 Fluently add and subtract within 5. Note: Fluency involves a mixture of just knowing some answers, knowing some answers from patterns, and knowing some answers from the use of strategies.

First Grade

Whole Numbers

NY-1.OA.1 Use addition and subtraction within 20 to solve one-step word problems involving situations of adding to, taking from, putting together, taking apart, and/or comparing, with unknowns in all positions. Note: Problems should be represented using objects, drawings, and equations with a symbol for the unknown number. Problems should be solved using objects or drawings, and equations

NY-1.OA.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.

NY-1.OA.3 Apply properties of operations as strategies to add and subtract. e.g.,
- 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.)
Note: Students need not use formal terms for these properties.

NY-1.OA.4 Understand subtraction as an unknown addend problem within 20. e.g., subtract 10 – 8 by finding the number that makes 10 when added to 8.

NY-1.OA.5 Relate counting to addition and subtraction. e.g., by counting on 2 to add 2

NY-1.OA.6a Add and subtract within 20. Use strategies such as:
- counting on;
- making ten;
- decomposing a number leading to a ten;
- using the relationship between addition and subtraction; and
- creating equivalent but easier or known sums.
NY-1.OA.6b Fluently add and subtract within 10. Note: Fluency involves a mixture of just knowing some answers, knowing some answers from patterns, and knowing some answers from the use of strategies.

NY-1.NBT.4 Add within 100, including:
- a two-digit number and a one-digit number;
- a two-digit number and a multiple of 10. Use concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones, and sometimes it is necessary to compose a ten. Relate the strategy to a written representation and explain the reasoning used.
Notes: Students should be taught to use strategies based on place value, properties of operations, and the relationship between addition and subtraction; however, when solving any problem, students can choose any strategy. A written representation is any way of representing a strategy using words, pictures, or numbers.

NY-1.NBT.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.

NY-1.NBT.6 Subtract multiples of 10 from multiples of 10 in the range 10-90 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 used to a written representation and explain the reasoning.

Notes: Students should be taught to use concrete models and drawings; as well as strategies based on place value, properties of operations, and the relationship between addition and subtraction. When solving any problem, students can choose to use a concrete model or a drawing. Their strategy must be based on place value, properties of operations, or the relationship between addition and subtraction. A written representation is any way of representing a strategy using words, pictures, or numbers.

Second Grade

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

NY-2.OA.2a Fluently add and subtract within 20 using mental strategies. Strategies could include:
- counting on;
- making ten;
- decomposing a number leading to a ten;
- using the relationship between addition and subtraction; and
- creating equivalent but easier or known sums.

Note: Fluency involves a mixture of just knowing some answers, knowing some answers from patterns, and knowing some answers from the use of strategies.
NY-2.OA.2b Know from memory all sums within 20 of two one-digit numbers.

NY-2.NBT.5 Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
Notes: Students should be taught to use strategies based on place value, properties of operations, and the relationship between addition and subtraction; however, when solving any problem, students can choose any strategy. Fluency involves a mixture of just knowing some answers, knowing some answers from patterns, and knowing some answers from the use of strategies

NY-2.NBT.6 Add up to four two-digit numbers using strategies based on place value and properties of operations.

NY-2.NBT.7a 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 representation.

Notes: Students should be taught to use concrete models and drawings; as well as strategies based on place value, properties of operations, and the relationship between addition and subtraction. When solving any problem, students can choose to use a concrete model or a drawing. Their strategy must be based on place value, properties of operations, and/or the relationship between addition and subtraction. A written representation is any way of representing a strategy using words, pictures, or numbers.
NY-2.NBT.7b Understand that in adding or subtracting up to 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.

NY-2.NBT.8 Mentally add 10 or 100 to a given number 100-900, and mentally subtract 10 or 100 from a given number 100-900.

NY-2.NBT.9 Explain why addition and subtraction strategies work, using place value and the properties of operations.
Note: Explanations may be supported by drawings or objects.

NY-2.MD.6 Represent whole numbers as lengths from 0 on a number line with equally spaced points corresponding to the numbers 0, 1, 2, …, and represent whole-number sums and differences within 100 on a number line.

Third Grade

NY-3.OA.1 Interpret products of whole numbers. e.g., Interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each. Describe a context in which a total number of objects can be expressed as 5 × 7

NY-3.OA.2 Interpret whole-number quotients of whole numbers. e.g., Interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. Describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8.

NY-3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities. e.g., using drawings and equations with a symbol for the unknown number to represent the problem.

NY-3.OA.5 Apply properties of operations as strategies to multiply and divide. e.g.,

- 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)

Note: Students need not use formal terms for these properties. Note: A variety of representations can be used when applying the properties of operations, which may or may not include parentheses.

NY-3.OA.7a Fluently solve single-digit multiplication and related divisions, using strategies such as the relationship between multiplication and division or properties of operations. e.g., Knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8.
NY-3.OA.7b Know from memory all products of two one-digit numbers. Note: Fluency involves a mixture of just knowing some answers, knowing some answers from patterns, and knowing some answers from the use of strategies.

NY-3.OA.8 Solve two-step word problems posed with whole numbers and having whole-number answers using the four operations.
NY-3.OA.8a Represent these problems using equations or expressions with a letter standing for the unknown quantity.
NY-3.OA.8b Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
Note: Two-step problems need not be represented by a single expression or equation.

NY-3.NBT.2 Fluently add and subtract within 1,000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. Note: Students should be taught to use strategies and algorithms based on place value, properties of operations, and the relationship between addition and subtraction; however, when solving any problem, students can choose any strategy. Note: A range of algorithms may be used.

NY-3.NBT.3 Multiply one-digit whole numbers by multiples of 10 in the range 10-90 using strategies based on place value and properties of operations. e.g., 9 × 80, 5 × 60

Fractions
NY-3.NF.1 Understand a **unit fraction**, $\frac{1}{b}$, is the quantity formed by 1 part when a whole is partitioned into b equal parts. Understand a fraction $\frac{a}{b}$ is the quantity formed by a parts of size $\frac{1}{b}$.
Note: Fractions are limited to those with denominators 2, 3, 4, 6, and 8.

NY-3.NF.2 Understand a fraction as a number on the number line; represent fractions on a number line.
Note: Fractions are limited to those with denominators 2, 3, 4, 6, and 8.
NY-3.NF.2a Represent a fraction $\frac{1}{b}$ on a number line by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size $\frac{1}{b}$ and that the endpoint of the part starting at 0 locates the number $\frac{1}{b}$ on the number line.
NY-3.NF.2b Represent a fraction $\frac{a}{b}$ on a number line by marking off a lengths $\frac{1}{b}$ from 0. Recognize that the resulting interval has size $\frac{a}{b}$ and that its endpoint locates the number $\frac{a}{b}$ on the number line.

NY-3.NF.3 Explain equivalence of fractions and compare fractions by reasoning about their size.
Note: Fractions are limited to those with denominators 2, 3, 4, 6, and 8.
NY-3.NF.3a Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.
NY-3.NF.3b Recognize and generate equivalent fractions. e.g., $\frac{1}{2} = \frac{2}{4}$; $\frac{4}{6} = \frac{2}{3}$ Explain why the fractions are equivalent. e.g., using a visual fraction model.
NY-3.NF.3c Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers.
e.g., Express 3 in the form $3 = \frac{3}{1}$, recognize that $\frac{6}{3} = 2$, and locate $\frac{4}{4}$ and 1 at the same point on a number line.

Fourth Grade

Whole Numbers
NY-4.OA.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted.
NY-4.OA.3a Represent these problems using equations or expressions with a letter standing for the unknown quantity.
NY-4.OA.3b Assess the reasonableness of answers using mental computation and estimation strategies including rounding. Note: Multi-step problems need not be represented by a single expression or equation.

NY-4.OA.4 Find all factor pairs for a whole number in the range 1-100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1-100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1-100 is prime or composite.

NY-4.NBT.4 Fluently add and subtract multi-digit whole numbers using a standard algorithm. Note: Grade 4 expectations are limited to whole numbers less than or equal to 1,000,000.

NY-4.NBT.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. Note on and/or: Students should be taught to use equations, rectangular arrays, and area models; however, when illustrating and explaining any calculation, students can choose any strategy. Note: Grade 4 expectations are limited to whole numbers less than or equal to 1,000,000.

NY-4.NBT.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. Notes on and/or: Students should be taught to use strategies based on place value, the properties of operations, and the relationship between multiplication and division; however, when solving any problem, students can choose any strategy. Students should be taught to use equations, rectangular arrays, and area models; however, when illustrating and explaining any calculation, students can choose any strategy. Note: Grade 4 expectations are limited to whole numbers less than or equal to 1,000,000.

Fractions
NY-4.NF.1 Explain why a fraction $\frac{a}{b}$ is equivalent to a fraction $\frac{a \times n}{b \times n}$ 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.
<u>Note:</u> Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

NY-4.NF.3 Understand a fraction $\frac{a}{b}$ with a > 1 as a sum of fractions $\frac{1}{b}$ Note: $\frac{1}{b}$ refers to the unit fraction for $\frac{a}{b}$
NY-4.NF.3a Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
NY-4.NF.3b 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 such as, but not limited to:
- 3/8 = 1/8 + 1/8 + ⅛
- 3/8 = 1/8 + 2/8
- $2\frac{1}{8}$ = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.

NY-4.NF.3c Add and subtract mixed numbers with like denominators. e.g., replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.
NY-4.NF.3d Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators. e.g., using visual fraction models and equations to represent the problem.
<u>Note:</u> Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10,12, and 100.

NY-4.NF.4 Apply and extend previous understandings of multiplication to multiply a whole number by a fraction.
<u>Note:</u> This standard refers to n groups of a fraction (where n is a whole number), e.g., 4 groups of $\frac{1}{3}$; which lends itself to being thought about as repeated addition. In grade 5 (NY-5. NF.4) students will be multiplying a fraction by a whole number, e.g., $\frac{1}{3}$ of 4.
NY-4.NF.4a Understand a fraction $\frac{a}{b}$ as a multiple of $\frac{1}{b}$ e.g., Use a visual fraction model to represent $\frac{5}{4}$ as the product $5 \times \frac{1}{4}$, recording the conclusion with the equation $\frac{5}{4}$= $5 \times \frac{1}{4}$.
NY-4.NF.4b Understand a multiple of $\frac{a}{b}$ as a multiple of $\frac{1}{b}$, and use this understanding to multiply a whole number by a fraction.
e.g., Use a visual fraction model to express $3 x \frac{2}{5}$ as $6 x \frac{1}{5}$, recognizing this product as $\frac{6}{5}$, in general, n × $\frac{a}{b}$= $\frac{(n \times a)}{b}$.
NY-4.NF.4c Solve word problems involving multiplication of a whole number by a fraction. e.g., using visual fraction models and equations to represent the problem. e.g., If each person at a party will eat ⅜ 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?
<u>Note:</u> Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

Decimals
NY-4.NF.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. e.g., express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.
<u>Notes:</u>
- Students who can generate equivalent fractions can develop strategies for adding fractions with unlike denominators in general. But addition and subtraction with unlike denominators in general is not a requirement at this grade.
- Grade 4 expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

<u>5th Grade</u>

Whole Numbers
NY-5.NBT.5 Fluently multiply multi-digit whole numbers using a standard algorithm.

NY-5.NBT.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. Notes on and/or: • Students should be taught to use strategies based on place value, the properties of operations, and the relationship between multiplication and division; however, when solving any problem, students can choose any strategy. • Students should be taught to use equations, rectangular arrays, and area models; however, when illustrating and explaining any calculation, students can choose any strategy.

Fractions

NY-5.NF.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.

e.g.,

- $\frac{1}{3} + \frac{2}{9} = \frac{3}{9} + \frac{2}{9} = \frac{5}{9}$
- $\frac{2}{3} + \frac{5}{4} = \frac{8}{12} + \frac{15}{12} = \frac{23}{12}$

NY-5.NF.2 Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators. e.g., 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.

e.g., Recognize an incorrect result $\frac{2}{5} + \frac{1}{2} = \frac{3}{7}$ by observing that $\frac{3}{7} < \frac{1}{2}$.

NY-5.NF.3 Interpret a fraction as division of the numerator by the denominator ($\frac{a}{b} = a \div b$).

e.g., Interpret $\frac{3}{4}$ as the result of dividing 3 by 4, noting that $\frac{3}{4}$ multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size $\frac{3}{4}$.

Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers.
e.g., using visual fraction models or equations to represent the problem.
e.g., 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?

NY-5.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction

NY-5.NF.6 Solve real world problems involving multiplication of fractions and mixed numbers.

NY-5.NF.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.
NY-5.NF.7a Interpret division of a unit fraction by a non-zero whole number, and compute such quotients.
e.g., 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.
NY-5.NF.7b Interpret division of a whole number by a unit fraction, and compute such quotients.
e.g., 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.
NY-5.NF.7c Solve real-world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions. e.g., using visual fraction models and equations to represent the problem. e.g., How much chocolate will each person get if 3 people share 12 lb. of chocolate equally? How many 13-cup servings are in 2 cups of raisins?
Note: Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement until grade 6 (NY-6. NS.1).

Decimals
NY-5.NBT.7 Using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between operations:
- **add and subtract decimals to hundredths;**
- **multiply and divide decimals to hundredths. Relate the strategy to a written method and explain the reasoning used.**

Notes on and/or: Students should be taught to use concrete models and drawings; as well as strategies based on place value, properties of operations, and the relationship between operations. When solving any problem, students can choose to use a concrete model or a drawing. Their strategy must be based on place value, properties of operations, or the relationship between operations.
Note: Division problems are limited to those that allow for the use of concrete models or drawings, strategies based on properties of operations, and/or the relationship between operations (e.g., 0.25 ÷ 0.05). Problems should not be so complex as to require the use of an algorithm (e.g., 0.37 ÷ 0.05).

Rational Numbers/Negative Numbers
NY-5.G.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and

the coordinates correspond. e.g., x-axis and x-coordinate, y-axis and y-coordinate.

6th Grade

Whole Numbers
NY-6.NS.2 Fluently divide multi-digit numbers using a standard algorithm.

NY-6.NS.4 Find the greatest common factor of two whole numbers less than or equal to 100. 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 other than 1. Find the least common multiple of two whole numbers less than or equal to 12. e.g., Express 36 + 8 as 4 (9 + 2)

Fractions
NY-6.NS.1 Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions.
Note: Strategies may include but are not limited to the following: using visual fraction models, a standard algorithm, and equations to represent the problem. e.g., 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 .
e.g.,
- **How much chocolate will each person get if 3 people share 12 lb of chocolate equally?**
- **How many 34 cup servings are in 23 of a cup of yogurt?**
How wide is a rectangular strip of land with length 34 mi and area 12 square mi?

Decimals
NY-6.NS.3 Fluently add, subtract, multiply, and divide multi-digit decimals using a standard algorithm for each operation.

Rational Numbers/Negative Numbers
NY-6.NS.6 Understand a rational number as a point on the number line. Use number lines and coordinate axes to represent points on a number line and in the coordinate plane with negative number coordinates.

7th Grade

Rational Numbers/Negative Numbers/Fractions/Decimals
NY-7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers. Represent addition and subtraction on a horizontal or vertical number line.
NY-7.NS.1a Describe situations in which opposite quantities combine to make 0.
NY-7.NS.1b Understand addition of rational numbers; p + q is 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.
NY-7.NS.1c 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.
NY-7.NS.1d Apply properties of operations as strategies to add and subtract rational numbers

NY-7.NS.2 Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
NY-7.NS.2a 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.
NY-7.NS.2b 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 $-(\frac{p}{q}) = \frac{-p}{q} = \frac{p}{-q}$. Interpret quotients of rational numbers by describing real world contexts.
NY-7.NS.2c Apply properties of operations as strategies to multiply and divide rational numbers.
NY-7.NS.2d Convert a fraction to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.

NY-7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.

Note: Computations with rational numbers extend the rules for manipulating fractions to complex fractions limited to $\frac{\frac{a}{b}}{\frac{c}{d}}$ where a, b, c, and d are integers and b, c, and d ≠ 0.

NY-7.EE.3 Solve multi-step real-world 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. Assess the reasonableness of answers using mental computation and estimation strategies. e.g.,

- 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.

Algebra I

AI-N.RN.3 Use properties and operations to understand the different forms of rational and irrational numbers.
a.) Perform all four arithmetic operations and apply properties to generate equivalent forms of rational numbers and square roots.
Note: Tasks include rationalizing numerical denominators of the form $\Box/\sqrt{\Box}$ where a is an integer and b is a natural number.
b.) Categorize the sum or product of rational or irrational numbers.
- The sum and product of two rational numbers is rational.
- The sum of a rational number and an irrational number is irrational.
- The product of a nonzero rational number and an irrational number is irrational.
- The sum and product of two irrational numbers could be either rational or irrational.