

Math: Grade 5

I. Numbers and Number Sense

- A. Read and write numbers (in digits and words) up to the billions.
- B. Recognize place value up to the billions.
- C. Order and compare number to 999,999,999 using the signs $<$, $>$, and $=$.
- D. Write numbers in expanded form.
- E. Integers
 - i. Locate positive and negative integers on a number line.
 - ii. Compare integers using the symbols $<$, $>$, and $=$.
 - iii. Know the sum of an integer and its opposite is 0.
 - iv. Add and subtract positive and negative integers.
- F. Using a number line, locate positive and negative whole numbers.
- G. Round to the nearest ten; to the nearest hundred; to the nearest thousand; to the nearest hundred thousand.
- H. Exponents
 - i. Review perfect squares and square roots to 144; recognize the square root sign, $\sqrt{\quad}$
 - ii. Using the terms *squared* and *cubed* and *to the n th power*, read and evaluate numerical expressions with exponents.
 - iii. Identify the powers of ten up to 10^6 .
- I. Identify a set and the members of a set as indicated by $\{ \}$.
- J. Identify numbers under 100 as prime or composite.
- K. Identify prime factors of numbers to 100 and write exponential notation for multiple primes.
- L. Determine the greatest common factor (GCF) of given numbers.
- M. Determine the least common multiples (LCM) of given numbers.

II. Ratio and Percent

- A. Ratio
 - i. Determine and express simple ratios.
 - ii. Use ratio to complete a simple scale drawing.
 - iii. Ratio and rate: solve problems on speed as ratio using the formula $S=D/T$ (or $D = R \times T$)
- B. Percent
 - i. Recognize the percent sign (%) and under percent as “per hundred.”
 - ii. Find the given percent of a number.
 - iii. Express equivalences between fractions, decimals, and percents, and know common equivalences:
 - 1. $1/10 = 10\%$
 - 2. $1/4 = 25\%$
 - 3. $1/2 = 50\%$
 - 4. $3/4 = 75\%$

III. Fractions and Decimals

- A. Fractions
 - i. Determine the least common denominator (LCD) of fractions with unlike denominators.
 - ii. Recognize equivalent fractions (for example, $1/2 = 3/6$).

- iii. Put fractions in lowest terms.
- iv. Compare fractions with like and unlike denominators, using the signs $<$, $>$, and $=$.
- v. Identify the reciprocal of a given fraction; know that the product of a given number and its reciprocal = 1.
- vi. Add and subtract mixed numbers and fractions with like and unlike denominators.
- vii. Multiply and divide mixed numbers and fractions.
- viii. Round fractions to the nearest whole number.
- ix. Write fractions as decimals (e.g. $\frac{1}{4} = 0.25$).

B. Decimals

- i. Read, write, and order decimals to the nearest ten thousandth.
- ii. Write decimals in expanded form.
- iii. Read and write decimals on a number line.
- iv. Round decimals (and decimal quotients) to the nearest tenth; to the nearest hundredth; to the nearest thousandth.
- v. Estimate decimal sums, differences, and products by rounding.
- vi. Add and subtract decimals through ten-thousandths.
- vii. Multiply decimals: by 10, 100, and 1,000; by another decimal.
- viii. Divide decimals by whole numbers and decimals.

IV. Computation

A. Addition

- i. Commutative and associative properties: know the names and understand the properties.

B. Multiplication

- i. Commutative, associative, and distributive properties: know the names and understand the properties.
- ii. Multiply two factors of up to four digits each.
- iii. Write numbers in expanded form using multiplication.
- iv. Estimate a product.
- v. Solve word problems involving multiplication.

C. Division

- i. Understand multiplication and division as inverse operations.
- ii. Know what it means for one number to be “divisible” by another number.
- iii. Know that you cannot divide by 0; that any number divided by 1 = that number.
- iv. Estimate the quotient.
- v. Know how to move the decimal point when dividing by 10, 100, or 1,000.
- vi. Divide dividends up to four digits by one-digit, two-digit, and three-digit divisors.
- vii. Solve division problems with remainders; round a repeating decimal quotient.
- viii. Check division by multiplying (and adding remainder).

D. Solving Problems and Equations

- i. Solve word problems with multiple steps.
- ii. Solve problems with more than one operation.

V. Measurement

A. Review linear measurement, weight, and capacity (volume).

B. Review equivalences (e.g., 1 hr = 60min, 1 minute = 60 seconds, 1yd = 3ft, 1 dozen =12)

- C. Convert to common units in problems involving addition and subtraction of different units.
- D. Time: Solve problems on elapsed time; regroup when multiplying and dividing amounts of time.

VI. Geometry

- A. Identify and draw points, segments, rays, lines.
- B. Identify and draw lines: horizontal; vertical; perpendicular; parallel; intersecting.
- C. Measure the degrees in an angle, and know that:
 - i. Right angle = 90 degrees
 - ii. Acute angle = Less than 90 degrees
 - iii. Obtuse angle = Greater than 90 degrees
 - iv. Straight angle = 180 degrees
- D. Identify and construct different types of triangles: equilateral, right, isosceles.
- E. Know what it means for triangles to be congruent.
- F. Identify polygons:
 - i. Triangle
 - ii. Quadrilateral
 - iii. Pentagon
 - iv. Hexagon
 - v. Octagon
 - vi. Parallelogram
 - vii. Trapezoid
 - viii. Rhombus
 - ix. Rectangle
 - x. Square
- G. Know that regular polygons have sides of equal length and angles of equal measure.
- H. Circles
 - i. Identify radius (plural: radii) and diameter (radius = $\frac{1}{2}$ diameter).
 - ii. Using a compass, draw circles with a given diameter or radius.
 - iii. Find the circumference of a circle using the formula $C = \pi d$, and $C = 2\pi r$, using 3.14 as the value of π .
- I. Area
 - i. Review the formula for the area of a rectangle (Area=length x width) and solve problems involving finding area in a variety of square units.
 - ii. Find the area of triangles, using the formula $A = \frac{1}{2}(bh)$.
 - iii. Find the area of a parallelogram using the formula $A=bh$.
 - iv. Find the area of an irregular figure (such as a trapezoid) by dividing into regular figures which you know how to find the area.
 - v. Compute volume of rectangular prisms in cubic units using the formula $V=lwh$.
 - vi. Find the surface area of a rectangular prism.

VII. Probability and Statistics

- A. Understand probability as a a measure of the likelihood that an event will happen; using simple models, express probability of a given event as a fraction, as a percent, and as a decimal between 0 and 1.
- B. Collect and organize data in graphic form (bar, line, and circle graphs).

- C. Solve problems requiring interpretation and application of graphically displayed data.
- D. Find the average (mean) of a given set of numbers.
- E. Plot points in a coordinate plane, using ordered pairs of positive and negative whole numbers.
- F. Graph simple functions.

VIII. Pre-Algebra

- A. Recognize variables and solve basic equations using variables.
- B. Write and solve equations for word problems.
- C. Find the value of an expression given the replacement values for the variables, for example: What is $7 - c$ if c is 3.5?

Grade 6 Mathematics:

I. NUMBERS AND NUMBER SENSE

- Read and write numbers (in digits and words) up to the trillions.
- Recognize place value up to hundred-billions.
- Integers (review):
 - Locate positive and negative integers on a number line.
 - Compare integers using $, =$.
 - Know that the sum of an integer and its opposite is 0.
 - Add and subtract positive and negative integers.
- Determine whether a number is a prime number or composite number.
- Round to the nearest ten; to the nearest hundred; to the nearest thousand; to the nearest hundred thousand; to the nearest million.
- Compare and order whole numbers, mixed numbers, fractions, and decimals, using the symbols $, =$.
- Determine the greatest common factor (GCF) of given numbers.
- Determine the least common multiple (LCM) of given numbers.
- Exponents:
 - Review squares and square roots.
 - Using the terms squared and cubed and to the nth power, read and evaluate numerical expressions with exponents.
 - Review powers of ten.
 - Write numbers in expanded notation using exponents.

II. RATIO, PERCENT, AND PROPORTION

A. Ratio and proportion

- Solve proportions, including word problems involving proportions with one unknown.
- Use ratios and proportions to interpret map scales and scale drawings.
- Set up and solve proportions from similar triangles.
- Understand the justification for solving proportions by cross-multiplication.

B. Percent

- Convert between fractions, decimals, and percents.
- Find the given percent of a number, and find what percent a given number is of another number.
- Solve problems involving percent increase and decrease.
- Find an unknown number when a percent of the number is known.
- Use expressions with percents greater than 100% and less than 1%.

III. COMPUTATION

A. ADDITION

- Addition, commutative and associative properties: know the names and understand the properties.
 - Understand addition and subtraction as inverse operations.
 - Add and subtract with integers, fractions and decimals, both positive and negative.

B. MULTIPLICATION

- Commutative, associative, and distributive properties: know the names and understand the properties.
- Multiply multi-digit factors, with and without a calculator.
- Estimate a product.
- Multiply with integers, fractions, and decimals, both positive and negative.
- Distributive property for multiplication over addition or subtraction, that is, $A \times (B+C)$ or $A \times (B-C)$: understand its use in procedures such as multi-digit multiplication.

C. DIVISION

- Understand multiplication and division as inverse operations.
- Estimate the quotient.
- Divide multi-digit dividends by up to three-digit divisors, with and without a calculator.
- Divide with integers, fractions, or decimals, both positive and negative.

D. SOLVING PROBLEMS AND EQUATIONS

- Solve word problems with multiple steps.
- Solve problems with more than one operation, according to order of operations (with and without a calculator).

IV. MEASUREMENT

- Solve problems requiring conversion of units within the U. S. Customary System, and within the metric system.

- Associate prefixes used in metric system with quantities:

kilo = thousand

hecto = hundred

deka = ten

deci = tenth

centi = hundredth

milli = thousandth

- Time: solve problems on elapsed time; express parts of an hour in fraction or decimal form.

V. GEOMETRY

- Identify and use signs that mean congruent \cong

similar \sim

parallel \parallel

perpendicular \perp

- Construct parallel lines and a parallelogram.

- Construct a perpendicular bisector.

- Know that if two lines are parallel, any line perpendicular to one is also perpendicular to the other; and, that two lines perpendicular to the same line are parallel. 166

- Angles:

Identify and measure the degrees in angles (review terms: right, acute, obtuse, straight).

Bisect an angle.

Construct an angle congruent to a given angle.

Construct a figure congruent to a given figure, using reflection over a line of symmetry, and identify corresponding parts.

Show how congruent plane figures can be made to correspond through reflection, rotation, and translation.

• Triangles:

Know that the sum of the measures of the angles of a triangle is 180° .

Construct different kinds of triangles.

Know terms by which we classify kinds of triangles: by length of sides: equilateral, isosceles, scalene by angles: right, acute, obtuse

• Identify congruent angles and sides, and axes of symmetry, in parallelograms, rhombuses, rectangles, and squares.

• Find the area (A) and perimeter (P) of plane figures, or given the area or perimeter find the missing dimension, using the following formulas:

rectangle

$$A = lw$$

$$P = 2(l + w)$$

square

$$A = s^2$$

$$P = 4s$$

triangle

$$A = \frac{1}{2}bh$$

$$P = s_1 + s_2 + s_3$$

parallelogram

$$A = bh$$

$$P = 2(b + s)$$

• Circles:

Identify arc, chord, radius (plural: radii), and diameter; know that radius = $\frac{1}{2}$ diameter.

Using a compass, draw circles with a given diameter or radius.

Solve problems involving application of the formulas for finding the circumference of a circle: $C = \pi d$, and $C = 2\pi r$, using 3.14 as the value of pi.

Find the area of a circle using the formula $A = \pi r^2$

• Find volume of rectangular solids, or given the volume find a missing dimension, using the formulas $V = lwh$, or $V = bh$ (in which b = area of base).

VI. PROBABILITY AND STATISTICS

• Find the range and measures of central tendency (mean, median, and mode) of a given set of numbers.

• Understand the differences among the measures of central tendency and when each might be used.

• Understand the use of a sample to estimate a population parameter (such as the mean), and that larger samples provide more stable estimates.

• Represent all possible outcomes of independent compound events in an organized way and determine the theoretical probability of each outcome.

• Compute the probability of any one of a set of disjoint events as the sum of their individual probabilities.

• Solve problems requiring interpretation and application of graphically displayed data.

• Given a set of data, find the mean, median, range, and mode.

• Construct a histogram; a tree diagram.

• Coordinate plane: Plot points on a coordinate plane, using ordered pairs of positive and negative whole numbers. Use the terms origin (0,0), x-axis, and, y-axis. Graph simple functions and solve problems involving use of a coordinate plane.

VII. Pre-Algebra

• Recognize uses of variables and solve linear equations in one variable.

• Solve word problems by assigning variables to unknown quantities, writing appropriate equations, and solving them.

- Find the value for an expression, given replacement values for the variables; for example, what is $7/x - y$ when x is 2 and y is 10?
- Simplify expressions with variables by combining like terms.
- Understand the use of the distributive property in variable expressions such as $2x(2y + 3)$.

7th Mathematics:

I. Pre-Algebra

A. Properties of The Real Numbers

- Know and use the associative, commutative, and distributive properties by name and in simplifying expressions involving numbers and variables.
- Understand absolute value and evaluate expressions such as $|2x - 3| + 3x$.

B. Linear Applications and Proportionality

- Know the concept of slope.
- Translate situations of proportionality into equations of the form $y = mx$, where m is the constant of proportionality or slope; specifically know and understand $d = rt$ and $i = prt$.
- Show situations of constant proportionality as a line on the coordinate plane.
- Introduce the concept of a function and determine the equation of a linear function given its slope and intercepts in the form $y = mx + b$.
- Estimate the values of b and m from a given linear graph.

C. Polynomial Arithmetic

- Add, subtract, multiply, and divide monomials and polynomials (divide polynomials by monomials only).
- Factor binomials that have a common monomial factor.

D. Equivalent Equations and Inequalities

- Review equality properties for equations.
- Know that addition or subtraction of the same value from both sides of an inequality maintains the inequality.
- Know that multiplying or dividing both sides of an inequality by a positive number maintains the inequality, but multiplying or dividing by a negative number reverses the inequality; show why using a number line.
- Simplify and solve linear equations in one variable such as $3(2x - 5) + 4x = 12(x + 5)$.
- Simplify and graph solutions to linear inequalities in one variable such as $3(2x - 5) + 4x \leq 12(x + 5)$.

E. Integer Exponents

- Know the meaning of an exponent n when n is positive or negative.
- Know that a non-zero number to the zero power is one.
- Understand why a negative number to an even power is positive and a negative number to odd power is negative.
- Know the multiplication properties of exponents:
 - Product of powers: $(a^m)(a^n) = a^{(m+n)}$
 - Power of a power: $(a^m)^n = a^{mn}$
 - Power of a product: $(ab)^m = (a^m)(b^m)$.
- Convert decimal numbers to and from scientific notation.
- Know the proper order of operations with exponents.

II. Geometry

A. Three-Dimensional Objects

- Describe and construct simple right prisms, cylinders, cones, and spheres using the concepts of parallel and perpendicular; calculate the surface areas and volumes of these objects.
- Know that the section created by the intersection of a plane and a sphere is a circle.
- Calculate the surface area of a sphere using the equation $SA = 4\pi r^2$.
- Calculate the volume of a sphere using the equation $V = \frac{4}{3}\pi r^3$.

B. Angle Pairs

- Construct parallel lines and a transversal using a compass and straight edge.
- Understand congruent angles, vertical angles, complementary angles, supplementary angles, adjacent angles, corresponding angles, and alternate interior and alternate exterior angles.

C. Triangles

- Know that a triangle is determined by its three sides or by two sides and the included angle (SSS and SAS triangle congruence) and solve problems.
- Use SSS to prove that the construction of the bisector of an angle is valid.
- Use SSS to prove that the construction of the perpendicular bisector of a segment is valid.
- Prove that the base angles of an isosceles triangle are congruent.
- Demonstrate that the sum of the interior angles of a triangle equals 180 degrees.
- Know that the shape of a triangle is determined by two (hence all three) of its angles (AA(A) triangle similarity) and solve related problems.
- Construct a circle that circumscribes a triangle using compass and straight edge.
- Know and understand the Pythagorean Theorem and its converse and use it to find the length of the missing side of a right triangle and lengths of other line segments and, in some situations, empirically verify the Pythagorean theorem by direct measurement and a calculator.
- Use the Pythagorean Theorem to determine the exact ratios of the sides in 30-60-right triangles and isosceles right triangles.
- Determine the image of a triangle under translations, rotations, and reflections.

D. Measurement

- Choose appropriate units of measure and use ratios to convert within and between measurement systems to solve problems.
- Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (for example, miles per hour and feet per second, cubic inches to cubic centimeters).
- Use measures expressed as rates (for example, speed, density) and measures expressed as products (for example, person-days) to solve problems; check the units of the solutions; and use dimensional analysis to check the reasonableness of the answer.
- Compute the perimeter, area, and volume of common geometric objects and use the results to find measures of less common objects.
- Know how perimeter, area, and volume are affected by changes of scale.
- Estimate and compute the area of more complex or irregular two- and three-dimensional figures by breaking the figures down into more basic geometric objects.
- Relate the changes in measurement with a change of scale to the units used (for example, square inches, cubic feet) and to conversions between units (1 square foot = 144 square inches of [1 ft² = 144 in²], 1 cubic inch is approximately 16.38 cubic centimeters [1 in³ = [16.36 cm³]).

III. Probability and Statistics

- Show the relationship between two variables using a scatter-plot and describe the apparent relationship informally.
- Find the upper and lower quartiles for a data set.
- Understand that if p is the probability of an event occurring, $1 - p$ is the probability of the event not occurring.
- Understand the difference between independent and dependent events.

8th Mathematics:

I. Algebra

A. Properties of The Real Numbers

- Raise a positive number to a fractional power and simplify appropriately, including rationalizing the denominator of a simple radical expression.
- Know and use of the rules of exponents extended to fractional exponents.
- Use the definition of absolute value to solve equations such as $|2x - 3| + 3x = 4x - 2$ and understand why “extraneous solutions” are not solutions at all.

B. Relations, Functions, and Graphs (Two Variables)

- Plot a set of ordered pairs and surmise a reasonable graph of which the points are a part.
- Make a reasonable table of ordered pairs from a given function rule, plot the points, and surmise its graph.
- Know that the points of intersections of two graphs are simultaneous solutions of the relations that define them and indicate approximate numerical solutions.

C. Linear Equations and Functions (Two Variables)

- Graph linear equations by finding the x- and y-intercepts; for example, know that $2x + 3y = 4$ is linear and graph it using its intercepts.
- Convert between slope-intercept form ($y = mx + b$) and standard form ($ax + by = c$).
- Write an equation for a line given two points or one point and its slope.
- Know lines are parallel or perpendicular from their slopes.
- Find the equation of a line perpendicular to a given line that passes through a given point.
- Understand and graph the solution set of a linear inequality.
- Solve a system of two linear equations in two variables algebraically and interpret the answer graphically.
- Solve a system of two linear inequalities in two variables and sketch the solution set.
- Solve word problems (including mixture, digit, and age problems) that involve linear equations.

D. Arithmetic of Rational Expression

- Factor second- and higher-degree polynomials when standard techniques apply, such as factoring the GCF out of all terms of a polynomial, the difference of two squares, and perfect squares trinomials.
- Add, subtract, multiply, and divide rational expressions and express in simplest form.

E. Quadratic Equations and Functions

- Solve quadratic equations in one variable by factoring or by completing the square.
- Complete the square to write a quadratic expression as the difference of two squares.
- Graph quadratic functions by completing the square to find the vertex and know that their zeros (roots) are the x-intercepts.
- Know the quadratic formula and be familiar with its proof by completing the square.
- Know how to clear fractions to solve equations that lead to linear or quadratic equations.
- Know how to use squaring to solve problems that lead to linear or quadratic equations.
- Solve word problems, including physical problems such as the motion of an object under the force of gravity, and combined rate (work) problems.

II. Geometry

A. Analytic Geometry

- reinforce the knowledge of algebra with geometry and vice versa.

- know that the midpoint of a line segment of any slope, projected perpendicularly onto the horizontal x-axis or vertical y-axis, will be the midpoint of its projection.
- know the similar triangles connection (aa similarity) with slope and that this is the tangent of the angle the line makes with the x-axis.

B. Introduction to Trigonometry

- Know that in a right triangle the cosine of an angle is the ratio of the adjacent side to the hypotenuse and the sine is the ratio of the opposite side to the hypotenuse.
- Know the values of the sine, cosine, and tangent of 0, 30, 45, 60, and 90 degrees and Use a scientific calculator to determine the approximate value of any acute angle.
- use a scientific calculator to determine the approximate value of an acute angle of a Given sine, cosine, or tangent.

A. Triangles and Proofs

- Prove that the bisector of an angle is the set of all points equidistant from both sides.
- Prove that any triangle inscribed in a circle with one side as the diameter is a right triangle.
- Prove the Pythagorean Theorem.
- Know that a line tangent to a circle is perpendicular to the radius at the point of tangency.
- Taking geometry as a model, understand the concept of a mathematical proof, as distinct from an opinion, an approximation, or a conjecture based on specific cases.
- In geometry and elsewhere, understand that a single-counter example suffices to disprove a general assertion.