Archdiocese of Washington Catholic Schools
Academic Standards
Mathematics

8th GRADE

Standard 1 - Number Sense

Students know the properties of rational* and irrational* numbers expressed in a variety of forms. They understand and use exponents*, powers, and roots.

8.1.1	Read, write, compare, and solve problems using decimals in scientific notation*. Example: Write 0.00357 in scientific notation.
8.1.2	Know that every rational number is either a terminating or repeating decimal and that every irrational number is a non-repeating decimal. Example: Recognize that 2.375 is a terminating decimal, 5.121212… is a repeating decimal, and that π = 3.14159265… is a non-repeating decimal. Name a rational number. Explain your reasoning.
8.1.3	Understand that computations with an irrational number and a rational number (other than zero) produce an irrational number. Example: Tell whether the product of 7 and π is rational or irrational. Explain how you know that your answer is correct.
8.1.4	Understand and evaluate negative integer* exponents. Example: Write 2^{-3} as a fraction.
8.1.5	Use the laws of exponents for integer exponents. Example: Write $2^2 \times 2^3$ as $2 \times 2 \times 2 \times 2 \times 2$ and then as a single power of 2. Explain what you are doing.
8.1.6	Use the inverse relationship between squaring and finding the square root of a perfect square integer. Example: Find the value of $(\sqrt{144})^2$.
8.1.7	Calculate and find approximations of square roots. Example: For an integer that is not a perfect square, find the two integers (one larger, one smaller) that are closest to its square root and explain your reasoning.

rational number: a real number that can be written as a ratio of two integers (e.g., $\frac{1}{2}$, $\frac{5}{6}$, $\frac{23}{9}$)

*integers: …, -3, -2, -1, 0, 1, 2, 3, …

*irrational number: a real number that cannot be written as a ratio of two integers (e.g., π, $\sqrt{3}$, 7π)

*exponent: e.g., the exponent 4 in 3^4 tells you to write four 3s and compute $3 \leq 3 \leq 3 \leq 3$

*scientific notation: a shorthand way of writing numbers using powers of ten (e.g., 300,000 = 3×10^5)

Standard 2 - Computation

Students compute with rational numbers* expressed in a variety of forms. They solve problems involving ratios, proportions, and percentages.

8.2.1   Add, subtract, multiply, and divide rational numbers (integers*, fractions, and terminating decimals) in multi-step problems.

           Example: $-3.4 + 2.8 \times 5.75 = ?$, $1\frac{4}{5} + -\frac{3}{8} \times 2\frac{2}{9} = ?$, $81.04 \div 17.4 - 2.79 = ?$.

8.2.2   Solve problems by computing simple and compound interest.
           Example: You leave $100 in each of three bank accounts paying 5% interest per year. One account pays simple interest, one pays interest compounded annually, and the third pays interest compounded quarterly. Use a spreadsheet to find the amount of money in each account after one year, two years, three years, ten years, and twenty years. Compare the results in the three accounts and explain how compounding affects the balance in each account.

8.2.3   Use estimation techniques to decide whether answers to computations on a calculator are reasonable.
           Example: Your friend uses his calculator to find 15% of $25 and gets $375. Without solving, explain why you think the answer is wrong.

8.2.4   Use mental arithmetic to compute with common fractions, decimals, powers, and percents.
           Example: Find 20% of $50 without using pencil and paper.

       *   rational number: a real number that can be written as a ratio of two integers* (e.g., $\frac{1}{2}$, $\frac{5}{6}$, $\frac{23}{9}$)

       *   integers: …, -3, -2, -1, 0, 1, 2, 3, …

Standard 3 - Algebra and Functions

Students solve simple linear equations and inequalities. They interpret and evaluate expressions involving integer* powers. They graph and interpret functions. They understand the concepts of slope* and rate.

8.3.1   Write and solve linear equations and inequalities in one variable, interpret the solution or solutions in their context, and verify the reasonableness of the results.
Example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be least $100. Write an inequality for the number of sales you need to make, solve it, and check that your answer is reasonable.

8.3.2   Solve systems of two linear equations using the substitution method and identify approximate solutions graphically.
Example: Solve the system.
$$2x + 3y = 7$$
$$x + 2y = 5$$

8.3.3   Interpret positive integer powers as repeated multiplication and negative integer powers as repeated division or multiplication by the multiplicative inverse.
Example: Use a spreadsheet to explore the relationship between positive and negative integer powers by making a table of values of powers of 3, from 3^{-5} to 3^5.

8.3.4   Use the correct order of operations to find the values of algebraic expressions involving powers.
Example: Use a scientific calculator to find the value of $3(2x + 5)^2$ when $x = -35$.

8.3.5   Identify and graph linear functions and identify lines with positive and negative slope.
Example: Draw the graphs of $y = 2x – 1$, $y = 3x – 1$, $y = -2x – 1$, and $y = -3x – 1$. Find the slope of each graph. What do you notice?

8.3.6   Find the slope of a linear function given the equation and write the equation of a line given the slope and any point on the line.
Example: Write an equation of the line with slope 2 and y-intercept -4.

8.3.7   Demonstrate an understanding of rate as a measure of one quantity with respect to another quantity.
Example: A car moving at a constant speed travels 90 km in 2 hours, 135 km in 3 hours, 180 km in 4 hours, etc. Draw a graph of distance as a function of time and find the slope of the graph. Explain what the slope tells you about the movement of the car.

8.3.8   Demonstrate an understanding of the relationships among tables, equations, verbal expressions, and graphs of linear functions.
Example: Write an equation that represents the verbal description: "the perimeter of a square is four times the side length." Construct a table of values for this relationship and draw its graph.

**   REVISED 2010: Standards 8.3.9 and 8.3.10 dealing with quadratic functions were deleted. These skills are in the Grade 8 Algebra I standards.

8.3.11   Identify functions as linear or non-linear and examine their characteristics in tables, graphs, and equations. (Standard was previously 7.3.9)

* integers: …, -3, -2, -1, 0, 1, 2, 3, …
* slope: between any two points on a line, the slope is the change in vertical distance divided by the change in horizontal distance ("rise" over "run")

## Standard 4 - Geometry

Students deepen their understanding of plane and solid geometric shapes and properties by constructing shapes that meet given conditions, by identifying attributes of shapes, and by applying geometric concepts to solve problems.

8.4.1   Identify and describe basic properties of geometric shapes: altitudes*, diagonals, angle and perpendicular bisectors*, central angles*, radii, diameters, and chords*.
Example: Describe a central angle of a circle in words and draw a diagram.

8.4.2   Perform simple constructions, such as bisectors of segments and angles, copies of segments and angles, and perpendicular segments. Describe and justify the constructions.
Example: Explain the procedures used to construct the three angle bisectors of a triangle.

8.4.3   Identify properties of three-dimensional geometric objects (e.g., diagonals of rectangular solids) and describe how two or more figures intersect in a plane or in space.
Example: Find two lines in your classroom that are not parallel, yet do not meet.

8.4.4   Draw the translation (slide), rotation (turn), reflection (flip), and dilation (stretches and shrinks) of shapes.
Example: Draw a rectangle and slide it 3 inches horizontally across your page. Then rotate it clockwise through 90º about the bottom left vertex. Draw the new rectangle in a different color.

8.4.5   Use the Pythagorean Theorem and its converse to solve problems in two and three dimensions.
Example: Measure the dimensions of a shoe box and calculate the length of a diagonal from the top right to the bottom left of the box. Measure with a string to evaluate your solution.

*altitude: a line segment from the vertex of a triangle to meet the line containing the opposite side in a right angle (altitude is $\overline{BD}$ in triangle ABC)
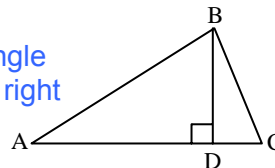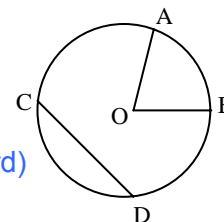
*perpendicular bisector: a line (or ray or line segment) at right angles to a given line segment that divides it in half ($\overleftrightarrow{CD}$ is the perpendicular bisector of $\overline{AB}$)
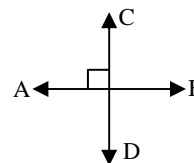
*central angle: the angle formed by joining two points on a circle to the center ($\angle$AOB is a central angle)

*chord: a line segment joining two points on a circle ($\overline{CD}$ is a chord)

Standard 5 - Measurement

Students convert between units of measure and use rates and scale factors to solve problems. They compute the perimeter, area, and volume of geometric objects. They investigate how perimeter, area, and volume are affected by changes of scale.

8.5.1   Convert common measurements for length, area, volume, weight, capacity, and time to equivalent measurements within the same system.
Example: The area of a hall is 40 square yards. What is the area in square feet?

8.5.2   Solve simple problems involving rates and derived measurements for attributes such as velocity and density.
Example: A car travels at 60 mph for 20 minutes. How far does it travel? What units are appropriate for distance? Explain your answer.

8.5.3   Solve problems involving scale factors, area, and volume using ratio and proportion.
Example: Calculate the volume and surface area of cubes with side 1 cm, 2 cm, 3 cm, etc. Make a table of your results and describe any patterns in the table.

8.5.4   Use formulas for finding the perimeter and area of basic two-dimensional shapes and the surface area and volume of basic three-dimensional shapes, including rectangles, parallelograms*, trapezoids*, triangles, circles, prisms*, cylinders, spheres, cones, and pyramids.
Example: Find the total surface area of a right triangular prism 14 feet high and with a base that measures 8 feet by 6 feet.

8.5.5   Estimate and compute the area of irregular two-dimensional shapes and the volume of irregular three-dimensional objects by breaking them down into more basic geometric objects.
Example: Find the volume of a dog house that has a rectangular space that is 3 ft by 2 ft by 5 ft and has a triangular roof that is 1.5 ft higher than the walls of the house.
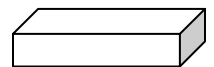
*parallelogram: a four-sided figure with both pairs of opposite sides parallel
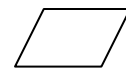
*trapezoid: a four-sided figure with one pair of opposite sides parallel

*prism: a solid shape with fixed cross-section (a right prism is a solid shape with two parallel faces that are congruent polygons and other faces that are rectangles)

Standard 6 - Data Analysis and Probability

Students collect, organize, represent, and interpret relationships in data sets that have one or more variables. They determine probabilities and use them to make predictions about events.

8.6.1   Identify claims based on statistical data and, in simple cases, evaluate the reasonableness of the claims. Design a study to investigate the claim.
Example: A study shows that teenagers who use a certain brand of toothpaste have fewer cavities than those using other brands. Describe how you can test this claim in your school.

8.6.2   Identify different methods of selecting samples, analyzing the strengths and weaknesses of each method, and the possible bias in a sample or display.
Example: Describe possible bias in the following survey: A local television station has a daily call-in poll. Viewers of the morning and noon newscasts are asked to call one telephone number to answer "yes" and a different telephone number to answer "no." The results are reported on the six-o'clock newscast.

8.6.3   Understand the meaning of, and be able to identify or compute the minimum value, the lower quartile*, the median*, the upper quartile*, the interquartile range, and the maximum value of a data set.
Example: Arrange a set of test scores in increasing order and find the lowest and highest scores, the median, and the upper and lower quartiles.

8.6.4   Analyze, interpret, and display single- and two-variable data in appropriate bar, line, and circle graphs; stem-and-leaf plots*; and box-and-whisker plots* and explain which types of display are appropriate for various data sets.
Example: The box-and-whisker plots below show winning times (hours:minutes) for the Indianapolis 500 race in selected years:

2:40	2:50	3:00	3:10	3:20	3:30	3:40	3:50	4:00	
									1981-1995
									1966-1980*
									1951-1965
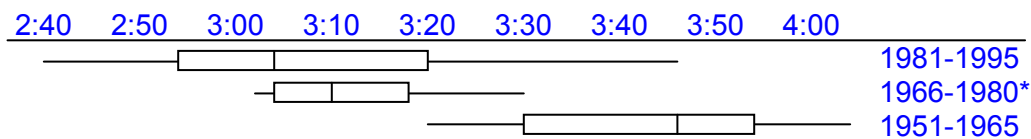
*Except 1967, 1973, 1975, and 1976.

In the years from 1951-1965, the slowest time was 3 h 57 min. Explain how the slowest time changed through the years 1951-1995. How did winning times change during that period? How did the median times change in the same period?

8.6.5   Represent two-variable data with a scatter plot* on the coordinate plane and describe how the data points are distributed. If the pattern appears to be linear, draw a line that appears to best fit the data and write the equation of that line.
Example: Survey some of the students at each grade level in your school, asking them how much time they spend on homework. Plot the grade level and time of each student as a point (grade, time) on a scatter diagram. Describe and justify any relationship between grade and time spent on homework.

8.6.6   Understand and recognize equally likely events.
Example: When you roll a number cube, what is the probability that the number on the top face will be a 6? Explain your answer.

8.6.7   Find the number of possible arrangements of several objects by using the Basic Counting Principle. Example: You are planning to place four pictures in a line on a shelf. Find the number of ways you can arrange the four pictures.

8.6.8   Describe the difference between combinations* and permutations* and their impact on the possible arrangements of several objects.

* lower quartile: the value that separates the lowest one-fourth of the values from the rest of the values

* median: the value that divides a set of data, written in order of size, into two equal parts

* upper quartile: the value that separates the highest one-fourth of the values from the rest of the values

* stem-and-leaf plot: e.g., this one shows 62, 63, 67, 71, 75, 75, 76, etc.

Stem	Leaf
6	2 3 7
7	1 5 5 6 8 9
8	0 1 1 2 3 5 5 7 8 8
9	1 2 2 3 3 4

* box-and-whisker plot: a diagram showing median, quartiles, and range (see diagram on previous page)

* scatter plot: a coordinate graph showing ordered pairs of data

* combinations: an unordered collection of distinct objects

* permutations: an ordered combination of objects

Standard 7 - Problem Solving

Students make decisions about how to approach problems and communicate their ideas.

8.7.1   Analyze problems by identifying relationships, telling relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.
Example: Solve the problem: "For computers, binary numbers are great because they are simple to work with and they use just two values of voltage, magnetism, or other signal. This makes hardware easier to design and more noise resistant. Binary numbers let you represent any amount you want using just two digits: 0 and 1. The number you get when you count ten objects is written 1010. In expanded notation, this is $1 \le 2^3 + 0 \le 2^2 + 1 \le 2^1 + 0 \le 2^0$. Write the number for thirteen in the binary (base 2) system." Decide to make an organized list.

8.7.2   Make and justify mathematical conjectures based on a general description of a mathematical question or problem.
Example: In the first example, if you have only two symbols, 0 and 1, then one object: 1, two objects: 10, three objects: 11, four objects: 100. Predict the symbol for five objects.

8.7.3   Decide when and how to divide a problem into simpler parts.
Example: In the first example, write expanded notation for the number five in base 2; begin with the fact that 5 = 4 + 1.

Students use strategies, skills, and concepts in finding and communicating solutions to problems.

8.7.4   Apply strategies and results from simpler problems to solve more complex problems.
Example: In the first example, write the first five numbers in base 2 notation and look for a pattern.

8.7.5   Make and test conjectures using inductive reasoning.
Example: In the first example, predict the base 2 notation for six objects, then use expanded notation to test your prediction.

8.7.6   Express solutions clearly and logically using the appropriate mathematical terms and notation. Support solutions with evidence in both verbal and symbolic work.
Example: In the first example, explain how you will find the base two notation for thirteen objects.

8.7.7   Recognize the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.
Example: Measure the length and width of a basketball court. Use the Pythagorean Theorem to calculate the length of a diagonal. How accurately should you give your answer?

8.7.8   Select and apply appropriate methods for estimating results of rational-number computations.
Example: Use a calculator to find the cube of 15. Check your answer by finding the cubes of 10 and 20.

8.7.9   Use graphing to estimate solutions and check the estimates with analytic approaches.
Example: Use a graphing calculator to draw the straight line $x + y = 10$. Use this to estimate solutions of the inequality $x + y > 10$ by testing points on each side of the line.

8.7.10   Make precise calculations and check the validity of the results in the context of the problem.
Example: In the first example, list the first thirteen numbers in base 2 notation. Use patterns or expanded notation to confirm your list.

Students determine when a solution is complete and reasonable and move beyond a particular problem by generalizing to other situations.

8.7.11   Decide whether a solution is reasonable in the context of the original situation.
Example: In the basketball court example, does the accuracy of your answer depend on your initial measuring?

8.7.12   Note the method of finding the solution and show a conceptual understanding of the method by solving similar problems.
Example: In the first example, use your list of base 2 numbers to add numbers in base 2. Explain exactly how your addition process works.