

8th Grade Math Proficiency Objectives

Strand One: Number Sense and Operations

Every student should understand and use all concepts and skills from the previous grade levels. The standards are designed so that new learning builds on preceding skills and are needed to learn new skills. Communication, Problem-Solving, Reasoning & Proof, Connections, and Representation are the process standards that are embedded throughout the teaching and learning of mathematical strands.

Concept 1: Number Sense

Understand and apply numbers, ways of representing numbers, the relationships among numbers, and different number systems.

- Compare and order real numbers including very large and small integers, and decimals and fractions close to zero.
- Classify real numbers as rational or irrational.
- Model the relationship between the subsets of the real number system.
- Model and solve problems involving absolute value.

Concept 2: Numerical Operations

Understand and apply numerical operations and their relationship to one another.

- Solve problems with factors, multiples, divisibility or remainders, prime numbers, and composite numbers.
- Describe the effect of multiplying and dividing a rational number by
 - a number less than zero,
 - a number between zero and one,
 - one, and
 - a number greater than one.*
- Solve problems involving percent increase, percent decrease, and simple interest rates.
- Convert standard notation to scientific notation and vice versa (include positive and negative exponents).
- Simplify numerical expressions using the order of operations that include grouping symbols, square roots, cube roots, absolute values, and positive exponents.

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Concept 3: Estimation

Use estimation strategies reasonably and fluently while integrating content from each of the other strands.

- Make estimates appropriate to a given situation.
- Estimate the location of rational and common irrational numbers on a number line.

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Strand Two: Data Analysis, Probability, and Discrete Math

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Concept 1: Data Analysis (Statistics)

Identify patterns and apply pattern recognition to reason mathematically. Students begin with simple repetitive patterns of many iterations. This is the beginning of recursive thinking. Later, students can study sequences that can best be defined using recursion.

- Solve problems by selecting, constructing, interpreting, and calculating with displays of data, including box and whisker plots and scatterplots.
- Make inferences by comparing the same summary statistic for two or more data sets.
- Describe how summary statistics relate to the shape of the distribution.
- Determine whether information is represented effectively and appropriately given a graph or a set of data by identifying sources of bias and compare and contrast the effectiveness of different representations of data.
- Evaluate the design of an experiment.

Concept 2: Probability

Understand and apply the basic concepts of probability. This is the field of mathematics that deals with the likelihood that an event will occur expressed as the ratio of the number of favorable outcomes in the set of outcomes to the total number of possible outcomes.

- Determine theoretical and experimental conditional probabilities in compound probability experiments.
- Interpret probabilities within a given context and compare the outcome of an experiment to predictions made prior to performing the experiment.
- Use all possible outcomes (sample space) to determine the probability of dependent and independent events.

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Concept 3: Discrete Math – Systematic Listing and Counting

Understand and demonstrate the systematic listing and counting of possible outcomes. This field of mathematics is generally referred to as Combinatorics.

- Represent, analyze, and solve counting problems with or without ordering and repetitions.
- Solve counting problems and represent counting principles algebraically including factorial notation.

Concept 4: Vertex-Edge Graphs

Understand and apply the concepts of vertex-edge graphs and networks. This field connects graph theory with practical problems.

- Use directed graphs to solve problems.

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Strand Three: Patterns, Algebra, and Functions

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Concept 1: Patterns

Identify patterns and apply pattern recognition to reason mathematically. Students begin with simple repetitive patterns of many iterations. This is the beginning of recursive thinking. Later, students can study sequences that can best be defined using recursion.

- Recognize, describe, create, and analyze numerical and geometric sequences using tables, graphs, words, or symbols; make conjectures about these sequences.

Concept 2: Functions and Relationships

Describe and model functions and their relationships. For example, distribution and communication networks, laws of physics, population models, and statistical results can all be represented in the symbolic language of algebra.

- Sketch and interpret a graph that models a given context; describe a context that is modeled by a given graph.
- Determine if a relationship represented by a graph or table is a function.
- Write the rule for a simple function using algebraic notation.
- Identify functions as linear or nonlinear and contrast distinguishing properties of functions using equations, graphs, or tables.
- Demonstrate that proportional relationships are linear using equations, graphs, or tables.

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Concept 3: Algebraic Representations

Represent and analyze mathematical situations and structures using algebraic representations. Algebraic representation is about abstract structures and about using the principles of those structures in solving problems expressed with symbols.

- Write or identify algebraic expressions, equations, or inequalities that represent a situation.
- Evaluate an expression containing variables by substituting rational numbers for the variables.
- Analyze situations, simplify, and solve problems involving linear equations and inequalities using the properties of the real number system.
- Translate between different representations of linear equations using symbols, graphs, tables, or written descriptions.
- Graph an inequality on a number line.

Concept 4: Analysis of Change

Analyze how changing the values of one quantity corresponds to change in the values of another quantity.

- Interpret the relationship between a linear equation and its graph, identifying and computing slope and intercepts.
- Solve problems involving simple rates.

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Strand Four: Geometry and Measurement

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Concept 1: Geometric Properties

Analyze the attributes and properties of two- and three-dimensional figures and develop mathematical arguments about their relationships (in conjunction with strand 5, concept 2).

- Identify the attributes of circles: radius, diameter, chords, tangents, secants, inscribed angles, central angles, intercepted arcs, circumference, and area.
- Predict results of combining, subdividing, and changing shapes of plane figures and solids.
- Use proportional reasoning to determine congruence and similarity of triangles.
- Use the Pythagorean Theorem to solve problems.

Concept 2: Transformation of Shapes

Apply spatial reasoning to create transformations and use symmetry to analyze mathematical situations.

- Model the result of rotations in multiples of 45 degrees of a 2-dimensional figure about the origin.
- Describe the transformations that create a given tessellation.
- Identify lines of symmetry in plane figures or classify types of symmetries of 2-dimensional figures.

Concept 3: Coordinate Geometry

Specify and describe spatial relationships using coordinate geometry and other representational systems.

- Make and test a conjecture about how to find the midpoint between any two points in the coordinate plane.
- Use the Pythagorean Theorem to find the distance between two points in the coordinate plane.

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Concept 4: Measurement

Understand and apply appropriate units of measure, measurement techniques, and formulas to determine measurements.

- Solve problems involving conversions within the same measurement system.
- Solve geometric problems using ratios and proportions.
- Calculate the surface area and volume of rectangular prisms, right triangular prisms, and cylinders.

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Strand Five: Structure and Logic

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Concept 1: Algorithms and Algorithmic Thinking

Use reasoning to solve mathematical problems. Determine step-by-step series of instructions to explain mathematical processes.

- Create an algorithm to solve problems involving indirect measurements, using proportional reasoning, dimensional analysis, and the concepts of density and rate.

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Concept 2: Logic, Reasoning, Problem Solving, and Proof

Evaluate situations, select problem solving strategies, draw logical conclusions, develop and describe solutions, and recognize their applications. Develop mathematical arguments based on induction and deduction, and distinguish between valid and invalid arguments.

- Analyze a problem situation to determine the question(s) to be answered.
- Analyze and compare mathematical strategies for efficient problem solving; select and use one or more strategies to solve a problem.
- Identify relevant, missing, and extraneous information related to the solution to a problem.
- Represent a problem situation using multiple representations, describe the process used to solve the problem, and verify the reasonableness of the solution.
- Apply a previously used problem-solving strategy in a new context.
- Communicate the answer(s) to the question(s) in a problem using appropriate representations, including symbols and informal and formal mathematical language.
- Isolate and organize mathematical information taken from symbols, diagrams, and graphs to make inferences, draw conclusions, and justify reasoning.
- Describe when to use proportional reasoning to solve a problem.
- Make and test conjectures based on information collected from explorations and experiments.
- Solve logic problems involving multiple variables, conditional statements, conjectures, and negation using words, charts, and pictures.
- Identify simple valid arguments using if... then statements.
- Make, validate, and justify conclusions and generalizations about linear relationships.
- Verify the Pythagorean Theorem using a valid argument.