

Mathematics Content Strands

M1 Numbers and Operations

Number pervades all areas of mathematics. The other four Content Standards as well as all five Process Standards are grounded in understanding number. Central to this standard is the development of number sense, which allows students to naturally combine or decompose numbers, solve problems using the relationships among operations and knowledge of the base-ten system, and make a reasonable estimate for the answer to a problem.

Computational fluency – having and using efficient and accurate methods for computing – is essential. Students should be able to perform computations in different ways, including mental calculations, estimation, and paper-and-pencil calculations using mathematically sound algorithms. All students should use calculators at appropriate times, setting the calculator aside when the instructional focus is on developing computational algorithms.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- understand numbers, ways of representing numbers, relationships among numbers and number systems;
- understand meanings of operations and how they relate to one another;
- understand how to compute fluently and make reasonable estimates.

M2 Algebra

The ideas of algebra are a major component of the school mathematics curriculum and help to unify it. Mathematical investigations and discussions of arithmetic and its properties frequently include aspects of algebraic reasoning. Such experiences present rich contexts and opportunities for enhancing mathematical understanding and are an important precursor to the more formalized study of algebra in the middle and secondary grades. A strong foundation in algebra should be in place by the end of the eighth grade, and all high school students should pursue ambitious goals in algebra.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- understand patterns, relations, and functions;
- represent and analyze mathematical situations and structures using algebraic symbols;
- use mathematical models to represent and understand quantitative relationships;
- analyze change in various contexts.

M3 Geometry

Geometry and spatial sense are fundamental components of mathematics learning. They offer ways to interpret and reflect on our physical environment and can serve as tools for the study of other topics in mathematics and science. Geometry is a natural area of mathematics for the development of students' reasoning and justification skills that build across the grades.

Geometry should be learned using concrete models, drawings, and dynamic software. As the study of the relationships among shapes and their properties becomes more abstract, students should come to understand the role of definitions and theorems and be able to construct their own proofs.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships;
- specify locations and describe spatial relationships using coordinate geometry and other representational systems;
- apply transformations and use symmetry to analyze mathematical situations;
- use visualization, spatial reasoning, and geometric modeling to solve problems.

M4 Measurement

The study of measurement is crucial in the K-12 mathematics curriculum because of its practicality and pervasiveness in many aspects of everyday life. Measurement is possibly the area of mathematics that is most important when considering everyday applications of mathematics, and highlights connections between mathematics and areas outside of the school curriculum such as social studies, science, art, and physical education. The study of measurement helps students establish connections within mathematics and provides an opportunity for learning about and unifying ideas concerning number and operations, algebra, geometry, statistics, probability, and data analysis.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- understand measurable attributes of objects and the units, systems, and processes of measurement;
- apply appropriate techniques, tools, and formulas to determine measurements.

Data Analysis and Probability

To analyze data and reason statistically are essential to be an informed citizen, employee, and consumer. The amount of statistical information available to help make decisions in business, politics, research, and everyday life is staggering. Through experiences with the collection and analysis of data, students can learn to make sense of and interpret information and allow them to make appropriate arguments and recognize inappropriate arguments as well.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;
- select and use appropriate statistical methods to analyze data;
- develop and evaluate inferences and predictions that are based on data;
- understand and apply basic concepts of probability.

Mathematics Process Standards

The DoDEA PK-12 mathematics program includes the process standards: problem solving, reasoning and proof, communication, connections, and representation. Instruction in mathematics must focus on process standards in conjunction with all PK-12 content standards throughout the grade levels.

Problem Solving	Reasoning and Proof	Communication	Connections	Representation
<p>Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:</p> <ul style="list-style-type: none"> • build new mathematical knowledge through problem solving; • solve problems that arise in mathematics and in other contexts; • apply and adapt a variety of appropriate strategies to solve problems; • monitor and reflect on the process of mathematical problem solving. 	<p>Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:</p> <ul style="list-style-type: none"> • recognize reasoning and proof as fundamental aspects of mathematics; • make and investigate mathematical conjectures; • develop and evaluate mathematical arguments and proofs; • select and use various types of reasoning and methods of proof. 	<p>Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:</p> <ul style="list-style-type: none"> • organize and consolidate their mathematical thinking through communication; • communicate their mathematical thinking coherently and clearly to peers, teachers, and others; • analyze and evaluate the mathematical thinking and strategies of others; • use the language of mathematics to express mathematical ideas precisely. 	<p>Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:</p> <ul style="list-style-type: none"> • recognize and use connections among mathematical ideas; • understand how mathematical ideas interconnect and build on one another to produce a coherent whole; • recognize and apply mathematics in contexts outside of mathematics. 	<p>Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:</p> <ul style="list-style-type: none"> • create and use representations to organize, record, and communicate mathematical ideas; • select, apply, and translate among mathematical representations to solve problems; • use representations to model and interpret physical, social, and mathematical phenomena.

DoDEA Mathematics Standards: Grade 8

Strand:
Standards:

M1 Numbers and Operations

In Grade 8, all students should:

- 8.M.1a:** use the law 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.M.1b:** explain the meaning of exponents that are negative and zero;
Example: Stephanie thinks that 4^{-1} is the same as -4 . Provide an explanation that will convince her that 4^{-1} is actually $\frac{1}{4}$.
- 8.M.1c:** use scientific, exponential, and calculator notation to express very large or small numbers;
Example: The distance from the sun to Pluto is 38 times the distance from the Sun to Earth. If the distance from the sun to earth is 93 million miles, write the distance from the Sun to Pluto in scientific notation.
- 8.M.1d:** expand scientific notation to include negative exponents;
Example: The mass of an electron is 9.10938×10^{-31} kg. Write this in expanded form.
- 8.M.1e:** explain and use the additive and multiplicative identities and the additive and multiplicative inverses;
Example: Show how inverses are used to solve the equation $10 = 2X + 3$.
- 8.M.1f:** apply order of operations to simplify expressions and perform operations involving numbers written in exponential notation or radical form;
Example: Evaluate the expression: $21 \div 7 + \frac{1}{2} (31 - 27)^{-3}$
- 8.M.1g:** estimate and solve problems that include rational numbers, ratios, and proportions;
Example: Jane was preparing to go to Germany for 3 months as an exchange student. She needed to change some U.S. Dollars into Euros. If the exchange rate is currently \$1.5453 for each Euro, how many Euros can she get for \$500?

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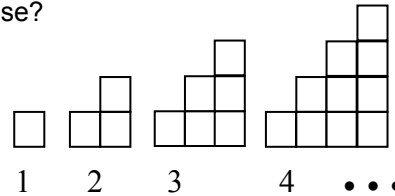
M2

Algebra

In Grade 8, all students should:

8.M.2a: identify and describe patterns and sequences by finding the nth term;

Example: If this pattern were to continue, how many squares are needed for the nth staircase?



8.M.2b: identify functions as linear or nonlinear and contrast their properties using tables, graphs, or equations;

Example: Using the data in the table below, explain why the relation between the side of a square and its area is not linear.

Length of side of a square	Area of square
1	1
2	4
3	9
4	16
5	25

8.M.2c: analyze relationships between linear equations and their graphs by connecting the meaning of intercepts and slope to the context of the situation;

Example: The linear equation $y = 20x + 7$ represents the total cost of fees for rock-climbing at 'Soaring Heights' adventure store. If a full-day equipment rental is \$7, explain what the x and the 20 in the equation might represent.

8.M.2d: use symbolic algebra to represent situations and to solve problems involving linear and nonlinear relationships;

Example: A person paddles a canoe 24 miles downstream in 2 hours. Write an equation that will allow you to determine the distance from the start at any point in time.

8.M.2e: recognize, generate, and justify equivalent forms of algebraic expressions;

Example: Show that $3(4x + 5x - 1) + 2(x + 3)$ and $29x + 3$ are equivalent.

8.M.2f: solve linear equations and inequalities;

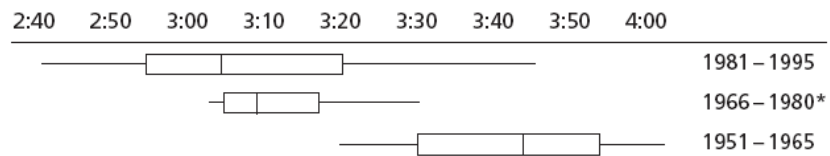
Example: Graph the solution set on the number line for $2 - 3x > 12$.

8.M.2g: represent situations using systems of linear equations and solve graphically;

Example: Brandon and Rayna are driving on the same road to a sushi restaurant. Rayna starts from her home, which is 5 miles closer to the restaurant than Brandon's starting location. Rayna drives at a speed of 50 mph, while Brandon drives at a speed of 65 mph. Explain under what circumstances Brandon will arrive at the restaurant first. Write a system of linear equations that describes the situation and use the graphs to explain your solution.

8.M.2h: represent and solve problems using various representations, e.g., graphs, tables, and equations;

Example: The box-and-whisker plots below show winning times (hours:minutes) for the Indianapolis 500 race in selected years.



*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?

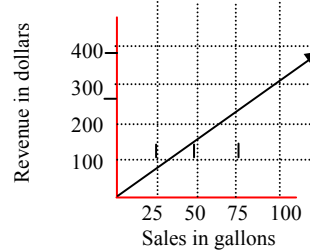
8.M.2i: connect the rate of change to the slope of a line;

Example: The table provides data for the distance a ball will roll down a ramp based on the height of the ramp from which it is released. Explain the rate of change in context of the problem.

Ramp Height	Distance
20 cm	58 cm
30 cm	94 cm
40 cm	130 cm
50 cm	166 cm

8.M.2j: analyze changes in linear relationships using graphs;

Example: The following graph depicts the revenue from ice cream sales based on number of gallons sold. Determine the price per gallon of ice cream.



8.M.2k: describe and compare how changes in a linear equation affect the related graph;

Example: Compare the graphs for the following 2 equations:

$$Y = 5x - 3 \quad \text{and} \quad Y = 3 - 5x$$

Strand:
Standards:

M3

Geometry

In Grade 8, all students should:

8.M.3a: know and apply relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects;

Example: Explain what happens to the volume of a cube if its dimensions are tripled.

8.M.3b: verify the Pythagorean Theorem;

Example: Example: Use the length and width of your classroom to calculate the distance across the room diagonally. Check by measuring.

8.M.3c: apply the Pythagorean Theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle;

Example: Tell which of the following can be the dimensions for a right triangle.

$$3 - 4 - 5; \quad 5 - 10 - 15; \quad 7 - 24 - 25$$

8.M.3d: identify and describe angle relationships formed by parallel lines cut by a transversal using appropriate terminology, e.g., alternate interior, alternate exterior, supplementary, vertical angles, corresponding angles, complementary, consecutive interior;

Example: Explain how you would know that if a transversal is perpendicular to one of two parallel lines that it must also be perpendicular to the other.

8.M.3e: plot ordered pairs of rational numbers on the coordinate plane in all four quadrants;

Example: In a coordinate plane, draw a rectangle whose area is 18 and has a vertex in each of the four quadrants.

8.M.3f: use geometric models to represent and explain numerical and algebraic relationships;

Example: Use an array model to illustrate the multiplication problems below.

$$2 \times 3$$

$$\frac{3}{4} \times \frac{5}{8}$$

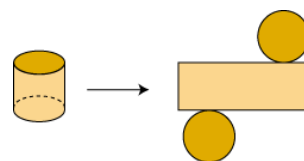
Strand:
Standards:

M4 Measurement

In Grade 8, all students should:

8.M.4a: calculate the surface area and volume of selected prisms, pyramids and cylinders;

Example: Determine the surface area of a cylinder by determining the area of its net.



8.M.4b: use formulas to a specified level of precision in finding the surface area and volume of prisms, pyramids and cylinders and the volume of spheres and cones;

Example: Determine the difference in air volume needed for a men's basketball and a women's basketball, if the circumference of the men's ball is 76.2 cm and the circumference of the women's ball is 72.4 cm.

8.M.4c: find the sum of the interior and exterior angles of regular convex polygons with and without the use of a protractor;
Example: Determine the sum of the angles of a Stop Sign (regular octagon).

8.M.4d: solve simple rate problems;
Example: Determine the better buy, a small drink (12 oz) for \$1.00, a medium drink (20 oz) for \$1.50 or a large drink (32 oz) for \$2.50.

**Strand:
Standards:**

M5 Data Analysis and Probability

In Grade 8, all students should:

8.M.5a: know and use the correct graphical representations for discrete and continuous data;
Example: Explain why a line graph is not an appropriate representation for categorical data such as favorite colors.

8.M.5b: find, interpret, and use measures of center, quartile, and interquartile range to compare two sets of data;
Example: Explain why quartile is a better measure than interquartile range for comparing the population with lowest incomes to the population with the highest incomes.

8.M.5c: find the equation of a line of best fit for data represented as a scatter plot;
Example: Create a scatter plot and determine an equation for the line of best fit for the data collected on time it takes to have a line of people stand up, raise their hands, and sit back down in completing what is commonly termed as a Wave.

Number of people	1	15	20	25	30	35	40	45	50
Time to complete a wave (in seconds)	8	18	25	32	38	44	50	55	62

8.M.5d: compare sampling methods and analyze effects of random versus biased sampling and justify conclusions;

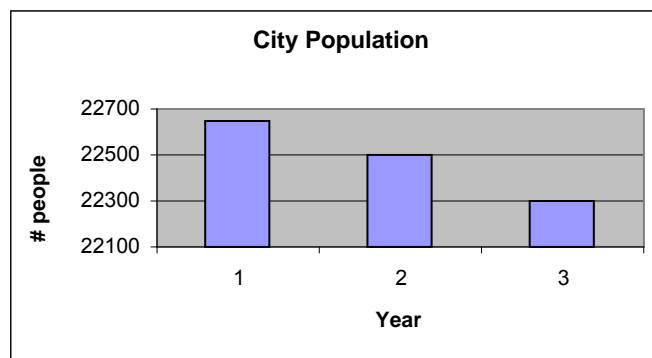
Example: If you were going to try to determine the average number of hours spent on homework for students in your school, describe how you could conduct a sampling without asking each student for information.

8.M.5e: construct convincing and appropriate arguments for a conclusion based on analysis of data presented;

Example: Describe data that you could collect to support an argument to eliminate block scheduling in your school.

8.M.5f: identify faulty arguments or common errors in data analysis;

Example: A city planner uses the following chart to demonstrate significant population decrease over the last 3 years. Explain why the decrease may not be as significant as the bar graph illustrates.



8.M.5g: compute the probability of the occurrence of independent and simple dependent events;

Example: Determine the probability of drawing a Red Face Card from a regulation deck of playing cards.

8.M.5h: differentiate between permutations and combinations;

Example: Your class is conducting a probability experiment involving drawing colored balls from a bag containing 5 red, 5 black, 3 white, and 2 blue balls. Explain what the probability of you drawing a red ball is if you are the third student to draw a ball and two students prior have drawn a red ball and a white ball. How is the probability changed if each of the previous students replaced their balls after they made a draw.