21st Century Learning Mathematics Standard
J.O. Combs Unified School District #44
Grade 8

The eighth grade math program emphasizes students' understanding and use of linear functions, linear equations, and systems of linear equations to represent, analyze, and solve a variety of problems. Students translate among verbal, tabular, graphical, and algebraic representations of functions, and they describe how such aspects of a function as slope and *y*-intercept appear in different representations. Eighth graders use exponents and scientific notation to describe very large and very small numbers. They use square roots when they apply the Pythagorean Theorem. Building on their work in previous grades to organize and display data to pose and answer questions, students see numerical data as an aggregate, which they can often summarize with one or several numbers. They may use box-and-whisker plots to display data, and they informally estimate lines of best fit to make and test conjectures. Problem solving is embedded in the curriculum and calculators, software, and manipulatives are used to solve problems. Opportunities to apply these skills to real world situations help to make sense of mathematics and prepare students with the necessary 21st century skills.

NUMBER AND OPERATIONS

1. NUMBER SYSTEMS

- M8.1.1 Classifies real numbers.
- M8.1.2 Orders real numbers (required: number lines and lists).

2. NUMERICAL RELATIONSHIPS

- M8.2.1 Uses opposites, reciprocals, and equivalent forms to evaluate and solve problems.
- M8.2.2 Converts numbers in standard notation to scientific notation and scientific notation to standard notation (required: using negative exponents).

3. ADDITION AND SUBTRACTION

- M8.3.1 Adds and subtracts rational numbers.

4. MULTIPLICATION AND DIVISION

- M8.4.1 Multiplies and divides rational numbers (required: including estimation).
- M8.4.2 Describes the effect of multiplying and dividing by rational numbers (required: zero, numbers between zero and one, and numbers less than zero).

5. HIGHER ORDER OPERATIONS

- M8.5.1 Simplifies numerical expressions using the order of operations (required: cube roots and grouping symbols; e.g., $\left\{3+\left[4-\left(2+\sqrt{21+4}\right)\right]-6^2\right\}$.
- M8.5.2 Evaluates expressions with integer exponents.
- M8.5.3 Approximates the value of non-perfect squares.
- M8.5.4 Solves problems that involve absolute value.

PATTERNS, ALGEBRA, AND FUNCTIONS

6. PATTERNS

- M8.6.1 Uses slope concepts to generate and graph linear functions. (required: slope-intercept form, point-slope form, midpoint, and distance formula)
- M8.6.2 Given a table of values, equation or graph, generates the other two.
- M8.6.3 Graphs a non-linear function (required: exponential and quadratic).
- M8.6.4 Analyzes graphs to determine if they represent functions.

7. Algebraic Concepts

- M8.7.1 Translates and solves multi-step equations using real numbers when given a word phrase (e.g., two less than the product of 5 and a number is -14 is translated to $5x - 2 = -14$).
- M8.7.2 Evaluates expressions using two variables ($a + b$, given a = -3.3 and b = 7) [required: real numbers].
- M8.7.3 Solves and graphs linear multi-step equations.

Geometry

8. Figures

- M8.8.1 Builds nets of three-dimensional figures.
- M8.8.2 Determines parallel and perpendicular lines by their slope.
- M8.8.3 Uses coordinate geometry to represent the properties of geometric shapes.
- M8.8.4 Predicts the results of combining, subdividing, and changing shapes of plane figures and solids (e.g., paper folding, tiling, and rearranging cut up pieces).

9. Transformations

- M8.9.1 Determines whether a given pair of figures on a coordinate plane represents a translation, reflection, rotation and/or dilation.
- M8.9.2 Performs a transformation to determine the ordered pair of the image (e.g., translate right 4-units and down 2-units and identify new ordered pairs.

Measurement

10. Dimensional Measurement

- M8.10.1 Calculates surface area and volume of cones and pyramids.
- M8.10.2 Describes the change in volume as a ratio when one or more dimensions are altered.
- M8.10.3 Calculates the missing dimension given the volume, area or perimeter of a figure.
- M8.10.4 Calculates the area of a sector (required: 180° arcs and 90° arcs).

11. Measurement systems

- M8.11.1 Converts capacity and mass between U.S. customary and metric when given the conversion ratios.
- M8.11.2 Performs dimensional conversions that involve multiple conversion factors (e.g., square inches and square feet).

Data Analysis

12. Probability and Discrete Mathematics

- M8.12.1 Determines the probability of the complement of an event (e.g., heads is the complement of tails).
- M8.12.2 Determines the probability that a specific event will occur in a multi-stage probability experiment (e.g., if I roll a die and flip a coin, then the probability is $\frac{1}{2} \bullet \frac{1}{6} = \frac{1}{12}$.
- M8.12.3 Determines the number of outcomes of an event using combinations.
- M8.12.4 Analyzes contextual situations to determine whether to use combinations, permutations, or the Fundamental Counting Principle.

13. DATA ORGANIZATION & INTERPRETATION

- M8.13.1 Selects methods for collecting and organizing data (e.g., tables, charts, sampling techniques).
- M8.13.2 Determines correlations and line of best fit in a two-variable set of data (e.g., scatter plot).
- M8.13.3 Evaluates the effects of sample size, sample choice, incorrect, missing, or additional data, bias, and misleading graphical representation.
- M8.13.4 Analyzes data using graphical representations, spreadsheets, graphing calculators, and statistics software (required: box and whisker plot and circle graphs).

MATHEMATICAL PROCESSES

14. PROBLEM SOLVING

- M8.14.1 Formulates problems from a variety of mathematical situations (required: rates and percent change).
- M8.14.2 Selects and applies appropriate specific strategies (required: model using a flow chart, construct an equation, vertex-edged graphs/networks, and Pythagorean Theorem) and tools (e.g., rulers, protractors, manipulatives, graphing calculators, and technology) to construct a solution.
- M8.14.3 Solves and checks the solution of multi-step problems.

15. REASONING AND PROOF

- M8.15.1 Applies inductive and deductive reasoning in making and supporting mathematical conjectures (required: if – then statements).
- M8.15.2 Verifies and explains an argument, using appropriate mathematical ideas and language.
- M8.15.3 Uses counterexamples to refute incorrect statements.