

# PRE-ALGEBRA

## PURPOSE:

Students will use real numbers to analyze, graph, and apply properties in these mathematical areas: measures of central tendency, solving single variable equations, ratios, proportions, probability, and percents. They will apply algebraic concepts and evaluate using measurement formulas to determine surface area and volume of prisms, cylinders, pyramids, and cones. Students will be able to translate between numerical, tabular, and graphical representations of linear relationships.

## BENCHMARKS AND INDICATORS:

### Number Sense

#### 1.1 Demonstrates number sense for real numbers and algebraic expressions

- P11K1 explains and uses equivalent representations for real number and algebraic expressions including integers, fractions, decimals, percents, ratios; scientific notation; absolute value
- P11K3 knows and explains what happens to the product or quotient when a real number is multiplied or divided by:
  - a. a rational number greater than zero and less than one,
  - b. a rational number greater than one
- P11A2 determines whether or not solutions to real world problems using algebraic expressions are reasonable

#### 1.2 Demonstrates an understanding of the real number system; recognizes, applies, and explains their properties, and extends these properties to algebraic expressions

- P12K1 explains and illustrates the relationship between the subsets of the real number system using mathematical models, e.g. number lines or Venn Diagrams
- **\*P12K3a-e names, uses, and describes these properties with the real number system and demonstrates their meaning including the use of concrete objects**
  - a. **commutative** ( $a + b = b + a$  and  $ab = ba$ ), **associative** [ $a + (b + c) = (a + b) + c$  and  $a(bc) = (ab)c$ ], **distributive** [ $a(b + c) = ab + ac$ ], and **substitution properties** (if  $a = 2$ , then  $3a = 3 \times 2 = 6$ );
  - b. **identity properties for addition and multiplication and inverse properties of addition and multiplication** (**additive identity**:  $a + 0 = a$ , **multiplicative identity**:  $a \cdot 1 = a$ , **additive inverse**:  $+5 + -5 = 0$ , **multiplicative inverse**:  $8 \times 1/8 = 1$ );
  - c. **symmetric property of equality** (if  $a = b$ , then  $b = a$ );
  - d. **addition and multiplication properties of equality** (if  $a = b$ , then  $a + c = b + c$  and if  $a = b$ , then  $ac = bc$ ) and **inequalities** (if  $a > b$ , then  $a + c > b + c$  and if  $a > b$ , and  $c > 0$  then  $ac > bc$ );
  - e. **zero product property** (if  $ab = 0$ , then  $a = 0$  and/or  $b = 0$ )

#### 1.3 Uses computational estimation with real numbers

- **\*P13A1 adjusts original rational number estimate of a real-world problem based on additional information (a frame of reference) e.g., estimate how long it takes to walk from here to there; time how long it takes to take five steps and adjust your estimate (must be able to set up a proportion to solve)**

- P13K3 knows and explains why a decimal representation of an irrational number is an approximate value

### 1.1 Models, performs, and explains computation with real numbers and polynomials

- **P14A2 Performs operation with integers and uses order of operations to simplify**
- **\*P14A1a,b,d generates and/or solves multi-step real-world problems with real number and algebraic expressions using computational procedures (addition, subtraction, multiplication, division, roots, and powers excluding logarithms), and mathematical concepts with**
  - a. applications from business, chemistry, and physics that involve addition, subtraction, multiplication, division, squares, and square roots when the formula are given as part of the problem and variables are defined, e.g., given  $F = ma$ , where  $F$  = force in newtons,  $m$  = mass in kilograms,  $a$  = acceleration in meters per second squared. Find the acceleration if a force of 20 newtons is applied to a mass of 3 kilograms
  - b. volume and surface area given the measurement formulas of rectangular solids and cylinders e.g., a silo has a diameter of 8 feet and a height of 20 feet. How many cubic feet of grain can it store?
  - c. probabilities, e.g. if probability of getting a defective battery is 2%, how many bad batteries might you expect to get if you were to buy 250 batteries?
  - d. application of percents (2.4.A1a), e.g., given the formula  $A = P(1 + \frac{r}{n})^{nt}$ ,  $A$  = amount,  $P$  = principal,  $r$  = annual interest,  $n$  compounding periods per year,  $t$  = number of years. If \$1,000 is placed in a savings account with a 6% annual interest rate and is compounded semiannually, how much money will be in the account at the end of 2 years? Also, percent increase and percent decrease

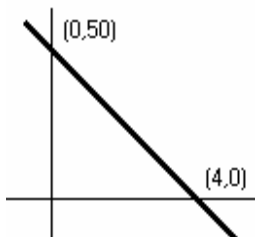
## Algebra

### 2.2 Uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities

- **P22K3a solves one variable equations and inequalities analytically and graphically**
- **N\*P22K3c Solves systems of linear equations with two unknowns using integer coefficients and constants;**
- **N\*P22A2a linear equations and inequalities both analytically and graphically, e.g., tickets for a school play are \$5 for adults and \$3 for students. You need to sell at least \$65 in tickets. Give an inequality and a graph that represents this situation and three possible solutions**

### 2.3 Analyzes functions

- **\*P23K6 recognizes how changes in the constant and/or slope within a linear function changes the appearance of a graph**
- **\*P23A2 interprets the meaning of the x- and y- intercepts, slope, and/or points on and off the line on a graph in the context of a real-world situation, e.g., the graph below represents a tank full of water being emptied. What does the y-intercept represent? What does the x-intercept represent? What is the rate at which it is emptying? What does the point (2, 25) represent in this situation? What does the point (2,30) represent in this situation?**
- **The Water Tank x axis=hours y axis=gallons**



2.4 Develops and uses mathematical models to represent and justify mathematical relationships found involving tenth grade knowledge and skills

- P24K1 use chess board and coordinate planes to model relationships between ordered pairs and equations and inequalities and linear functions e.g. Match a line to its equation by the slope of the line.

## Geometry

3.1 Recognizes geometric figures and compares and justifies their properties of geometric figures

- **\*P31A1a applying the Pythagorean Theorem, e.g., when checking for square corners on concrete forms for a foundation, determine if a right angle is formed by using the Pythagorean Theorem;**
- P31K4 recognizes that similar figures have congruent angles, and their corresponding sides are proportional

3.2 Estimates, measures and uses geometric formulas

- P32K1 determines and uses real number approximation for length, width, volume, distance, perimeter, area, surface area, and angle measurement using standard and nonstandard units of measure
- P32K3 approximates conversions between customary and metric systems given the conversion unit or formula
- P32K4 states, recognizes, and applies formulas for:
  - a. perimeter and area of squares, rectangles, triangles;
  - b. circumference and area of circles; volume of rectangular solids
- P32K6 recognizes and applies properties of corresponding parts of similar and congruent figures to find measurements of missing parts

3.3 Recognizes and applies transformations on two- and three-dimensional figures

- **\*P33A1 analyzes the impact of transformations on the perimeter and area of circles, rectangles, and triangles and volume of rectangular prisms and cylinders e.g., reducing by a factor of  $\frac{1}{2}$  multiplies an area by a factor of  $\frac{1}{4}$  and multiplies the volume by a factor of  $\frac{1}{8}$ , whereas, rotating a geometric figure does not change perimeter or area**
- P33K1 describes and performs single and multiple transformations (reflection, translation, rotation, reduction, and enlargement)

3.4 Uses an algebraic perspective to analyze the geometry of two- and three-dimensional figures

- **\*P34K4 finds and explains the relationship between the slopes of parallel and perpendicular lines (2.4.K1f), e.g., the equation of a line  $2x + 3y = 12$ . The slope of this line is  $-2/3$ . What is the slope of a line perpendicular to this line?**
- **\*P34K6 recognizes the equation of a line and transforms the equation into slope-intercept form in order to identify the slope and y-intercept and uses this information to graph the line**
- P34K5 uses the Pythagorean Theorem to find distance

## **Data**

4.1 Applies probability theory to draw conclusions, generate convincing arguments, make predictions and decisions, and analyze decisions including the use of concrete objects

- **\*P41K3 explains the relationship between probability and odds and computes one given the other.**
- P41A3 compares theoretical and experimental probabilities

4.2 Statistics – The student collects, organizes, displays, explains, and interprets numerical (rational) and non-numerical data sets

- **P42K4 explains the effects of outliers on the measures of central tendency (mean, median, mode) and range and interquartile range of a real number data set**
- **\*P42K5 approximates a line of best fit given a scatter plot and makes predictions using the graph or the equation of that line**
- **\*P42A1a-h uses data analysis (mean, median, mode, range, quartile, interquartile range) in real-world problems with rational number data sets to compare and contrast two sets of data, to make accurate inferences and predictions, to analyze decisions, and to develop convincing arguments from these data displays**
  - a. frequency tables and line plots;
  - b. bar, line, and circle graphs;
  - c. Venn diagrams or other pictorial displays;
  - d. charts and tables;
  - e. stem-and-leaf plots (single and double);
  - f. scatter plots
  - g. box-and-whiskers plots;
  - h. histograms.