

# GEOMETRY

## PURPOSE:

Students will identify and apply geometric properties for triangles (including congruence, similarity, special triangles, and trigonometry), all types of quadrilaterals, any other polygons up to 12 sides, and circles. They will apply algebraic concepts, evaluate measurement formulas, and perform transformations on 2-dimensional and 3-dimensional figures.

## BENCHMARKS AND INDICATORS:

### Number Sense

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

- G12K1 explains and illustrates the relationship between the subsets of the real number system using mathematical models
- **\*G12K3a-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

- **\*G13A1 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)**
- G13K3 knows and explains why a decimal representation of an irrational number is an approximate value. e.g. 3.14 is approximation for  $\pi$  (knows the difference between an exact and approximate answer)

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

- **\*G14A1a,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?
  - d. application of percents, 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?

## Algebra

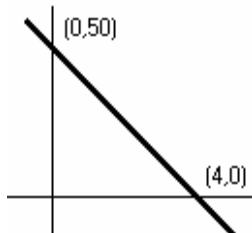
### 2.2 Uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities in variety of situations

- **\*G22K3c Solves systems of linear equations with two unknowns using integer coefficients and constants;**
- **\*G22A2a 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

- **\*G23K6 recognizes how changes in the constant and/or slope within a linear function changes the appearance of a graph**
- **\*G23A2 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

- G24K1 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 and/or slope of the line.

## Geometry

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

- G31K1a recognizes and uses properties of quadrilaterals and triangles to solve problems
- G31K1b draws and recognizes medians, altitudes, angle bisector and perpendicular bisectors for triangles and use them to make circumscribed and inscribed circles
- G31K2 discusses properties of regular polygons related to:
  - a. angle measures,
  - b. diagonals
- G31K3 recognizes and describes the symmetries (point, line, plane) that exist in three-dimensional figures
- G31K4 recognizes that similar figures have congruent angles, and their corresponding sides are proportional
- G31K5 uses the Pythagorean Theorem to:
  - a. determine if a triangle is a right triangle,
  - b. find a missing side of a right triangle
- G31K6 recognizes and describes:
  - a. congruence of triangles using: Side-Side-Side (SSS), Angle-Side-Angle (ASA), Side-Angle-Side (SAS), and Angle-Angle-Side (AAS);
  - b. the ratios of the sides in special right triangles:  $30^\circ$ - $60^\circ$ - $90^\circ$  and  $45^\circ$ - $45^\circ$ - $90^\circ$
- G31K7 recognizes, describes, and compares the relationships of the angles formed when parallel lines are cut by a transversal
- G31K8 recognizes and identifies parts of a circle: arcs, chords, sectors of circles, secant and tangent lines, central and inscribed angles
- **\*G31A1 solves real-world problems by:**
  - a. using the properties of corresponding parts of similar and congruent figures, e.g., scale drawings, map reading, or proportions;
  - b. \* 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;**
  - c. using properties of parallel lines, e.g., street intersections
- G31A2 uses deductive reasoning to justify the relationships between the sides of  $30^\circ$ - $60^\circ$ - $90^\circ$  and  $45^\circ$ - $45^\circ$ - $90^\circ$  triangles using the ratios of sides of similar triangles

### 3.2 Estimates, measures and uses geometric formulas

- G32K1 determines and uses real number approximations (estimations) for length, width, weight, volume, temperature, time, distance, perimeter, area, surface area, and angle measurement using standard and nonstandard units of measure
- G32K2 selects and uses measurement tools, units of measure, and level of precision appropriate for a given situation to find accurate real number representations for length,

weight, volume, temperature, time, distance, area, surface area, mass, midpoint, and angle measurements

- G32K4 states, recognizes, and applies formulas for
  - a. perimeter and area of squares, rectangle, and triangles;
  - b. circumference and area of circles; volume of rectangular solids
- G32K5 uses given measurement formulas to find perimeter, area, volume, and surface area of two- and three-dimensional figures (regular and irregular)
- G32K6 recognizes and applies properties of corresponding parts of similar and congruent figures to find measurements of missing sides
- G32K7 knows, explains, and uses ratios to describe rates of change (\$), e.g., miles per gallon, meters per second, calories per ounce, or rise over run

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

- G33K1 describes and performs single and multiple transformations [reflection, rotation, translation, reduction (contraction/shrinking), enlargement (magnification/growing)] on two- and three-dimensional figures
- G33K3 generates a two-dimensional representation of a three-dimensional figure

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

- G34K1 recognizes and examines two- and three-dimensional figures and their attributes including the graphs of functions on a coordinate plane using various methods including mental math, paper and pencil, concrete objects, and graphing utilities or other appropriate technology
- G34K2 determines if a given point lies on the graph of a given line or parabola without graphing and justifies the answer
- G34K3 calculates the slope of a line from a list of ordered pairs on the line and explains how the graph of the line is related to its slope
- **\*G34K4 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?**
- G34K5 uses the Pythagorean Theorem to find distance (may use the distance formula)
- **\*G34K6 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**
- G34K7 recognizes the equation  $y = ax^2 + c$  as a parabola; represents and identifies characteristics of the parabola including opens upward or opens downward, steepness (wide/narrow), the vertex, maximum and minimum values, and line of symmetry; and sketches the graph of the parabola

## 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

- **\*G41K3 explains the relationship between probability and odds and computes one given the other**

### 4.2 Collects, organizes, displays, explains, and interprets numerical (rational) and non-numerical data sets

- **G42K4** 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
- **\*G42K5** approximates a line of best fit given a scatter plot and makes predictions using the graph or the equation of that line
- **\*G42A1a-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