Georgia Mathematics

Geometry: Concepts and Connections

Mathematical Practices

0 Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals. G.MP

- 0.1 Make sense of problems and persevere in solving them. G.MP.1
- 0.2 Reason abstractly and quantitatively. G.MP.2
- 0.3 Construct viable arguments and critique the reasoning of others. G.MP.3
- 0.4 Model with mathematics. G.MP.4
- 0.5 Use appropriate tools strategically. G.MP.5
- 0.6 Attend to precision. G.MP.6
- 0.7 Look for and make use of structure. G.MP.7
- 0.8 Look for and express regularity in repeated reasoning. G.MP.8

Mathematical Modeling

1 Apply mathematics to real-life situations; model real-life phenomena using mathematics. G.MM.1

- 1.1 Explain mathematically applicable problems using a mathematical model. G.MM.1.1
- 1.2 Create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. G.MM.1.2
- 1.3 Using abstract and quantitative reasoning, make decisions about information and data from a mathematically applicable situation. G.MM.1.3
- 1.4 Use various mathematical representations and structures with this information to represent and solve real-life problems. G.MM.1.4

Patterning & Algebraic Reasoning

2 Interpret the structure of polynomial expressions and perform operations with polynomials within a geometric framework. G.PAR.2

- 2.1 Interpret polynomial expressions of varying degrees that represent a quantity in terms of its given geometric framework. G.PAR.2.1
- 2.2 Perform operations with polynomials and prove that polynomials form a system analogous to the integers in that they are closed under these operations. G.PAR.2.2
- 2.3 Using algebraic reasoning, add, subtract, and multiply single variable polynomials. G.PAR.2.3

Geometric & Spatial Reasoning

3 Experiment with transformations in the plane to develop precise definitions for translations, rotations, and reflections and use these to describe symmetries and congruence to model and explain real-life phenomena. G.GSR.3

- 3.1 Use geometric reasoning and symmetries of regular polygons to develop definitions of rotations, reflections, and translations. G.GSR.3.1
- 3.2 Verify experimentally the congruence properties of rotations, reflections, and translations: lines are taken to lines and line segments to line segments of the same length; angles are taken to angles of the same measure; parallel lines are taken to parallel lines. G.GSR.3.2
- 3.3 Use geometric descriptions of rigid motions to draw the transformed figures and to predict the effect on a given figure. Describe a sequence of transformations from one figure to another and use transformation properties to determine congruence. G.GSR.3.3
- 3.4 Explain how the criteria for triangle congruence follow from the definition of congruence in terms of rigid motions. Use congruency criteria for triangles to solve problems and to prove relationships in geometric figures. G.GSR.3.4

4 Establish facts between angle relations and generate valid arguments to defend facts established. Prove theorems and solve geometric problems involving lines and angles to model and explain real-life phenomena. G.GSR.4

- 4.1 Use the undefined notions of point, line, line segment, plane, distance along a line segment, and distance around a circular arc to develop and use precise definitions and symbolic notations to prove theorems and solve geometric problems. G.GSR.4.1
- 4.2 Classify quadrilaterals in the coordinate plane by proving simple geometric theorems algebraically. G.GSR.4.2
- 4.3 Make formal geometric constructions with a variety of tools and methods. G.GSR.4.3
- 4.4 Prove and apply theorems about lines and angles to solve problems. G.GSR.4.4
- 4.5 Use geometric reasoning to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. G.GSR.4.5

5 Describe dilations in terms of center and scale factor and use these terms to describe properties of dilations; use the precise definition of a dilation to describe similarity and establish the criterion for triangles to be similar; use these terms, definitions, and criterion to prove similarity, model, and explain real-life phenomena. G.GSR.5

- 5.1 Verify experimentally the properties of dilations. G.GSR.5.1
- 5.2 Given two figures, use and apply the definition of similarity in terms of similarity transformations. G.GSR.5.2
- 5.3 Use the properties of similarity transformations to establish criterion for two triangles to be similar. Use similarity criteria for triangles to solve problems and to prove relationships in geometric figures. G.GSR.5.3
- 5.4 Construct formal proofs to justify and apply theorems about triangles. G.GSR.5.4

6 Examine side ratios of similar triangles; use the relationship between right triangles to develop an understanding of sine and cosine to solve geometric problems and to model and explain real-life phenomena. G.GSR.6

- 6.1 Explain that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. G.GSR.6.1
- 6.2 Explain and use the relationship between the sine and cosine of complementary angles. G.GSR.6.2
- 6.3 Use trigonometric ratios and the Pythagorean Theorem to solve for sides and angles of right triangles in applied problems. G.GSR.6.3

7 Explore the concept of a radian measure and special right triangles. G.GSR.7

- 7.1 Explore and interpret a radian as the ratio of the arc length to the radius of a circle. G.GSR.7.1
- 7.2 Explore and explain the relationship between radian measures and degree measures and convert fluently between degree and radian measures. G.GSR.7.2
- 7.3 Use special right triangles on the unit circle to determine the values of sine, cosine, and tangent for 30° ($\pi/6$), 45° ($\pi/4$) and 60° ($\pi/3$) angle measures. Use reflections of triangles to determine reference angles and identify coordinate values in all four quadrants of the coordinate plane. G.GSR.7.3

8 **Examine and apply theorems involving circles; describe and derive arc length and area of a sector; and model and explain real-life situations involving circles.** G.GSR.8

- 8.1 Identify and apply angle relationships formed by chords, tangents, secants and radii with circles. G.GSR.8.1
- 8.2 Using similarity, derive the fact that the length of the arc (arc length) intercepted by an angle is proportional to the radius; derive the formula for the area of a sector. Solve mathematically applicable problems involving applications of arc length and area of sector. G.GSR.8.2
- 8.3 Write and graph the equation of circles in standard form. G.GSR.8.3

9 **Develop informal arguments for geometric formulas using dissection arguments, limit arguments, and Cavalieri's principle; solve realistic problems involving volume; explore and visualize relationships between two-dimensional and three-dimensional objects to model and explain real-life phenomena.** G.GSR.9

- 9.1 Use volume formulas for prisms, cylinders, pyramids, cones, and spheres to solve problems including right and oblique solids. G.GSR.9.1
- 9.2 Use geometric shapes, their measures, and their properties to describe objects and approximate volumes. G.GSR.9.2
- 9.3 Apply concepts of density based on area and volume in modeling situations. G.GSR.9.3

Probabilistic Reasoning

10 Solve problems involving the probability of compound events to make informed decisions; interpret expected value and measures of variability to analyze probability distributions. G.PR.10

- 10.1 Describe categories of events as subsets of a sample space using unions, intersections, or complements of other events. Apply the Addition Rule conceptually, P(A or B) = P(A) + P(B) - P(A and B), and interpret the answers in context. G.PR.10.1
- 10.2 Apply and interpret the general Multiplication Rule conceptually to independent events of a sample space, P(A and B) = [P(A)]x[P(B|A)] =[P(B)]x[P(A|B)] using contingency tables or tree diagrams. G.PR.10.2
- 10.3 Use conditional probability to interpret risk in terms of decision-making and investigate questions such as those involving false positives or false negatives from screening tests. G.PR.10.3
- 10.4 Define permutations and combinations and apply this understanding to compute probabilities of compound events and solve meaningful problems. G.PR.10.4
- 10.5 Interpret the probability distribution for a given random variable and interpret the expected value. G.PR.10.5
- 10.6 Develop a probability distribution for variables of interest using theoretical and empirical (observed) probabilities and calculate and interpret the expected value. G.PR.10.6
- 10.7 Calculate the expected value of a random variable and interpret it as the mean of a given probability distribution. G.PR.10.7
- 10.8 Compare the payoff values associated with the probability distribution for a random variable and make informed decisions based on expected value and measures of variability. G.PR.10.8

Data & Statistical Reasoning

11 Examine real-life situations presented in a two-way frequency table to calculate probabilities, to model categorical data, and to explain real-life phenomena. G.DSR.11

- 11.1 Construct and summarize categorical data for two categories in two-way frequency tables. G.DSR.11.1
- 11.2 Use categorical data in two-way frequency tables to calculate and interpret probabilities based on the investigation. G.DSR.11.2