Geometry Course-Level Expanded Expectations

CONGRUENCE: CO

G.CO.A	Experiment with transformations in the plane.	
G.CO.A.1	Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc.	The expectation of the student is to know precise definitions of angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line and distance along a line and distance around a circular arc.
G.CO.A.2	Represent transformations in the plane, and describe them as functions that take points in the plane as inputs and give other points as outputs.	The expectation of the student is to represent transformations in the plane (e.g., transparencies and geometry software); describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not. (*e.g., translation versus horizontal stretch*)
G.CO.A.3	Describe the rotational symmetry and lines of symmetry of two-dimensional figures.	The expectation of the student is given a figure (e.g., rectangle, parallelogram, trapezoid or regular polygon) describe the rotations and reflections that carry it onto itself.
G.CO.A.4	Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.	The expectation of the student is to develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.
G.CO.A.5	Demonstrate the ability to rotate, reflect or translate a figure, and determine a possible sequence of transformations between two congruent figures.	The expectation of the student is given a geometric figure and a rotation, reflection or translation, draw the transformed figure using. (e.g., graph paper, tracing paper or geometry software.) Specify a sequence of transformations that will carry a given figure onto another.
G.CO.B	Understand congruence in terms of rigid motions.	

G.CO.B.6	Develop the definition of congruence in terms of rigid motions.	The expectation of the student is to use the descriptions of rigid motions (translations, rotations, reflections) to transform figures and predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions (preserving size and shape) to decide if they are congruent. (e.g., Is there a combination of rigid motions that transforms the first figure onto the second?)
G.CO.B.7	Develop the criteria for triangle congruence from the definition of congruence in terms of rigid motions.	The expectation of the student is to use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. Explain how the criteria for triangle congruence (ASA, AAS, SAS and SSS) follow from the definition of congruence in terms of rigid motions and that they represent minimum requirements for congruence of any two triangles.
G.CO.C	**Prove geometric theorems.**	
G.CO.C.8	Prove theorems about lines and angles.	The expectation of the student is to prove theorems about lines and angles. (Theorems should include, but are not limited to, the following: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.)
G.CO.C.9	Prove theorems about triangles.	The expectation of the student is to prove theorems about triangles. (Theorems should include, but are not limited to, the following: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.)
G.CO.C.10	Prove theorems about polygons.	The expectation of the student is to prove theorems about polygons. (Theorems should include, but are not limited to, the following: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.)
G.CO.D	**Make geometric constructions.**	

G.CO.D.11	Construct geometric figures using various tools and methods.	The expectation of the student is to make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). a. Construct basic geometric components. (*e.g., copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line*) b. Construct specific geometric shapes. (*e.g., regular hexagons inscribed in circles, equilateral triangles, squares, etc.*)

SIMILARITY, RIGHT TRIANGLES AND TRIGONOMETRY: SRT

G.SRT.A	**Understand similarity in terms of similarity transformations.**	
G.SRT.A.1	Construct and analyze scale changes of geometric figures.	The expectation of the student is to verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the same ratio as given by the scale factor.
G.SRT.A.2	Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures.	The expectation of the student is given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
G.SRT.A.3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	The expectation of the student is to use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
G.SRT.B	**Prove theorems involving similarity.**	

G.SRT.B.4	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	The expectation of the student is to prove theorems about triangles. (Theorems should include, but not be limited to: a line parallel to one side of a triangle divides the other two sides proportionally, and conversely, the Pythagorean Theorem proven using triangle similarity.) Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
G.SRT.C	**Define trigonometric ratios, and solve problems involving right triangles.**	
G.SRT.C.5	Understand that side ratios in right triangles define the trigonometric ratios for acute angles.	The expectation of the student is to understand, using similarity, that side ratios in right triangles define the trigonometric ratios (sine, cosine, tangent, secant, cosecant, cotangent) for acute angles.
G.SRT.C.6	Explain and use the relationship between the sine and cosine of complementary angles.	The expectation of the student is to explain and use the relationship between the sine and cosine of complementary angles.
G.SRT.C.7	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles.	The expectation of the student is to use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
G.SRT.C.8	Derive the formula $A = 1/2\ ab\ \sin(C)$ for the area of a triangle.	The expectation of the student is to derive the formula $A=1/2\ ab\ \sin(C)$ for the area of a triangle.

CIRCLES: C

G.C.A	**Understand and apply theorems about circles.**	
G.C.A.1	Prove that all circles are similar using similarity transformations.	The expectation of the student is to prove that all circles are similar using similarity transformations (dilations).
G.C.A.2	Identify and describe relationships among inscribed angles, radii and chords of circles.	The expectation of the student is to identify and describe relationships among inscribed angles, radii and chords. (Include, but not limited to, the relationship between central, inscribed and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.)
G.C.A.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	The expectation of the student is to construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
G.C.B	**Find arc lengths and areas of sectors of circles.**	

G.C.B.4	Derive the formula for the length of an arc of a circle.	The expectation of the student is to derive, using similarity, the fact that the length of the arc intercepted by an angle is proportional to the radius.
G.C.B.5	Derive the formula for the area of a sector of a circle.	The expectation of the student is to derive the formula for the area of a sector of a circle using ratios of arc lengths.

EXPRESSING GEOMETRY PROPERTIES WITH EQUATIONS: GPE

G.GPE.A	**Translate between the geometric description and the equation for a conic section.**	
G.GPE.A.1	Derive the equation of a circle.	The expectation of the student is to derive the equation of a circle, given the center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
G.GPE.A.2	Derive the equation of a parabola given a focus and directrix.	The expectation of the student is to derive the equation of a parabola given a focus and directrix, using the fact that the distances to the focus and to the directrix are equal from any point on the parabola.
G.GPE.B	**Use coordinates to prove geometric theorems algebraically.**	
G.GPE.B.3	Use coordinates to prove geometric theorems algebraically.	The expectation of the student is to use coordinates to prove simple geometric theorems algebraically. (*e.g., prove or disprove that a figure defined by four given points in the Cartesian coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point (0, 2).*)
G.GPE.B.4	Prove the slope criteria for parallel and perpendicular lines and use them to solve problems.	The expectation of the student is to prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems. (*e.g., Find the equation of a line parallel or perpendicular to a given line that passes through a given point.*)
G.GPE.B.5	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	The expectation of the student is to find the point on a directed line segment between two given points that partitions the segment in a given ratio.
G.GPE.B.6	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.	The expectation of the student is to use coordinates to compute perimeters of polygons and areas of triangles and rectangles. (*e.g., using the distance formula*)

GEOMETRIC MEASUREMENT AND DIMENSION: GMD

G.GMD.A	**Explain volume formulas and use them to solve problems.**	
G.GMD.A.1	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid and cone.	The expectation of the student is to give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid and cone. Use dissection arguments, Cavalieri's principle or informal limit arguments.
G.GMD.A.2	Use volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems.	The expectation of the student is to use volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve mathematical modeling problems.
G.GMD.B	**Visualize relationships between two-dimensional and three-dimensional objects.**	
G.GMD.B.3	Identify the shapes of two-dimensional cross-sections of three-dimensional objects.	The expectation of the student is to identify the shapes of two-dimensional cross-sections of three-dimensional objects. (e.g., What is the shape of a plane section parallel to the base of a cylinder? What is the shape of a plane section not parallel to but not intersecting the base of a cube?
G.GMD.B.4	Identify three-dimensional objects generated by transformations of two-dimensional objects.	The expectation of the student is to identify three-dimensional objects generated by transformations of two-dimensional objects.

MODELING WITH GEOMETRY: MG

G.MG.A	**Apply geometric concepts in modeling situations.**	
G.MG.A.1	Use geometric shapes, their measures and their properties to describe objects.	The expectation of the student is to use geometric shapes, their measures and their properties to describe objects. (*e.g., Modeling a tree trunk or a human torso as a cylinder. Estimate the volume of a water tower using a sphere or cylinder.*)
G.MG.A.2	Apply concepts of density based on area and volume in modeling situations.	The expectation of the student is to apply concepts of density based on area and volume in modeling situations. (*e.g., persons per square mile, BTUs per cubic foot*)
G.MG.A.3	Apply geometric methods to solve design mathematical modeling problems.	The expectation of the student is to apply geometric methods to solve design mathematical modeling problems. (*e.g., Design an object or structure to satisfy physical constraints or minimize cost. Calculate how many boxes a truck can hold.*)

CONDITIONAL PROBABILITY AND RULES THE RULES OF PROBABILITY: CP

G.CP.A	Understand independence and conditional probability and use them to interpret data.	
G.CP.A.1	Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections or complements of other events.	The expectation of the student is to describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections or complements of other events ("or", "and", "not").
G.CP.A.2	Understand the definition of independent events and use it to solve problems.	The expectation of the student is to understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
G.CP.A.3	Calculate conditional probabilities of events.	The expectation of the student is to understand the conditional probability of A given B as P(A and B)/P(B). Interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A. The conditional probability of B given A is the same as the probability of B. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A. Interpret the answer in terms of the model.
G.CP.A.4	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.	The expectation of the student is to construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Using the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. (*e.g., Collect data from a random sample of students in your school on their favorite subject among math, science and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*)
G.CP.A.5	Recognize and explain the concepts of conditional probability and independence in a context.	The expectation of the student is to recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. (*e.g., Compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*)
G.CP.A.6	Apply and interpret the Addition Rule for calculating probabilities.	The expectation of the student is to apply the Addition Rule, P(A or B) = P(A) + P(B) − P(A and B), and interpret the answer in terms of the model.

G.CP.A.7	Apply and Interpret the general Multiplication Rule in a uniform probability model.	The expectation of the student is to apply and interpret the general Multiplication Rule in a uniform probability model.
G.CP.A.8	Use permutations and combinations to solve problems.	The expectation of the student is to use permutations and combinations to solve problems.