Geometry | G

Geometry emphasizes similarity, right triangle trigonometry, congruence, and modeling geometry concepts in real life situations. Students build upon previous knowledge of similarity, congruence, and triangles to prove theorems and reason mathematically. This course also introduces students to geometric constructions and circles. Students show a progression of mastery and understanding of the use and application of surface area and volume.

The major work of Geometry is from the following domains and clusters:

- **Congruence**
  - Understand congruence in terms of rigid motions.
  - Prove geometric theorems.
- **Similarity, Right Triangles, and Trigonometry**
  - Understand similarity in terms of similarity transformations.
  - Prove theorems involving similarity.
  - Define trigonometric ratios and solve problems involving triangles.
- **Expressing Geometric Properties with Equations**
  - Use coordinates to prove simple geometric theorems algebraically.
- **Modeling with Geometry**
  - Apply geometric concepts in modeling situations.

Supporting work is from the following domains and clusters:

- **Congruence**
  - Experiment with transformations in the plane.
  - Make geometric constructions.
- **Circles**
  - Understand and apply theorems about circles.
  - Find areas of sectors of circles.
- **Expressing Geometric Properties with Equations**
  - Translate between the geometric description and the equation for a circle.
- **Geometric Measurement and Dimension**
  - Explain volume and surface area formulas and use them to solve problems.

Mathematical Modeling

Mathematical Modeling is a Standard for Mathematical Practice (MP4) and a Conceptual Category. Specific modeling standards appear throughout the high school standards indicated with a star (★). Where an entire domain is marked with a star, each standard in that domain is a modeling standard.

Standards for Mathematical Practice

Being successful in mathematics requires the development of approaches, practices, and habits of mind that need to be in place as one strives to develop mathematical fluency, procedural skills, and conceptual understanding. The Standards for Mathematical Practice are meant to address these areas of expertise that teachers should seek to develop in their students. These approaches, practices, and habits of mind can be summarized as "processes and proficiencies" that successful mathematicians have as a part of their work in mathematics. Additional explanations are included in the main introduction of these standards.

Standards for Mathematical Practice
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Literacy Standards for Mathematics

Communication in mathematics employs literacy skills in reading, vocabulary, speaking and listening, and writing. Mathematically proficient students communicate using precise terminology and multiple representations including graphs, tables, charts, and diagrams. By describing and contextualizing mathematics, students create arguments and support conclusions. They evaluate and critique the reasoning of others, analyze, and reflect on their own thought processes. Mathematically proficient students have the capacity to engage fully with mathematics in context by posing questions, choosing appropriate problem-solving approaches, and justifying solutions. Further explanations are included in the main introduction.

Literacy Skills for Mathematical Proficiency
1. Use multiple reading strategies. 2. Understand and use correct mathematical vocabulary. 3. Discuss and articulate mathematical ideas. 4. Write mathematical arguments.

Geometry

Congruence (G.CO)

Cluster Headings	Content Standards	Scope & Clarifications
A. Experiment with transformations in the plane.	**G.CO.A.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, plane, distance along a line, and distance around a circular arc.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.CO.A.2 Represent transformations in the plane in multiple ways, including technology. Describe transformations as functions that take points in the plane (pre-image) as inputs and give other points (image) as outputs. Compare transformations that preserve distance and angle measure to those that do not (e.g., translation versus horizontal stretch).	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry the shape onto itself.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.CO.A.5 Given a geometric figure and a rigid motion, draw the image of the figure in multiple ways, including technology. Specify a sequence of rigid motions that will carry a given figure onto another.	*Rigid motions include rotations, reflections, and translations.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*
B. Understand congruence in terms of rigid motions.	**G.CO.B.6** Use geometric descriptions of rigid motions to transform figures and to 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 to determine informally if they are congruent.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*

Cluster Headings	Content Standards	Scope & Clarifications
B. Understand congruence in terms of rigid motions.	**G.CO.B.7** 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.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.CO.B.8 Explain how the criteria for triangle congruence (ASA, SAS, AAS, and SSS) follow from the definition of congruence in terms of rigid motions.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
C. Prove geometric theorems.	**G.CO.C.9** Prove theorems about lines and angles.	*Proving includes, but is not limited to, completing partial proofs; constructing two-column or paragraph proofs; using transformations to prove theorems; analyzing proofs; and critiquing completed proofs.* *Theorems include but are not limited to: 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.10 Prove theorems about triangles.	*Proving includes, but is not limited to, completing partial proofs; constructing two-column or paragraph proofs; using transformations to prove theorems; analyzing proofs; and critiquing completed proofs.* *Theorems include but are not limited to: 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.*

Cluster Headings	Content Standards	Scope & Clarifications
C. Prove geometric theorems.	**G.CO.C.11** Prove theorems about parallelograms.	*Proving includes, but is not limited to, completing partial proofs; constructing two-column or paragraph proofs; using transformations to prove theorems; analyzing proofs; and critiquing completed proofs.* *Theorems include but are not limited to: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*
D. Make geometric constructions.	**G.CO.D.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).	*Constructions include but are not limited to: copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; constructing a line parallel to a given line through a point not on the line, and constructing the following objects inscribed in a circle: an equilateral triangle, square, and a regular hexagon.*

Similarity, Right Triangles, and Trigonometry (G.SRT)

Cluster Headings	Content Standards	Scope & Clarifications
A. Understand similarity in terms of similarity transformations.	**G.SRT.A.1** Verify informally the properties of dilations given by a center and a scale factor.	*Properties include but are not limited to: 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 of the dilation unchanged; the dilation of a line segment is longer or shorter in the ratio given by the scale factor.*

Cluster Headings	Content Standards	Scope & Clarifications
A. Understand similarity in terms of similarity transformations	**G.SRT.A.2** 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.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.SRT.A.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
B. Prove theorems involving similarity.	**G.SRT.B.4** Prove theorems about similar triangles.	*Proving includes, but is not limited to, completing partial proofs; constructing two-column or paragraph proofs; using transformations to prove theorems; analyzing proofs; and critiquing completed proofs.* *Theorems include but are not limited to: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.*
	G.SRT.B.5 Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
C. Define trigonometric ratios and solve problems involving triangles.	**G.SRT.C.6** Understand 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.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*

Cluster Headings	Content Standards	Scope & Clarifications
C. Define trigonometric ratios and solve problems involving triangles.	**G.SRT.C.8** Solve triangles. ⋆ **a.** Know and use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **b.** Know and use the Law of Sines and Law of Cosines to solve problems in real life situations. Recognize when it is appropriate to use each.	*Ambiguous cases will not be included in assessment.*

Circles (G.C)

Cluster Headings	Content Standards	Scope & Clarifications
A. Understand and apply theorems about circles.	**G.C.A.1** Recognize that all circles are similar.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.C.A.2 Identify and describe relationships among inscribed angles, radii, and chords.	*Include 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, and properties of angles for a quadrilateral inscribed in a circle.*
	G.C.A.3 Construct the incenter and circumcenter of a triangle and use their properties to solve problems in context.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
B. Find areas of sectors of circles.	**G.C.B.4** Know the formula and find the area of a sector of a circle in a real-world context.	*For example, use proportional relationships and angles measured in degrees or radians.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*

Expressing Geometric Properties with Equations (G.GPE)

Cluster Headings	Content Standards	Scope & Clarifications
A. Translate between the geometric description and the equation for a circle.	**G.GPE.A.1** Know and write the equation of a circle of given center and radius using the Pythagorean Theorem.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
B. Use coordinates to prove simple geometric theorems algebraically.	**G.GPE.B.2** Use coordinates to prove simple geometric theorems algebraically.	*For example, prove or disprove that a figure defined by four given points in the 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).* *There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.GPE.B.3 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.	*For example, find the equation of a line parallel or perpendicular to a given line that passes through a given point.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.GPE.B.4 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	*There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.GPE.B.5 Know and use coordinates to compute perimeters of polygons and areas of triangles and rectangles.★	*For example, use the distance formula.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*

Geometric Measurement and Dimension (G.GMD)

Cluster Headings	Content Standards	Scope & Clarifications
A. Explain volume and surface area formulas and use them to solve problems.	**G.GMD.A.1** Give an informal argument for the formulas for the circumference of a circle and the volume and surface area of a cylinder, cone, prism, and pyramid.	*Informal arguments may include but are not limited to using the dissection argument, applying Cavalieri's principle, and constructing informal limit arguments.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.GMD.A.2 Know and use volume and surface area formulas for cylinders, cones, prisms, pyramids, and spheres to solve problems.★	*There are no assessment limits for this standard. The entire standard is assessed in this course.*

Modeling with Geometry (G.MG)

Cluster Headings	Content Standards	Scope & Clarifications
A. Apply geometric concepts in modeling situations.	**G.MG.A.1** Use geometric shapes, their measures, and their properties to describe objects.★	*For example, modeling a tree trunk or a human torso as a cylinder.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*
	G.MG.A.2 Apply geometric methods to solve real-world problems.★	*Geometric methods may include but are not limited to using geometric shapes, the probability of a shaded region, density, and design problems.* *There are no assessment limits for this standard. The entire standard is assessed in this course.*

Major content of the course is indicated by the light green shading of the cluster heading and standard's coding.

	Major Content		Supporting Content