

California Tutorials are designed specifically for the California Common Core State Standards and the California Next Generation Science Standards to prepare students for the Smarter Balanced Assessment Consortium (SBAC) exams and the California Science Tests.

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

Unit 1: Points, Lines, and Angles

- **POINTS, RAYS, LINE SEGMENTS, LINES, AND FIGURES**

- G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

- **PARALLEL AND PERPENDICULAR LINES**

- G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- G-GPE.5: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically 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).

- **PARALLEL LINES AND ANGLE RELATIONSHIPS**

- G-CO.9: Geometry Congruence Prove geometric theorems Prove theorems about lines and angles.

- **PERPENDICULAR BISECTOR AND ANGLE BISECTOR THEOREMS**

- G-CO.9: Geometry Congruence Prove geometric theorems Prove theorems about lines and angles.
- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.

Unit 2: Coordinate Geometry

- **SLOPE-INTERCEPT FORM OF A LINEAR EQUATION**

- G-GPE.5: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically 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).

- **LENGTH AND THE DISTANCE FORMULA**

- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GPE.6: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
- G-GPE.7: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

- **MIDPOINT FORMULA ON THE COORDINATE PLANE**

- G-GPE.6: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

- **CONJECTURES IN COORDINATE GEOMETRY**

- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-GPE.4: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Use coordinates to prove simple geometric theorems algebraically.

Unit 3: Perimeter, Area, and Transformations on the Coordinate Plane

- **PERIMETER ON THE COORDINATE PLANE**

- G-GPE.7: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GPE.4: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Use coordinates to prove simple geometric theorems algebraically.
- **AREA ON THE COORDINATE PLANE**
 - G-GPE.7: Geometry Expressing Geometric Properties with Equations Use coordinates to prove simple geometric theorems algebraically Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **TRANSFORMATIONS ON THE COORDINATE PLANE**
 - G-CO.2: Geometry Congruence Experiment with transformations in the plane Represent transformations in the plane using, 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.3: Geometry Congruence Experiment with transformations in the plane Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
 - G-CO.5: Geometry Congruence Experiment with transformations in the plane 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.6: Geometry Congruence Understand congruence in terms of rigid motions 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 decide if they are congruent.
 - G-SRT.1.a: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations Verify experimentally the properties of dilations given by a center and a scale factor: 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.
 - G-SRT.2: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations 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-CO.4: Geometry Congruence Experiment with transformations in the plane Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
- G-SRT.1.b: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations Verify experimentally the properties of dilations given by a center and a scale factor: The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- **DILATIONS, TRANSLATIONS, ROTATIONS, AND REFLECTIONS**
 - G-CO.3: Geometry Congruence Experiment with transformations in the plane Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
 - G-CO.5: Geometry Congruence Experiment with transformations in the plane 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.6: Geometry Congruence Understand congruence in terms of rigid motions 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 decide if they are congruent.
 - G-CO.2: Geometry Congruence Experiment with transformations in the plane Represent transformations in the plane using, 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.4: Geometry Congruence Experiment with transformations in the plane Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
 - G-SRT.1.a: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations Verify experimentally the properties of dilations given by a center and a scale factor: 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.
 - G-SRT.1.b: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations Verify experimentally the properties of dilations given by a center and a scale factor: The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
 - G-SRT.2: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations 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.

Unit 4: Congruence and Similarity

• TRIANGLES AND CONGRUENCE TRANSFORMATIONS

- G-CO.6: Geometry Congruence Understand congruence in terms of rigid motions 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 decide if they are congruent.
- G-CO.7: Geometry Congruence Understand congruence in terms of rigid motions 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.
- G-CO.8: Geometry Congruence Understand congruence in terms of rigid motions Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.
- G-SRT.5: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.

• TRIANGLES AND SIMILARITY TRANSFORMATIONS

- G-SRT.2: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations 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.5: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.
- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-SRT.3: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

• CONGRUENCE OF OTHER POLYGONS

- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-CO.6: Geometry Congruence Understand congruence in terms of rigid motions 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 decide if they are congruent.
- G-CO.2: Geometry Congruence Experiment with transformations in the plane Represent transformations in the plane using, 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.5: Geometry Congruence Experiment with transformations in the plane 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.3: Geometry Congruence Experiment with transformations in the plane Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- **SIMILARITY OF OTHER POLYGONS**
 - G-SRT.2: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations 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.

Unit 5: Triangles

- **CLASSIFYING TRIANGLES**
 - G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
 - G-GMD.6.: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Verify experimentally that in a triangle, angles opposite longer sides are larger, sides opposite larger angles are longer, and the sum of any two side lengths is greater than the remaining side length; apply these relationships to solve real-world and mathematical problems.
 - G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.

- **TRIANGLE ANGLE THEOREMS**

- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.

- **TRIANGLE BISECTORS**

- G-CO.9: Geometry Congruence Prove geometric theorems Prove theorems about lines and angles.
- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.
- G-SRT.5: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- G-CO.12: Geometry Congruence Make geometric constructions Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
- G-C.3: Geometry Circles Understand and apply theorems about circles Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

- **MEDIANS AND ALTITUDES OF TRIANGLES**

- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.

Unit 6: Quadrilaterals and Constructions

- **PARALLELOGRAMS AND RECTANGLES**

- G-CO.11: Geometry Congruence Prove geometric theorems Prove theorems about parallelograms.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

- **SQUARES AND RHOMBI**

- G-CO.11: Geometry Congruence Prove geometric theorems Prove theorems about parallelograms.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

- **CONSTRUCTIONS**

- G-CO.12: Geometry Congruence Make geometric constructions Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
- G-CO.13: Geometry Congruence Make geometric constructions Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
- G-C.4: Geometry Circles Understand and apply theorems about circles Construct a tangent line from a point outside a given circle to the circle.

Unit 7: Triangles and Trigonometry

• PYTHAGOREAN THEOREM

- G-CO.10: Geometry Congruence Prove geometric theorems Prove theorems about triangles.
- G-SRT.8: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-SRT.4: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Prove theorems about triangles.
- G-SRT.5: Geometry Similarity, Right Triangles, and Trigonometry Prove theorems involving similarity Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

• TRIGONOMETRIC RATIOS

- G-SRT.6: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles 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.
- G-SRT.8: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- G-SRT.8.1: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Derive and use the trigonometric ratios for special right triangles (30,60,90 and 45,45,90).
- G-SRT.8.1: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Derive and use the trigonometric ratios for special right triangles (30,60,90 and 45,45,90).
- G-SRT.8.1: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Derive and use the trigonometric ratios for special right triangles (30,60,90 and 45,45,90).

- G-SRT.7: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Explain and use the relationship between the sine and cosine of complementary angles.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **LAWS OF SINE AND COSINE**
 - G-SRT.9: Geometry Similarity, Right Triangles, and Trigonometry Apply trigonometry to general triangles Derive the formula $= \frac{1}{2} ab \sin()$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
 - G-SRT.10: Geometry Similarity, Right Triangles, and Trigonometry Apply trigonometry to general triangles Prove the Laws of Sines and Cosines and use them to solve problems.
 - G-SRT.11: Geometry Similarity, Right Triangles, and Trigonometry Apply trigonometry to general triangles Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).
 - G-SRT.8: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- **RADIANS AND THE UNIT CIRCLE**
 - G-C.5: Geometry Circles Find arc lengths and areas of sectors of circles Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.
 - G-SRT.8: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
 - G-SRT.8.1: Geometry Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles Derive and use the trigonometric ratios for special right triangles (30,60,90 and 45,45,90).

Unit 8: Circles

- **CIRCLE BASICS**
 - G-C.2: Geometry Circles Understand and apply theorems about circles Identify and describe relationships among inscribed angles, radii, and chords.
 - G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- **CENTRAL ANGLES, INSCRIBED ANGLES, AND CHORDS**
 - G-CO.9: Geometry Congruence Prove geometric theorems Prove theorems about lines and angles.

- G-C.2: Geometry Circles Understand and apply theorems about circles Identify and describe relationships among inscribed angles, radii, and chords.
- G-C.3: Geometry Circles Understand and apply theorems about circles Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- **SECANTS, ANGLES, AND INTERCEPTED ARCS**
 - G-CO.9: Geometry Congruence Prove geometric theorems Prove theorems about lines and angles.
 - G-C.2: Geometry Circles Understand and apply theorems about circles Identify and describe relationships among inscribed angles, radii, and chords.
- **TANGENTS, ANGLES, AND INTERCEPTED ARCS**
 - G-CO.9: Geometry Congruence Prove geometric theorems Prove theorems about lines and angles.
 - G-C.2: Geometry Circles Understand and apply theorems about circles Identify and describe relationships among inscribed angles, radii, and chords.

Unit 9: Properties of Circles

- **CONGRUENT AND SIMILAR CIRCLES**
 - G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
 - G-CO.6: Geometry Congruence Understand congruence in terms of rigid motions 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 decide if they are congruent.
 - G-C.1: Geometry Circles Understand and apply theorems about circles Prove that all circles are similar.
 - G-CO.4: Geometry Congruence Experiment with transformations in the plane Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
 - G-SRT.2: Geometry Similarity, Right Triangles, and Trigonometry Understand similarity in terms of similarity transformations 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.
- **CIRCUMFERENCE AND ARC LENGTH**
 - G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of

point, line, distance along a line, and distance around a circular arc.

- G-GMD.1: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **AREA OF CIRCLES AND SECTORS**
 - G-GMD.1: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
 - G-CO.1: Geometry Congruence Experiment with transformations in the plane Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
 - G-C.5: Geometry Circles Find arc lengths and areas of sectors of circles Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.

Unit 10: Conic Sections

- **CIRCLES**
 - G-GPE.1: Geometry Expressing Geometric Properties with Equations Translate between the geometric description and the equation for a conic section Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- **PARABOLAS**
 - G-GPE.2: Geometry Expressing Geometric Properties with Equations Translate between the geometric description and the equation for a conic section Derive the equation of a parabola given a focus and directrix.

Unit 11: Surface Area

- **SURFACE AREA AND VOLUME OF SPHERES**
 - G-GMD.4: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GMD.3: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- **SURFACE AREA OF COMPOSITE SOLIDS**
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **SURFACE AREA OF SIMILAR SOLIDS**
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
 - G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
 - G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
 - G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
 - G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.

Unit 12: Volume

- **CONVERTING BETWEEN TWO-DIMENSIONAL FIGURES AND THREE-DIMENSIONAL SOLIDS**
 - G-GMD.4: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
- **VOLUME OF PRISMS AND PYRAMIDS**

- G-GMD.4: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GMD.1: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
- G-GMD.3: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- **VOLUME OF CYLINDERS AND CONES**
 - G-GMD.1: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
 - G-GMD.3: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
 - G-GMD.4: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **MODELING SITUATIONS WITH GEOMETRY**
 - G-MG.2: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
 - G-MG.3: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with topographic grid systems based on ratios).

Unit 13: Volume of Similar and Composite Shapes

- **VOLUME OF COMPOSITE SOLIDS**
 - G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree

trunk or a human torso as a cylinder).

- G-GMD.3: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

- **VOLUME OF SIMILAR SOLIDS**

- G-GMD.3: Geometry Geometric Measurement and Dimension Explain volume formulas and use them to solve problems Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.

- **EFFECTS OF CHANGING DIMENSIONS ON PERIMETER, AREA, AND VOLUME**

- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.
- G-MG.1: Geometry Modeling with Geometry Apply geometric concepts in modeling situations Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k , and k , respectively; determine length, area and volume measures using scale factors.

- G-GMD.5: Geometry Geometric Measurement and Dimension Visualize relationships between two-dimensional and three-dimensional objects Know that the effect of a scale factor k greater than zero on length, area, and volume is to multiply each by k , k^2 , and k^3 , respectively; determine length, area and volume measures using scale factors.

Unit 14: Basic Probability Concepts

• INTRODUCTION TO PROBABILITY

- S-CP.2: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand that two events and are independent if the probability of and occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
- S-CP.8: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Apply the general Multiplication Rule in a uniform probability model, $(A \text{ and } B) = P(A)P(B)$, and interpret the answer in terms of the model.
- S-CP.1: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data 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).
- S-CP.2: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand that two events and are independent if the probability of and occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
- S-CP.8: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Apply the general Multiplication Rule in a uniform probability model, $(A \text{ and } B) = P(A)P(B)$, and interpret the answer in terms of the model.
- S-CP.7: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Apply the Addition Rule, $(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.

• COMBINATIONS AND PERMUTATIONS

- S-CP.9: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Use permutations and combinations to compute probabilities of compound events and solve problems.

Unit 15: Advanced Probability Concepts

• CONDITIONAL PROBABILITY

- S-CP.3: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand the conditional probability of given as $P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$, and interpret independence of and as saying that the conditional

probability of given is the same as the probability of , and the conditional probability of given is the same as the probability of .

- S-CP.5: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
- S-CP.6: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Find the conditional probability of given as the fraction of s outcomes that also belong to , and interpret the answer in terms of the model.
- S-CP.2: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand that two events and are independent if the probability of and occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
- S-CP.3: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand the conditional probability of given as (and)/(), and interpret independence of and as saying that the conditional probability of given is the same as the probability of , and the conditional probability of given is the same as the probability of .
- S-CP.6: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Find the conditional probability of given as the fraction of s outcomes that also belong to , and interpret the answer in terms of the model.
- S-CP.4: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data 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.
- S-CP.3: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand the conditional probability of given as (and)/(), and interpret independence of and as saying that the conditional probability of given is the same as the probability of , and the conditional probability of given is the same as the probability of .
- S-CP.6: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Find the conditional probability of given as the fraction of s outcomes that also belong to , and interpret the answer in terms of the model.
- S-CP.3: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand the conditional probability of given as (and)/(), and interpret independence of and as saying that the conditional

probability of given is the same as the probability of , and the conditional probability of given is the same as the probability of .

- S-CP.6: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Find the conditional probability of given as the fraction of s outcomes that also belong to , and interpret the answer in terms of the model.
- S-CP.3: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data Understand the conditional probability of given as (and)/(), and interpret independence of and as saying that the conditional probability of given is the same as the probability of , and the conditional probability of given is the same as the probability of .
- S-CP.6: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Find the conditional probability of given as the fraction of s outcomes that also belong to , and interpret the answer in terms of the model.
- **GEOMETRIC PROBABILITIES**
 - S-CP.1: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data 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).
 - S-MD.7: Statistics and Probability Using Probability to Make Decisions Use probability to evaluate outcomes of decisions Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
 - S-CP.1: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data 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).
 - S-CP.7: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Apply the Addition Rule, (or) = () + () (and), and interpret the answer in terms of the model.
 - S-CP.1: Statistics and Probability Conditional Probability and the Rules of Probability Understand independence and conditional probability and use them to interpret data 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).
 - S-CP.7: Statistics and Probability Conditional Probability and the Rules of Probability Use the rules of probability to compute probabilities of compound events in a uniform probability model Apply the Addition Rule, (or) = () + () (and), and interpret the answer in terms of the model.

- **ANALYZING DECISIONS IN PROBABILITY**

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- S-MD.6: Statistics and Probability Using Probability to Make Decisions Use probability to evaluate outcomes of decisions Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
 - S-MD.7: Statistics and Probability Using Probability to Make Decisions Use probability to evaluate outcomes of decisions Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
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