Shapes

Kindergarten
K.G.1 Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to. K.G.2 Name shapes regardless of their orientation or overall size. K.G.3 Understand the difference between two-dimensional (lying in a plane, “flat”) and three-dimensional (“solid”) shapes. K.G.4 Analyze, compare, and sort two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts, and other attributes. e.g., number of sides and vertices/“corners”, or having sides of equal length.
First Grade
1.G.1 Distinguish between defining attributes versus non-defining attributes for a wide variety of shapes. Build and/or draw shapes to possess defining attributes. e.g., - A defining attribute may include, but is not limited to: triangles are closed and three-sided. - Non-defining attributes include, but are not limited to: color, orientation, and overall size. **Note on and/or:** Students should be taught to build and draw shapes to possess defining attributes; however, when answering questions, students can choose to build or draw the shape.
2nd Grade
2.G.1 Classify two-dimensional figures as polygons or non-polygons.
3rd Grade
3.G.1 Recognize and classify polygons based on the number of sides and vertices (triangles, quadrilaterals, pentagons, and hexagons). Identify shapes that do not belong to one of the given subcategories. **Note:** Include both regular and irregular polygons, however, students need not use formal terms “regular” and “irregular,” e.g., students should be able to classify an irregular pentagon as “a pentagon,” but do not need to classify it as an “irregular pentagon.”
4th Grade
4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. NY-4.G.2a. Identify and name triangles based on angle size (right, obtuse, acute). NY-4.G.2b Identify and name all quadrilaterals with 2 pairs of parallel sides as parallelograms. NY-4.G.2c Identify and name all quadrilaterals with four right angles as rectangles. 4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.
5th Grade
5.G.3 Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. e.g., All rectangles have four right angles and squares are rectangles, so all squares have four right angles. Note: The inclusive definition of a trapezoid will be utilized, which defines a trapezoid as “A quadrilateral with at least one pair of parallel sides.” NY-5.G.4 Classify two-dimensional figures in a hierarchy based on properties.
7th Grade
7.G.3 Describe the two-dimensional shapes that result from slicing three-dimensional solids parallel or perpendicular to the base. Note: Focus of standard is on plane sections resulting from the slicing of right rectangular prisms and right rectangular pyramids.
Geometry Congruence

GEO-G.CO.1 Know precise definitions of angle, circle, perpendicular lines, parallel lines, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc as these exist within a plane. **GEO-G.CO.11 Prove and apply theorems about parallelograms.** **<u>Notes:</u> Include multi-step proofs and algebraic problems built upon these concepts.** **The inclusive definition of a trapezoid will be utilized, which defines a trapezoid as "A quadrilateral with at least one pair of parallel sides." Examples of theorems include but are not limited to:** - **A diagonal divides a parallelogram into two congruent triangles.** - **Opposite sides/angles of a parallelogram are congruent.** - **The diagonals of parallelogram bisect each other.** - **If the diagonals of quadrilateral bisect each other, then quadrilateral is a parallelogram.** - **If the diagonals of a parallelogram are congruent then the parallelogram is a rectangle.** **Additional theorems covered allow for proving that a given quadrilateral is a particular parallelogram (rhombus, rectangle, square) based on given properties.**
<u>Geometry: Expressing Geometric Properties with Equations</u>
GEO-G.GPE.4 On the coordinate plane, algebraically prove geometric theorems and properties. Notes: Examples include but not limited to: - Given points and/or characteristics, prove or disprove a polygon is a specified quadrilateral or triangle based on its properties. - Given a point that lies on a circle with a given center, prove or disprove that a specified point lies on the same circle. This standard is a fluency recommendation for Geometry. Fluency with the use of coordinates to establish geometric results and the use of geometric representations as a modeling tool are some of the most valuable tools in mathematics and related fields.
<u>Geometry: Geometric Measurement and Dimension</u>
GEO-G.GMD.4 Identify the shapes of plane sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. Note: Plane sections are not limited to being parallel or perpendicular to the base.
<u>Geometry: Modeling with Geometry</u>
GEO-G.MG.1 Use geometric shapes, their measures, and their properties to describe objects

Areas and Volumes

Kindergarten

NY-K.G.5 Model objects in their environment by building and/or drawing shapes. e.g., using blocks to build a simple representation in the classroom. Note on and/or: Students should be taught to model objects by building and drawing shapes; however, when answering a question, students can choose to model the object by building or drawing the shape.

NY-K.G.6 Compose larger shapes from simple shapes. e.g., join two triangles to make a rectangle

First Grade

NY-1.G.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.
Note: Students do not need to learn formal names such as “right rectangular prism.”

2nd Grade

NY-2.G.2 Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.

NY-2.OA.4 Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns. Write an equation to express the total as a sum of equal addends.

3rd Grade

NY-3.MD.5 Recognize area as an attribute of plane figures and understand concepts of area measurement.
NY-3.MD.5a Recognize a square with side length 1 unit, called “a unit square,” is said to have “one square unit” of area, and can be used to measure area.
NY-3.MD.5b Recognize a plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units.

NY-3.MD.6 Measure areas by counting unit squares.
Note: Unit squares include square cm, square m, square in., square ft., and improvised units.

NY-3.MD.7 Relate area to the operations of multiplication and addition.
NY-3.MD.7a Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.
NY-3.MD.7b Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.
NY-3.MD.7c Use tiling to show in a concrete case that the area of a rectangle with whole-number side length a and side length b + c is the sum of a × b and a × c. Use area models to represent the distributive property in mathematical reasoning.
NY-3.MD.7d Recognize area as additive. Find areas of figures composed of non-overlapping rectangles, and apply this technique to solve real world problems.
Note: Problems include no more than one unknown side length.

NY-3.MD.8a Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths or finding one unknown side length given the perimeter and other side lengths.
NY-3.MD.8b Identify rectangles with the same perimeter and different areas or with the same area and different perimeters.

4th Grade

NY-4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. e.g., Find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.

NY-4.NF.4 Apply and extend previous understandings of multiplication to multiply a whole number by a fraction.
NY-4.NF.4a Understand a fraction a/b as a multiple of 1/b . e.g., Use a visual fraction model to represent 5 4 as the product 5 × 1 4 , recording the conclusion with the equation 5 4 = 5 × 1 4 .
NY-4.NF.4b Understand a multiple of a/b as a multiple of 1/b, and use this understanding to multiply a whole number by a fraction. e.g., Use a visual fraction model to express 3 × 2 5 as 6 × 1 5 , recognizing this product as 6 5 , in general, n × a/b = (n × a) /b . NY-4.NF.4c Solve word problems involving multiplication of a whole number by a fraction. e.g., using visual fraction models and equations to represent the problem. e.g., If each person at a party will eat 3 8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?

5th Grade

NY-5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement. NY-5.MD.3a Recognize that a cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume. NY-5.MD.3b Recognize that a solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. NY-5.MD.4 Measure volumes by counting unit cubes, using cubic cm, cubic in., cubic ft., and improvised units. **NY-5.MD.5 Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.** **NY-5.MD.5a Find the volume of a right rectangular prism with whole number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base.** **NY-5.MD.5b. Apply the formulas V = l × w × h and V = B × h for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.** **NY-5.MD.5c Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.** NY-5.NF.4b Find the area of a rectangle with fractional side lengths by tiling it with rectangles of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.
6th Grade
NY-6.G.1 Find area of triangles, trapezoids, and other polygons by composing into rectangles or decomposing into triangles and quadrilaterals. Apply these techniques in the context of solving real-world and mathematical problems. Note: The inclusive definition of a trapezoid will be utilized, which defines a trapezoid as “A quadrilateral with at least one pair of parallel sides.” (This definition includes parallelograms.) **NY-6.G.2 Find volumes of right rectangular prisms with fractional edge lengths in the context of solving real world and mathematical problems.** NY-6.G.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real world and mathematical problems. Note: Three-dimensional figures include only right rectangular prisms, right rectangular pyramids, and right triangular prisms. When finding surface areas, all necessary measurements will be given. NY-6.G.5 Use area and volume models to explain perfect squares and perfect cubes.
7th Grade
NY-7.G.4 Apply the formulas for the area and circumference of a circle to solve problems. Note: Students in grade 7 are not expected to calculate the radius of a circle given its area. NY-7.G.6 Solve real-world and mathematical problems involving area of two-dimensional objects composed of triangles and trapezoids. Solve surface area problems involving right prisms and right pyramids composed of triangles and trapezoids. Find the volume of right triangular prisms, and solve volume problems involving three-dimensional objects composed of right rectangular prisms. Notes: The inclusive definition of a trapezoid will be utilized, which defines a trapezoid as “A quadrilateral with at least one pair of parallel sides.” (This definition includes parallelograms and rectangles.) Right prisms include cubes.
8th Grade
NY-8.G.6 Understand a proof of the Pythagorean Theorem and its converse. NY-8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. NY-8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system **NY-8.G.9 Given the formulas for the volume of cones, cylinders, and spheres, solve mathematical and real-world problems.**
Geometry: Similarity, Right Triangles and Trigonometry

GEO-G.SRT.8 Use sine, cosine, tangent, the Pythagorean Theorem and properties of special right triangles to solve right triangles in applied problems. **Note: Special right triangles refer to the 30-60-90 and 45-45-90 triangles** GEO-G.SRT.9 Justify and apply the formula A= ½ ab sin (C) to find the area of any triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
<u>Geometry: Geometric Properties with Equations</u>
GEO-G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. Note: Midpoint formula is a derivative of this standard. GEO-G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles. Note: This standard is a fluency recommendation for Geometry. Fluency with the use of coordinates to establish geometric results and the use of geometric representations as a modeling tool are some of the most valuable tools in mathematics and related fields.
<u>Geometry: Circles</u>
GEO-G.C.5 Using proportionality, find one of the following given two others; the central angle, arc length, radius or area of sector. Note: Angle measure is in degrees.
<u>Geometry: Geometric Measurement and Dimension</u>
GEO-G.GMD.1 Provide informal arguments for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. GEO-G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
<u>Geometry: Modeling with Geometry</u>
GEO-G.MG.2 Apply concepts of density based on area and volume of geometric figures in modeling situations. GEO-G.MG.3 Apply geometric methods to solve design problems. Note: Applications may include designing an object or structure to satisfy constraints such as area, volume, mass and cost.
<u>Algebra II</u>
AII-F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, horizontal shift, and midline AII-F.TF.8 Prove the Pythagorean identity sin2 (θ) + cos2 (θ) = 1. Find the value of any of the six trigonometric functions given any other trigonometric function value and when necessary find the quadrant of the angle.

Similarity/Congruence

4th Grade

NY-4.G.2a. Identify and name triangles based on angle size (right, obtuse, acute).

4.MD.5 Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement.
4.MD.5a. Recognize an angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1 360 of a circle is called a “one-degree angle,” and can be used to measure angles.
4.MD.5b Recognize an angle that turns through n one-degree angles is said to have an angle measure of n degrees.

NY-4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

NY-4.MD.7 Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems. e.g., using an equation with a symbol for the unknown angle measure.

7th Grade

NY-7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. Note: Students in grade 7 are limited to solving equations that involve linear expressions on one side of the equation.

8th Grade

NY-8.G.2 Know that a two-dimensional figure is congruent to another if the corresponding angles are congruent and the corresponding sides are congruent. Equivalently, two two-dimensional figures are congruent if one is the image of the other after a sequence of rotations, reflections, and translations. Given two congruent figures, describe a sequence that maps the congruence between them on the coordinate plane.

NY-8.G.4 Know that a two-dimensional figure is similar to another if the corresponding angles are congruent and the corresponding sides are in proportion. Equivalently, two two-dimensional figures are similar if one is the image of the other after a sequence of rotations, reflections, translations, and dilations. Given two similar two-dimensional figures, describe a sequence that maps the similarity between them on the coordinate plane. Note: With dilation, the center and scale factor must be specified

NY-8.G.5 Use informal arguments 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. e.g., Arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so. Note: This standard does not include formal geometric proof. Multiple representations may be used to demonstrate understanding.

Geometry: Similarity, Right Triangles and Trigonometry

GEO-G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar. Explain using similarity transformations that similar triangles have equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. Notes: The center and scale factor of the dilation must always be specified with dilation. A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center (point) and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors.

GEO-G.SRT.3 Use the properties of similarity transformations to establish the AA~, SSS~, and SAS~ criterion for two triangles to be similar.

GEO-G.SRT.4 Prove and apply similarity theorems about triangles.
Notes: Include multi-step proofs and algebraic problems built upon these concepts.
Examples of theorems include but are not limited to:

- **If a line parallel to one side of a triangle intersects the other two sides of the triangle, then the line divides these two sides proportionally (and conversely).**
- **The length of the altitude drawn from the vertex of the right angle of a right triangle to its hypotenuse is the geometric mean between the lengths of the two segments of the hypotenuse.**
- **The centroid of the triangle divides each median in the ratio 2:1.**

GEO-G.SRT.5 Use congruence and similarity criteria for triangles to:
GEO-G.SRT.5a Solve problems algebraically and geometrically.
GEO-G.SRT.5b Prove relationships in geometric figures.
Notes: ASA, SAS, SSS, AAS, and Hypotenuse-Leg (HL) theorems are valid criteria for triangle congruence. AA~, SAS~, and

SSS~ are valid criteria for triangle similarity. **This standard is a fluency recommendation for Geometry. Fluency with the triangle congruence and similarity criteria will help students throughout their investigations of triangles, quadrilaterals, circles, parallelism, and trigonometric ratios. These criteria are necessary tools in many geometric modeling tasks** GEO-G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of sine, cosine and tangent ratios for acute angles GEO-G.SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.
Geometry: Congruence
GEO-G.CO.1 Know precise definitions of angle, circle, perpendicular lines, parallel lines, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc as these exist within a plane. GEO-G.CO.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. GEO-G.CO.8 Explain how the criteria for triangle congruence (ASA, SAS, SSS, AAS and HL (Hypotenuse Leg)) follow from the definition of congruence in terms of rigid motions. GEO-G.CO.9 Prove and apply theorems about lines and angles. Note: Include multi-step proofs and algebraic problems built upon these concepts. Examples of theorems include but are not limited to: - Vertical angles are congruent. - If two parallel lines are cut by a transversal, then the alternate interior angles are congruent. - The points on a perpendicular bisector are equidistant from the endpoints of the line segment. **GEO-G.CO.10 Prove and apply theorems about triangles.** **Note: Include multi-step proofs and algebraic problems built upon these concepts.** **Examples of theorems include but are not limited to: Angle Relationships:** - **The sum of the interior angles of a triangle is 180 degrees.** - **The measure of an exterior angle of a triangle is equal to the sum of the two non-adjacent interior angles of the triangle. Side Relationships:** - **The length of one side of a triangle is less than the sum of the lengths of the other two sides.** - **In a triangle, the segment joining the midpoints of any two sides will be parallel to the third side and half its length. Isosceles Triangles** - **Base angles of an isosceles triangle are congruent.**
Geometry: Circles
GEO-G.C.1 Prove that all circles are similar. GEO-G.C.2a Identify, describe and apply relationships between the angles and their intercepted arcs of a circle. GEO-G.C.2b. Identify, describe and apply relationships among radii, chords, tangents, and secants of a circle. Note: These relationships that pertain to the circle may be utilized to prove other relationships in geometric figures, e.g., the opposite angles in any quadrilateral inscribed in a circle are supplements of each other. Also includes algebraic problems built upon these concepts.
Algebra II
AII-F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle AII-F.TF.2 Apply concepts of the unit circle in the coordinate plane to calculate the values of the six trigonometric functions given angles in radian measure. AII-F.TF.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. Note: Focus of this standard is on cos(x), sin(x) and tan(x)

Transformations

4th Grade
4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.
5th Grade
NY-5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
6th Grade
NY-6.NS.8 Solve real-world and mathematical problems by graphing points on a coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. NY-6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices. Use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.
7th Grade
NY-7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. NY-7.G.2 Draw triangles when given measures of angles and/or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. Note: Create triangles through the use of freehand drawings, materials (scaffolds may include: pipe cleaners, Legos®, and toothpicks), rulers, protractors, and/or technology.
8th Grade
NY-8.G.1 Verify experimentally the properties of rotations, reflections, and translations. Notes: A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center/point of rotation and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors. NY-8.G.1a Verify experimentally lines are mapped to lines, and line segments to line segments of the same length. NY-8.G.1b Verify experimentally angles are mapped to angles of the same measure. NY-8.G.1c Verify experimentally parallel lines are mapped to parallel lines. NY-8.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. Note: Lines of reflection are limited to both axes and lines of the form y=k and x=k, where k is a constant. Rotations are limited to 90 and 180 degrees about the origin. Unless otherwise specified, rotations are assumed to be counterclockwise.
Algebra I: Interpreting Functions
AI-F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). Note: Domain and range can be expressed using inequalities, set builder notation, verbal description, and interval notations for functions of subsets of real numbers to the real numbers. AI-F.IF.7 Graph functions and show key features of the graph by hand and by using technology where appropriate. ★ (Shared standard with Algebra II)
Geometry: Congruence
GEO-G.CO.2 Represent transformations as geometric functions that take points in the plane as inputs and give points as outputs. Compare transformations that preserve distance and angle measure to those that do not. Note: Instructional strategies may include drawing tools, graph paper, transparencies and software programs. GEO-G.CO.3 Given a regular or irregular polygon, describe the rotations and reflections (symmetries) that map the polygon onto itself. Note: The inclusive definition of a trapezoid will be utilized, which defines a trapezoid as “A quadrilateral with at least one pair of parallel sides.

GEO-G.CO.4 Develop definitions of rotations, reflections, and translations in terms of points, angles, circles, perpendicular lines, parallel lines, and line segments. Notes: Includes point reflections. A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center (point) and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors.

GEO-G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another. Notes: Instructional strategies may include graph paper, tracing paper, and geometry software. Includes point reflections. A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center (point) and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors. Singular transformations that are equivalent to a sequence of transformations may be utilized, such as a glide reflection. However, glide reflections are not an expectation of the course.

GEO-G.CO.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 decide if they are congruent. Notes: A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center (point) and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors.

GEO-G.CO.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.

GEO-G.CO.8 Explain how the criteria for triangle congruence (ASA, SAS, SSS, AAS and HL (Hypotenuse Leg)) follow from the definition of congruence in terms of rigid motions.

GEO-G.CO.12 Make, justify and apply formal geometric constructions.
<u>Notes:</u> Examples of constructions include but are not limited to:

- Copy segments and angles.
- Bisect segments and angles.
- Construct perpendicular lines including through a point on or off a given line.
- Construct a line parallel to a given line through a point not on the line.
- Construct a triangle with given lengths.
- Construct points of concurrency of a triangle (centroid, circumcenter, incenter, and orthocenter).
- Construct the inscribed circle of a triangle.
- Construct the circumscribed circle of a triangle.
- Constructions of transformations. (see GEO-G.CO.5)

This standard is a fluency recommendation for Geometry. Fluency with the use of construction tools, physical and computational, helps students draft a model of a geometric phenomenon and can lead to conjectures and proofs.

GEO-G.CO.13 Make and justify the constructions for inscribing an equilateral triangle, a square and a regular hexagon in a circle.

<u>Geometry: Geometric Properties with Equations</u>

GEO-G.GPE.1a Derive the equation of a circle of given center and radius using the Pythagorean Theorem. Find the center and radius of a circle, given the equation of the circle.
Notes:

- Finding the center and radius may involve completing the square. The completing the square expectation for Geometry follows Algebra I: leading coefficients will be 1 (after possible removal of GCF) and the coefficients of the linear terms will be even.
- Completing the square may yield a fractional radius.

GEO-G.GPE.1b Graph circles given their equation. Note: For circles being graphed, the center will be an ordered pair of integers and the radius a positive integer.

GEO-G.GPE.5 On the coordinate plane:
GEO-G.GPE.5a Explore the proof for the relationship between slopes of parallel and perpendicular lines;
GEO-G.GPE.5b Determine if lines are parallel, perpendicular, or neither, based on their slopes; and
GEO-G.GPE.5c Apply properties of parallel and perpendicular lines to solve geometric problems.
Note: This standard is a fluency recommendation for Geometry. Fluency with the use of coordinates to establish geometric results and the use of geometric representations as a modeling tool are some of the most valuable tools in mathematics and related fields.

GEO-G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
Note: This standard is a fluency recommendation for Geometry. Fluency with the use of coordinates to establish geometric results and the use of geometric representations as a modeling tool are some of the most valuable tools in mathematics and related fields.

<u>Geometry: Similarity, Right Triangles, and Trigonometry</u>

GEO-G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor.
GEO-G.SRT.1a Verify experimentally that 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
GEO-G.SRT.1b Verify experimentally that the dilation of a line segment is longer or shorter in the ratio given by the scale factor
GEO-G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar. Explain using similarity transformations that similar triangles have equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. Notes: The center and scale factor of the dilation must always be specified with dilation. A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center (point) and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors.