Geometry Mathematics Standards

Comparison Tool for Standards Transition

Updated June 2012

This document can be used to assist educators in analyzing the commonalities and differences between the new Alaska mathematics standards and the Fourth Edition (Grade Level Expectations). This document is a first start toward a transition and districts may choose to augment with more detail.

The first column contains the new math standards. The second column shows the Grade Level Expectations (GLEs) that align to the new standards. The third column provides comments, usually highlighting differences between the new standards and GLEs that align in higher grades. Additionally, the comments may include a notation about an increase in rigor. Rigor may be defined as a standard that requires deeper understanding, higher-order thinking, expanded analytical processes, or simply a skill introduced at an earlier grade.

Note that some GLEs are coded with an L. This signifies that the GLE was not assessed on the statewide assessment; it was to be assessed at the local level. No new standards are identified as being for local assessment. Students advancing through the grades are expected to meet each year’s grade-specific standards and retain or further develop skills and understandings mastered in preceding grades.

In most cases there are not complete matches between the two sets of standards, and it should not be assumed that either the content or skills found in one set of standards will match completely with those of the other set.

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| 6.RP.2. Understand the concept of a unit rate (*a*/*b* associated with a ratio *a:b* with *b ≠* 0, and use rate language in the context of a ratio relationship) and apply it to solve real world problems (e.g., unit pricing, constant speed).*For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar.” “We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger.”* | **[6] E&C-5** developing and interpreting scale modelsAny aligned GLE found in the higher grades will need to be absorbed in the lower grade as part of the transition. | Grade 6 GLE provides a specific real-world model for understanding unit rate. **[7] E&C-6** solving proportions using a given scale**[8] E&C-5** using ratio and proportion |

The new standards represent a shift in the purpose of the standards. They are more instructional in nature, intended to guide classroom curriculum. The new standards do not serve as an assessment document, unlike the GLEs. The Department with the support of stakeholders will prepare an assessment framework that will guide the development of the new assessments. The new standards will be assessed starting spring 2016. Until then, all districts will continue administering the Standards Based Assessments aligned to the GLEs through spring 2015.

**The GLEs that are not matched to the new standards can be found in a separate document, HS Math GLEs.** The comment column indicates where the GLE may be matched to a new standard in a lower or higher grade. Although some GLEs will be taught at other grade levels, teachers must provide opportunities for these GLEs to be reviewed in preparation for the spring Standards Based Assessments through spring 2015.

| **Grade 6 Math GLEs not matched by new standards** | **Comments** |
| --- | --- |
| **The student demonstrates conceptual understanding of fractions (proper or mixed numbers), decimals, percents (whole number), or integers by****[6] N-2** identifying place value positions from thousandths to millions (L) | Grade 4 and 5 Standards **(4.NF.6, 4.NF.7, 5.NBT.3)** |

This GLE must be reviewed prior to the SBA through spring 2015.

Finally, the new standards for each grade level define what students should understand and be able to do by the end of each grade which includes the Standards for Mathematical Practice. The Standards for Mathematical Practice describe characteristics and traits that mathematics educators at all levels should seek to develop in their students. They describe ways that students should be engaging with mathematics as they progress through school. The integration of these standards into classroom instruction is a key strategy for increasing cognitive demand and conceptual learning. The Standards for Mathematical Practice are included in the separate document, HS Math GLEs.

The next page provides an overview of this conceptual category.

**Geometry Overview**

|  |  |
| --- | --- |
| **Congruence*** Experiment with transformations in the plane.
* Understand congruence in terms of rigid motions.
* Prove geometric theorems.
* Make geometric constructions.

**Similarity, Right Triangles, and Trigonometry*** Understand similarity in terms of similarity transformations.
* Prove theorems involving similarity.
* Define trigonometric ratios and solve problems involving right triangles.
* Apply trigonometry to general triangles.

**Circles*** Understand and apply theorems about circles.
* Find arc lengths and areas of sectors of circles.

**Expressing Geometric Properties with Equations*** Translate between the geometric description and the equation for a conic section.
* Use coordinates to prove simple geometric theorems algebraically.

**Geometric Measurement and Dimension*** Explain volume formulas and use them to solve problems.
* Visualize relationships between two-dimensional and three-dimensional objects.

**Modeling with Geometry*** Apply geometric concepts in modeling situations.
 | **In High School, students:*** Establish and use triangle congruence, prove theorems and solve problems about triangles, quadrilaterals, and other polygons, and apply reasoning to complete geometric constructions and explain why they work;
* Build a formal understanding of similarity, use similarity to solve problems, and apply similarity to understand right triangle trigonometry and the Pythagorean theorem, and develop the Laws of Sines and Cosines;
* Extend experience with two-dimensional and three-dimensional objects to include informal explanations of circumference, area and volume formulas, apply knowledge of two-dimensional shapes to consider the shapes of cross-sections and the result of rotating a two-dimensional object about a line;
* Use a rectangular coordinate system to verify geometric relationships and continue their study of quadratics by connecting the geometric and algebraic definitions of the parabola; and
* Prove basic theorems about circles and study relationships as an application of similarity, use the distance formula to write the equation of a circle, draw the graph in the coordinate plane, and apply techniques for solving quadratic equations to determine intersections between lines and circles or parabolas and between two circles.
 |
| **Connections to Equations:** The correspondence between numerical coordinates and geometric points allows methods from algebra to be applied to geometry and vice versa. The solution set of an equation becomes a geometric curve, making visualization a tool for doing and understanding algebra. Geometric shapes can be described by equations, making algebraic manipulation into a tool for geometric understanding, modeling, and proof. | **Mathematical Practices (MP)**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.
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**Congruence - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Experiment with transformations in the plane** |  |  |
| G-CO.1. Demonstrates understanding of key geometrical definitions, including angle, circle, perpendicular line, parallel line, line segment, and transformations in Euclidian geometry. Understand undefined notions of point, line, distance along a line, and distance around a circular arc. | NEW – not addressed in the GLEs  | Defining geometric terms are not included in the GLEs and many GLEs involve conceptual understanding of terms but not definitions.  |
| G-CO.2. 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). | **[9] G-3** [drawing or describing the results of applying transformations (translations, rotations, reflections, or dilations) to figures on a coordinate plane L] |  |
| G-CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. | **[9] G-3** [drawing or describing the results of applying transformations (translations, rotations, reflections, or dilations) to figures on a coordinate plane L] | Symmetry is implied in the stem of the GLE. |
| G-CO.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. | NEW – not addressed in the GLEs  |  |
| G-CO.5. 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. | **[9] G-3** [drawing or describing the results of applying transformations (translations, rotations, reflections, or dilations) to figures on a coordinate plane L] |  |
| **Understand congruence in terms of rigid motions** |  |  |
| 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. | **[10] G-3** identifying congruent and similar figures using Euclidean geometry (e.g., [constructions **L**], coordinate geometry)**[10] G-4** using transformations to show congruence or similarity of figures on a coordinate plane |  |
| 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. | NEW – not addressed in the GLEs  | GLEs do not specifically address triangle congruence. The GLE belowdoes address congruent figures.**[10] G-3** identifying congruent and similar figures using Euclidean geometry (e.g., [constructions **L**], coordinate geometry) |
| G-CO.8. Explain how the criteria for triangle congruence (ASA, SAS, SSS, AAS, and HL) follow from the definition of congruence in terms of rigid motions. | NEW – not addressed in the GLEs  | GLEs do not specifically address triangle congruence. |
| **Prove geometric theorems** |  |  |
| G-CO.9. Using methods of proof including direct, indirect, and counter examples to prove theorems about lines and angles. Theorems include: 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. | **[10] G-1** identifying, analyzing, comparing, or using properties of plane figures:• supplementary, complementary or vertical angles• angles created by parallel lines with a transversal• sum of interior or exterior angles of a polygon• central angles, chords, inscribed angles or arcs of a circle | GLEs do not explicitly require proving theorems in geometry.**[10] PS-4** using methods of proof including direct, indirect, and counter examples to validate conjectures |
| G-CO.10. Using methods of proof including direct, indirect, and counter examples to prove theorems about triangles. Theorems include: 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. | NEW – not addressed in the GLEs  | GLEs do not explicitly require proving theorems in geometry. GLEs reference proving theorems but do not specify theorems involving triangles. GLEs do not explicitly include many of the triangle properties.**[10] PS-4** using methods of proof including direct, indirect, and counter examples to validate conjectures |
| G-CO.11. Using methods of proof including direct, indirect, and counter examples to prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. | NEW – not addressed in the GLEs  | GLEs do not explicitly require proving theorems in geometry. GLEs reference proving theorems but do not specify theorems involving parallelograms. GLEs do not explicitly include many of the parallelogram properties.**[10] PS-4** using methods of proof including direct, indirect, and counter examples to validate conjectures |
| **Make geometric constructions** |  |  |
| G-CO.12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line. | **The student demonstrates a conceptual understanding of geometric drawings or constructions by** **[10] G-8** [drawing, measuring, or constructing geometric models of plane figures (containing parallel and/or perpendicular lines, angles, perpendicular bisectors, congruent angles, regular polygons) L] | GLEs do not require geometric constructions – they include the choices of drawing and measuring as a means of “constructing” as well. Tools and methods for construction are not specified in the GLEs (i.e., students can copy a segment by measuring with a ruler OR students can use a compass to copy a segment). |
| G-CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. | **[9] G-6** [drawing, measuring, or constructing geometric models of plane figures (containing parallel and/or perpendicular lines) L] |  |

**Similarity, Right Triangles, and Trigonometry - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Understand similarity in terms of similarity transformations** |  |  |
| G-SRT.1. Verify experimentally the properties of dilations given by a center and a scale factor:a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor. | NEW – not addressed in the GLEs  |  |
| G-SRT.2. Given two figures, use the definition of similarity in terms of transformations to explain whether or not they are similar. | NEW – not addressed in the GLEs  | GLEs do not specifically address triangle similarity. The GLE belowdoes address similar figures.**[10] G-3** identifying congruent and similar figures using Euclidean geometry (e.g., [constructions L], coordinate geometry) |
| G-SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. | NEW – not addressed in the GLEs  | GLEs do not specifically address triangle similarity. The GLE below does address similar figures.**[10] G-3** identifying congruent and similar figures using Euclidean geometry (e.g., [constructions L], coordinate geometry) |

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| **Prove theorems involving similarity** |  |  |
| G-SRT.4. Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely.* | NEW – not addressed in the GLEs  | Specific content is not found in the GLEs and do not include many of the triangle properties explicitly. GLEs reference proving theorems but do not specify theorems involving triangles. Methods for this standard are under the GLE below. **[10] PS-4** using methods of proof including direct, indirect, and counter examples to validate conjectures |
| G-SRT.5. Apply congruence and similarity properties and prove relationships involving triangles and other geometric figures. | **[9] MEA-2** applying indirect methods, such as the Pythagorean theorem to find missing dimensions in real-world applications | The GLE is not specific about using triangle similarity. GLEs do not address proving relationships.  |
| **Define trigonometric ratios and solve problems involving right triangles** |  |  |
| G-SRT.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. | NEW – not addressed in the GLEs  | GLEs use trigonometry to solve problems, not to define the terms. |
| G-SRT.7. Explain and use the relationship between the sine and cosine of complementary angles. | NEW – not addressed in the GLEs  |  |
| G-SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.\* | **[9] MEA-2** applying indirect methods, such as the Pythagorean theorem to find missing dimensions in real-world applications**[10] MEA-2** [Applying right triangle trigonometry (sine, cosine, and tangent) to find missing dimensions in real-world applications L] |  |
| **Apply trigonometry to general triangles** |  |  |
| G-SRT.9. (+) Derive the formula *A* = 1/2 *ab* sin(*C*) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. | NEW – not addressed in the GLEs  |  |
| G-SRT.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems. | NEW – not addressed in the GLEs  |  |
| G-SRT.11. (+) 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). | NEW – not addressed in the GLEs  |  |

**Circles - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Understand and apply theorems about circles** |  |  |
| G-C.1. Prove that all circles are similar. | NEW – not addressed in the GLEs  |  |
| G-C.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.* | **[10] G-1** identifying, analyzing, comparing, or using properties of plane figures:• supplementary, complementary or vertical angles• angles created by parallel lines with a transversal• sum of interior or exterior angles of a polygon• central angles, chords, inscribed angles or arcs of a circle  |  |
| G-C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. | NEW – not addressed in the GLEs  |  |
| G-C.4. (+) Construct a tangent line from a point outside a given circle to the circle. | NEW – not addressed in the GLEs  |  |
| **Find arc lengths and areas of sectors of circles** |  |  |
| G-C.5. Use and apply the concepts of arc length and areas of sectors of circles. Determine or 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. | NEW – not addressed in the GLEs  |  |

**Expressing Geometric Properties with Equations - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Translate between the geometric description and the equation for a conic section** |  |  |
| G-GPE.1. Determine or 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. | NEW – not addressed in the GLEs  |  |
| G-GPE.2. Determine or derive the equation of a parabola given a focus and directrix. | NEW – not addressed in the GLEs  |  |
| G-GPE.3. (+) Derive the equations of ellipses and hyperbolas given foci and directrices. | NEW – not addressed in the GLEs  |  |
| **Use coordinates to prove simple geometric theorems algebraically** |  |  |
| G-GPE.4. Perform simple coordinate proofs. *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,* √*3) lies on the circle centered at the origin and containing the point (0, 2).* | NEW – not addressed in the GLEs  |  |
| G-GPE.5. 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). |  **[10] G-7** graphing a system of equations on a coordinate grid, identifying a solution, or determining their relationship (intersecting, parallel, perpendicular) | The new standard includes finding an equation which is not included in the GLE. |

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| G-GPE.6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. | **[10] G-6** graphing a line segment on a coordinate grid and/or identifying its length or midpoint by using formulas | The GLE only indicates midpoint while the proposed standard includes any given ratio. |
| G-GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.\* | **[10] G-6** graphing a line segment on a coordinate grid and/or identifying its length or midpoint by using formulas | The GLEs do not indicate finding perimeters and areas with coordinates. |

**Geometric Measurement and Dimension - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Explain volume formulas and use them to solve problems** |  |  |
| G-GMD.1. Explain how to find the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.  | NEW – not addressed in the GLEs  |  |
| G-GMD.2. (+) Give an informal argument using Cavalieri’s principle for the formulas for the volume of a sphere and other solid figures. | NEW – not addressed in the GLEs  |  |
| G-GMD.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. *For example: Solve problems requiring determination of a dimension not given.*\* | **[9] G-4** determining the volume or surface area of prisms, cylinders, cones or pyramids**[10] G-5** determining the volume or surface area of spheres or compound solids |  |
| **Visualize relationships between two-dimensional and three-dimensional objects** |  |  |
| G-GMD.4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. | NEW – not addressed in the GLEs  | The proposed standard builds upon the GLE below which could include cones, torus, etc. **[10] G-2** [using isometric drawings to create two-dimensional drawings of three-dimensional objects (shapes that are composites of rectangular right prisms) **L**] |

**Modeling with Geometry - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Apply geometric concepts in modeling situations** |  |  |
| G-MG.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).\* | NEW – not addressed in the GLEs  |  |
| G-MG.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).\* | NEW – not addressed in the GLEs  |  |
| G-MG.3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\* | NEW – not addressed in the GLEs  |  |