Notes on Reading the Washington State Mathematics Standards Transition Documents

This document serves as a guide to translate between the 2008 Washington State K-8 Learning Standards for Mathematics and the Common Core State Standards (CCSS) for Mathematics. It begins with the Standards for Mathematical Practice which are the backbone of the CCSS for Mathematics. These practices highlight the change in focus, through instructional practices, of developing these 'habits of mind' in our students. One or more of these Standards for Mathematical Practice should be intentionally incorporated in the development of any concept or procedure taught.

The Standards for Mathematical Practice are followed by the key critical areas of focus for a grade-level. These critical areas are the overarching concepts and procedures that must be learned by students to be successful at the next grade level and beyond. As units are planned, one should always reflect back on these critical areas to ensure that the concept or fluency developed in the unit is tied directly to one of these. The CCSS were developed around these critical areas in order for instruction to be deep and focused on a few key topics each year. By narrowing the focus and deepening the understanding, increases in student achievement will be realized.

The body of this document includes a two-column table which indicates the alignment of the 2008 Washington State K-8 Learning Standards for Mathematics to the CCSS for Mathematics at a grade level. It is meant to be read from left to right across the columns. The right column contains all of the CCSS for Mathematics for that grade. The left column indicates the grade-level Washington standard that most aligns to it.

Bolded words are used to describe the degree of alignment between these sets of standards. If the words bolded are **Continue to**, this indicates that the CCSS standard and the Washington standard are closely aligned. The teacher should read the wording carefully on the CCSS standard because often there is a more in-depth development of the aligned Washington standard and often there are more than one standard that address a particular Washington standard. If the word **extend** is bolded that indicates that the Washington and CCSS standards are similar but the CCSS takes the concept further than the Washington standard. Lastly, if the words **Move students to** are bolded, then the CCSS standards take the Washington standard to a deeper or further understanding of this particular cluster concept. If the left-hand side is blank, the CCSS is new material that does not match the Washington standards at this grade level. Sometimes there can be a page or more of these unaligned standards. One is reminded that while this is new material for this grade level, other standards currently taught at this grade level in the 2008 Washington standards will have moved to other grades. The movement of these unaligned standards is laid out on the last pages of this document. Comments on CCSS Geometry standards are often found in italics at the end of a cluster.

Washington State
Geometry Mathematics Standards Transition Document

This document serves as one guide to translate between the 2008 Washington State Standards for Mathematics and the Common Core State Standards for Mathematics.

The Standards for Mathematical Practice describes varieties of expertise that mathematics educators at all levels should seek to develop in their students. These standards should be integrated throughout the teaching and learning of the content standards of the Common Core State Standards.

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.

With full implementation of the Common Core State Standards for mathematics in Geometry, instructional time should focus on six critical areas:

1) establishing congruence criteria and using triangle congruence as a foundation for the development of formal proof; and applying reasoning to complete geometric constructions;
2) building a formal understanding of similarity; identifying criteria for similarity of triangles, using similarity to solve problems, and applying similarity in right triangles to understand right triangle trigonometry, with particular attention to special right triangles and the Pythagorean Theorem;
3) extending two-dimensional and three-dimensional experience to include informal explanations of circumference, area and volume formulas; applying knowledge of two-dimensional shapes to consider the shapes of cross –sections and the result of rotating a two-dimensional object about a line;
4) using a rectangular coordinate system to verify geometric relationships including properties of special triangles and quadrilaterals, slopes of parallel and perpendicular lines, and connecting the geometric and algebraic definitions of the parabola;
5) proving basic theorems about circles, studying relationships among segments on chords, secants, and tangents as an application of similarity, using the distance formula to write the equation of a circle when given the radius and the coordinates of its center, drawing the graph of an equation of a circle in the coordinate plane, and applying techniques for solving quadratic equations to determine intersections between lines and circles or parabolas and between two circles; and
6) using the languages of set theory to compute and interpret theoretical and experimental probability for compound events, attending to mutually exclusive events, independent events, and conditional probability.

(+) denotes mathematics students should learn in order to take advanced courses, included to increase coherence, not for high stakes assessments

★ **denotes a "Modeling" standard throughout this document, both a conceptual category and a mathematical practice**

Unit 1 – Congruence, Proof and Constructions	
Aligned current WA standards	Geometry Common Core State Standards
Students currently:	***Students need to:*** **Experiment with transformations in a plane.** **Continue to** 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.1) When given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. (G.CO.3)
G.5.D Describe the symmetries of two-dimensional figures and describe transformations, including reflections across a line and rotations about a point. G.5.B Determine and apply properties of transformations.	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. (G.CO.4)
G.5.A Sketch results of transformations and compositions of transformations for a give two-dimensional figure on the coordinate plane, and describe the rule(s) for performing translations or for performing reflections about the coordinate axes or the line y=x. G.5.C Given two congruent or similar figures in a coordinate plane, describe a composition of translations, reflections, rotations and dilations that superimposes on figure on the other.	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.5)

G.3.B Determine and prove triangle congruence, triangle similarity, and other properties of triangles.	**Move students to** 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.2) *Build on student experience with rigid motions from earlier grades. Point out the basis of rigid motions in geometric concepts, e.g., translations move points a specified distance along a line parallel to a specified line; rotations move objects along a circular arc with a specified center through a specified angle.* **Understand congruence in terms of rigid motion.** **Continue to** use geometric descriptions of rigid motions to transform figures. (G.CO.6) 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.7) Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. (G.CO.8) **Move students 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.6) *Rigid motions are at the foundation of the definition of congruence. Students reason from the basic properties of rigid motions (that they preserve distance and angle), which are assumed without proof. Rigid motions and their assumed properties can be used to establish the usual triangle congruence criteria, which can then be used to prove other theorems.*

	Prove geometric theorems.
G.2.A Know, prove and apply theorems about parallel and perpendicular lines G.2.B Know, prove and apply theorems about angles that arise from parallel lines intersected by a transversal	**Continue 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.* (G.CO.9)
G.3.A Know, explain, and apply basic postulates and theorems about triangles and the special lines, line segments, and rays associated with a triangle. G.3.B Determine and prove triangle congruence, triangle similarity, and other properties of triangles.	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.* (G.CO.10)
G.3.F Know, prove and apply basic theorems about parallelograms G.3.G Know, prove and apply theorems about properties of quadrilaterals and other polygons	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.* (G.CO.11)
	Encourage multiple ways of writing proofs, such as in narrative paragraphs, using flow diagrams, in two-column format, and using diagrams without words. Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning. Implementation of G.CO.10 may be extended to include concurrence of perpendicular bisectors and angle bisector as preparation for G.C.3 in Unit 5.
	Make geometric constructions.
G.2.C Explain and perform basic compass and straightedge constructions related to parallel and perpendicular lines.	**Continue to** make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective

G.3.I Explain and perform constructions related to the circle	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*. (G.CO.12) **Extend to** constructing an equilateral triangle, a square, and a regular hexagon inscribed in a circle. (G.CO.13) *Build on prior student experience with simple constructions. Emphasize the ability to formalize and explain how these constructions result in the desired objects. Some of these constructions are closely related to previous standards and can be introduced in conjunction with them.*

Unit 2 – Similarity, Proof, and Trigonometry

Aligned current WA standards	Geometry Common Core State Standards
Students currently:	***Students need to:*** **Understand similarity in terms of similarity transformations.**
G.5.B Determine and apply properties of transformations.	**Extend to** verifying experimentally the properties of dilations given by a center and a scale factor. (G.SRT.1) 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.
G.3.B Determine and prove triangle congruence, triangle similarity, and other properties of triangles.	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.2)

	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. (G.SRT.3)
	Prove theorems involving similarity.
G.3.D Know, prove, and apply the Pythagorean Theorem and its converse.	**Continue to** prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.* (G.SRT.4)
	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. (G.SRT.5)
	Define trigonometric ratios and solve problems involving right triangles.
G.3.C Use the properties of special right triangles(30°–60°–90° and 45°–45°–90°) to solve problems.	**Continue to** 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.6)
G.3.E Solve problems involving the basic trigonometric ratios of sine, cosine, and tangent.	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. (G.SRT.8)
	Extend to explaining and using the relationship between the sine and cosine of complementary angles. (G.SRT.7)
	Apply geometric concepts in modeling situations.
	Move students to use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).* (G.MG.1)

	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).* (G.MG.2) 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).* (G.MG.3) *Focus on situations well modeled by trigonometric ratios for acute angles.* **Apply trigonometry to general triangles. (+)** **Move students to** 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. (G.SRT.9) (+) Prove the Laws of Sines and Cosines and use them to solve problems. (G.SRT.10) (+) 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.11) (+) *With respect to the general case of the Laws of Sines and Cosines, the definitions of sine and cosine must be extended to obtuse angles.*

Unit 3 – Extending to Three Dimensions	
Aligned current WA standards	Geometry Common Core State Standards
Students currently:	***Students need to:***
	Explain volume formulas and use them to solve problems.
G.6.C Apply formulas for surface area and volume of three-dimensional figures to solve problems.	**Continue to** use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.* (G.GMD.3) **Extend to** giving an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.* (G.GMD.1) *Informal arguments for area and volume formulas can make use of the way in which area and volume scale under similarity transformations: when one figure in the plane results from another by applying a similarity transformation with scale factor k, its area is k^2 times the area of the first. Similarly, volumes of solid figures scale by k^3 under a similarity transformation with scale factor k.*
	Visualize the relation between two-dimensional and three-dimensional objects.
G.3.K Analyze cross-sections of cubes, prisms, pyramids, and spheres and identify the resulting shapes. G.3.J Describe prisms, pyramids, parallelepipeds, tetrahedra, and regular polyhedra in terms of their faces, edges, vertices, and properties.	**Continue to** 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.GMD.4)

G.6.B Analyze distance and angle measures on a sphere and apply these measurements to the geometry of the earth.	**Apply geometric concepts in modeling situations.** **Move students to** use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). (G.MG.1)★ *Focus on situations that require relating two- and three-dimensional objects, determining and using volume, and the trigonometry of general triangles.*

Unit 4 – Connecting Algebra and Geometry Through Coordinates

Aligned current WA standards	Geometry Common Core State Standards
Students currently:	***Students need to:*** **Use coordinates to prove simple geometric theorems algebraically.**
G.4.C Verify and apply properties of triangles and quadrilaterals in the coordinate plane. G.4.D Determine the equation of a circle that is described geometrically in the coordinate plane and, given equations for a circle and a line, determine the coordinates of their intersection(s).	**Continue to** use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2). (*G.GPE.4)
G.4.A Determine the equation of a line in the coordinate plane that is described geometrically, including a line through two given points, a line through a given point parallel to a given line, and a line through a given point perpendicular to a given line.	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). (G.GPE.5)
G.4.B Determine the coordinates of a point that is described geometrically.	Find the point on a directed line segment between two given points that partitions the segment in a given ratio. (G.GPE.6)

	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. (G.GPE.7) *This unit has a close connection with the next unit. For example, a curriculum might merge G.GPE.1 and the Unit 5 treatment of G.GPE.4 with the standards in this unit. Reasoning with triangles in this unit is limited to right triangles; e.g., derive the equation for a line through two points using similar right triangles.* *Relate work on parallel lines in G.GPE.5 to work on A.REI.5 in High School Algebra I involving systems of equations having no solution or infinitely many solutions.* *G.GPE.7 provides practice with the distance formula and its connection with the Pythagorean theorem.* **Translate between the geometric description and the equation for a conic section.** **Move students to** derive the equation of a parabola given a focus and directrix. (G.GPE.2) *The directrix should be parallel to a coordinate axis.*

Unit 5 – Circles With and Without Coordinates

Aligned current WA standards	Geometry Common Core State Standards
Students currently:	***Students need to:***
	Understand and apply theorems about circles.
G.3.H Know, prove, and apply basic theorems relating circles to tangents, chords, radii, secants, and inscribed angles.	**Continue to** 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. (G.C.2) **Move students to** prove that all circles are similar. (G.C.1)
G.3.I Explain and perform constructions related to the circle.	**Continue to** construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. (G.C.3) Construct a tangent line from a point outside a given circle to the circle. (G.C.4) (+)
	Find arc lengths and areas of sectors of circles.
G.6.A Derive and apply formulas for arc length and area of a sector of a circle.	**Continue to** 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. (G.C.5) *Emphasize the similarity of all circles. Note that by similarity of sectors with the same central angle, arc lengths are Proportional to the radius. Use this as a basis for introducing radian as a unit of measure. It is not intended that it be applied to the development of circular trigonometry in this course.*
	Translate between the geometric description and the equation for a conic section.
G.4.D Determine the equation of a circle that is described geometrically in the coordinate plane and, given equations for a circle and a line, determine the coordinates of their intersection(s).	**Move students to** 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. (G.GPE.1)

G.4.B Determine the coordinates of a point that is described geometrically.	**Use coordinates to prove simple geometric theorems algebraically.** **Move students to** use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).* (G.GPE.4) *Include simple proofs involving circles.* **Apply geometric concepts in modeling situations.** **Move students to** use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).★ (G.MG.1) *Focus on situations in which the analysis of circles is required.*

Unit 6 – Applications of Probability

Aligned current WA standards	Geometry Common Core State Standards
Students currently: *There are no WA Geometry learning standards that match these CCSS probability standards.*	***Students need to:*** **Understand independence and conditional probability and use them to interpret data.** **Move students to** understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent. (S.CP.2) 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.1)

There are no WA Geometry learning standards that match these CCSS probability standards.	Understand the conditional probability of *A* and *B* as *P(A* and *B)/P(B),* and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*. (S.CP.3) 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. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* (S.CP.4) Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* (S.CP.5) *Build on work with two-way tables from Algebra I Unit 3 (S.ID.5) to develop understanding of conditional probability and independence.* **Use the rules of probability to compute probabilities of compound events in a uniform probability model.** **Move students to** use permutations and combinations to compute probabilities of compound events and solve problems. (S.CP.9) (+)

There are no WA Geometry learning standards that match these CCSS probability standards.	Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. (S.CP.6) Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. (S.CP.7) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. (S.CP.8) (+) **Use probability to evaluate outcomes of decisions. (+)** **Move students to** use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). (S.MD.6) (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). (S.MD.7) (+) *This unit sets the stage for work in Algebra II, where the ideas of statistical inference are introduced. Evaluating the risks associated with conclusions drawn from sample data (i.e. incomplete information) requires an understanding of probability concepts.*

With full implementation of the CCSS, Geometry teachers will no longer be responsible for teaching students the standards listed below. The grade level where these standards will be emphasized is in parentheses.

G.6.D Predict and verify the effect that changing one, two, or three linear dimensions has on perimeter, area, volume, or surface area of two- and three-dimensional figures. (Grade 7)

G.6.E Use different degrees of precision in measurement, explain the reason for using a certain degree of precision, and apply estimation strategies to obtain reasonable measurement and appropriate precision for a given purpose. (Algebra 1)

With full implementation of the CCSS, only a portion of this WA Geometry learning standard is taught. The portion not taught will be emphasized at the grade level indicated in parentheses.

G.6.C Apply formulas for surface area and volume of cylinders and volume of pyramids and cones to solve problems. (Grade 7)

While not a Geometry CCSS, attention to this 2008 WA Geometry learning standard will be a natural part of developing understanding of concepts.

G.2.D Describe the intersections of lines in the plane and in space, of lines and planes, and of planes in space.

G.6.F Solve problems involving measurement conversions within and between systems, including those involving derived units, and analyze solutions in terms of reasonableness of solutions and appropriate units.