Unpacked South Dakota State Mathematics Standards

Purpose: *In order for students to have the best chance of success, standards, assessment, curriculum resources, and instruction must be aligned in focus, coherence, and rigor. Unpacked standards documents are intended to help align instruction to the focus, coherence, and rigor of the South Dakota State Mathematics Standards. The standards have been organized in clusters as they are not so much built from topics, but rather woven out of progressions. Not all content in a given grade is emphasized equally in the mathematics standards. Some clusters require greater emphasis than others based on the depth of the ideas, the time that they take to master, and/or their importance to future mathematics or the demands of college and career readiness. To say that some things have greater emphasis is not to say that anything in the standards can safely be neglected in instruction. Neglecting standards will leave gaps in student skill and understanding and may leave students unprepared for the challenges of a later grade.*

Domain: Geometry	**Grade Level: Geometry**

G.G.GPE.B Cluster: Use coordinates to prove simple geometric systems algebraically

The focus of this cluster is coordinate geometry. Learners work with coordinates to find slope, distances, midpoints, and locations that are at a specified ratio from an endpoint. They then use this information to prove geometric relationships such as properties of quadrilaterals or location of a point on a circle. Using slope criteria for parallel and perpendicular lines, learners write equations of lines. Using lengths computed from coordinates, learners find perimeters and areas of polygons.

****This is an ADDITIONAL cluster.** *Students should spend the large majority of their time (65-85%) on the major work of the grade. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.*

G.G.GPE.B.4 Use coordinates to prove geometric relationships algebraically. For example, determine whether a figure defined by four given points in the coordinate plane is a rectangle; determine whether the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).

G.G.GPE.B.5 Define and use the slope criteria for parallel and perpendicular lines. (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

G.G.GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. e.g. Determine the point(s) that divide the segment with endpoints of (-4, 7) and (6, 3) into the ratio 2:3

G.G.GPE.B.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. *

Aspects of Rigor: (Conceptual, Procedural, and/or Application)

G.G.GPE.B.4 Use coordinates to prove geometric relationships algebraically. For example, determine whether a figure defined by four given points in the coordinate plane is a rectangle; determine whether the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand geometric relationships can be verified algebraically using the distance, slope, and/or midpoint between coordinates. Know the geometric properties necessary to classify a polygon. Understand distance is an application of the Pythagorean Theorem.	Calculate slope between two ordered pairs to prove parallel or perpendicular sides. Calculate the length of sides to prove congruence. Calculate the length of diagonals to prove congruence. Calculate the midpoint of diagonals to	Calculate the pitch of a roof or grade of land to facilitate rainfall drainage.

	prove they are bisected. Calculate the slopes of diagonals to prove they are perpendicular. Calculate the distance of a point from a center to determine whether it lies on a specified circle.	

G.G.GPE.B.5 Define and use the slope criteria for parallel and perpendicular lines. (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

Conceptual Understanding	***Procedural Fluency***	***Application***
Know that parallel lines have the same slope. Know that perpendicular lines have slopes that are opposite reciprocals and that their product is -1.	Calculate slope from given ordered pairs. Classify lines or segments as parallel or perpendicular given slopes, graphs, and/or equations of lines. Write equations for parallel lines and perpendicular lines given a point and an equation of a line.	

G.G.GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. e.g. Determine the point(s) that divide the segment with endpoints of (-4, 7) and (6, 3) into the ratio 2:3

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand distance is an application of the Pythagorean Theorem.	Calculate the midpoint of segments with given endpoints or points shown on a graph. Calculate the point that partitions a segment into a given ratio given endpoints or points shown on a graph.	Find the location on a map. For example, locate the point in a park that is ⅔ of the distance from the pool to the basketball court.

G.G.GPE.B.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. *

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand distance is an application of the Pythagorean Theorem. Understand the information required to calculate the perimeter and area of polygons.	Calculate lengths of sides of polygons given a graph or set of ordered pairs to compute the perimeter. Calculate the lengths of sides of rectangles and sides and heights of triangles to compute their areas.	

Enacting the Mathematical Practices - Evidence of Students Engaging in the Practices

1. **Make sense of problems and persevere in solving them.**
   - Learners must be challenged to develop deep understanding through exploring a range of tasks that require problem solving.
   - Make sense of formulas and the relationships among them.
2. **Reason abstractly and quantitatively**
   - Justifying formulas will move learners from concrete to abstract thinking.

- Reason quantitatively about coordinates and their relationship to properties.
- Ensure reasonableness of answers.

3. **Construct viable arguments and critique the reasoning of others.**
   - A central focus is constructing viable arguments about formulas in order to avoid ambiguity.
4. **Model with mathematics.**
   - Use coordinates to model geometric situations and generalize to formulas i.e. distance, slope.
5. **Use appropriate tools strategically.**
   - Use appropriate tools such as graph paper and dynamic geometry software to explore possible relationships.
6. **Attend to precision.**
   - Correctly apply procedures i.e distance, completing the square.
   - Determine appropriate level of precision (exact answer vs. rounding).
   - Use precise language to describe relationships.
7. **Look for and make use of structure.**
   - Learners explore patterns and consider the structure of relationships within the coordinate plane in order to form generalizations.
   - Look for relationships of parts in order to determine perimeters and areas.
8. **Look for and express regularity in repeated reasoning.**
   - Learners can connect algebraic operations with visual representations (i.e. distance and subtraction, midpoint and average).

Vertical and Horizontal Coherence and Learning Progressions

Previous Learning Connections	***Current Learning Connections***	***Future Learning Connections***
In 6th grade, learners find the area of polygons by composing into rectangles or decomposing into triangles and other shapes. They also draw polygons in the coordinate plane given coordinates for the vertices and find the length of horizontal and vertical sides. . In 7th grade, learners solve real-world and mathematical problems involving area of triangles, quadrilaterals, and polygons. In 8th grade, learners apply the Pythagorean Theorem to find the distance between two points in a coordinate system. In Algebra I, learners write equations of lines given a slope and point.	Learners have already had experience with properties of quadrilaterals, equations of circles, and finding area and perimeter earlier in the course. They now apply this knowledge to working with coordinates. Learners will use the concept of distance and midpoint throughout the rest of the geometry course They apply the concepts later when calculating volumes and surface areas or when proving types of quadrilaterals given the ordered pairs of their vertices. They also use distance and midpoint when writing and deriving the equation of circles.	Distance is an application important for many future concepts. For example, when writing equations of conic sections or converting between polar and rectangular coordinates or finding the magnitude of vectors.

Vocabulary (key terms and definitions)

- polygon
- slope
- parallel lines
- perpendicular lines
- opposite reciprocal
- perimeter
- area

Relevance, Explanations, and Examples:

Connect the distance formula to the Pythagorean Theorem and emphasize that it can be used in place of the distance formula.

Find the location of the centroid of a triangle given the endpoints of a median.

Consider using number lines to represent the distance between the x-coordinates and y-coordinates of two ordered pairs to visualize the horizontal and vertical change.

When using coordinate geometry to classify quadrilaterals require learners to show their work, and state the properties used to justify their classification.

When applying the power of analytic geometry to reduce geometric relationships to algebraic ones be careful that learners do not lose sight of the geometric meaning of the formulas.

Achievement Level Descriptors	
Cluster: **Use coordinates to prove simple geometric systems algebraically**	
Concepts and Procedures	***Level 1:***
	Level 2:
	Level 3:
	Level 4: