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.CO.C Cluster: Prove geometric theorems Learners focus on formalizing geometric proof structure and language. They write formal proofs focusing on angle relationships, triangle segment and angle relationships, and parallelogram properties.		
****This is a MAJOR 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.CO.C.9** Prove theorems about lines and angles. Theorems must include but not limited to: vertical angles are congruent; when a transversal intersects parallel lines, alternate interior angles are congruent and same side interior angles are supplementary (using corresponding angles postulate); points on a perpendicular bisector of a line segment are equidistant from the segment's endpoints. **G.G.CO.C.10** Prove congruence theorems about triangles. Theorems must include but not limited to: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the mid segment of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point. **G.G.CO.C.11** Prove theorems about parallelograms. Theorems must include but not limited to: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.		
Aspects of Rigor: (Conceptual, Procedural, and/or Application)		
G.G.CO.C.9 Prove theorems about lines and angles. Theorems must include but not limited to: vertical angles are congruent; when a transversal intersects parallel lines, alternate interior angles are congruent and same side interior angles are supplementary (using corresponding angles postulate); points on a perpendicular bisector of a line segment are equidistant from the segment's endpoints.		
Conceptual Understanding	***Procedural Fluency***	***Application***
Understand the formal language for relationships between angles including vertical angles, and angles created when a transversal intersects parallel lines.	Build formal justifications (proofs) for the theorems about lines and angles.	
G.G.CO.C.10 Prove congruence theorems about triangles. Theorems must include but not limited to: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the mid segment of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.		
Conceptual Understanding	***Procedural Fluency***	***Application***
Understand the formal language for	Build formal justifications (proofs) for	

relationships between angles and sides of triangles.	triangle theorems.	

G.G.CO.C.11 Prove theorems about parallelograms. Theorems must include but not limited to: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand the formal language for relationships between the segments and angles of parallelograms.	Build formal justifications (proofs) for parallelogram theorems.	

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 of the ideas in the clusters through exploring tasks that require problem solving.
    - As learners reason and experiment with rigid motions, determining a correct sequence of transformations will require perseverance.
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
    - Learners should be encouraged to form arguments explaining why certain patterns hold in transformations and constructions, and to critique arguments that are presented to them.
    - In addition to creating proofs (constructing viable arguments), learners should have an opportunity to compare their proofs to those created by their classmates (critique the reasoning of others).
4. **Model with mathematics.**
    - Learners will apply ideas about transformations to model real-world contexts.
5. **Use appropriate tools strategically.**
    - Learners should use a variety of tools constructions and transformations, including compass and straightedge, graph paper, tracing paper, or geometry software.
    - The use of a variety of tools will be useful in making generalizations and proofs about when two triangles will be congruent.
6. **Attend to precision.**
    - While appearances might lead learners to certain conclusions, they need to precisely describe the transformations that they use and ensure that they work as they thought.
    - Learners need to use precise mathematical language to thoroughly explain the reasoning behind their work and when formalizing definitions.
    - Precision is of crucial importance in constructions, since even small errors in executing a construction may lead to results that don't work.
    - Use precise geometric language within proofs.
7. **Look for and make use of structure.**
    - Learners should look for patterns in their explorations, leading them to making generalizations about the transformations and constructions.
    - Looking for structure is an important aspect of conjecturing.
8. **Look for and express regularity in repeated reasoning.**
    - Looking for patterns is an important aspect of conjecturing.
    - Learners will need to look for patterns that will help them see general methods for constructions that can be used.

Vertical and Horizontal Coherence and Learning Progressions

Previous Learning Connections	***Current Learning Connections***	***Future Learning Connections***
In 7th grade, learners use facts about supplementary, complementary, vertical, and adjacent angles.	Formalized theorems will be used to build theorems and proofs for concepts in future clusters.	Understanding the logical flow of developing a proof will be used in future courses such as during proving

In 8th grade, learners use informal arguments to establish facts about the angle sum and exterior angle of triangles, and about the angles created when parallel lines are cut by a transversal.		trigonometric identities.
Vocabulary (key terms and definitions)		
- alternate interior angles - alternate exterior angles - same side (consecutive) interior angles - same side (consecutive) exterior angles - corresponding angles - vertical angles	- linear pair of angles transversal - medians - angle bisector - perpendicular bisector - altitude - Base - base angles	- bisector - isosceles - diagonals - parallelogram - theorem - postulate - midsegment
Relevance, Explanations, and Examples:		
Proofs should be formal but a variety of forms should be used. Include instruction on properties important to proofs such as reflexive property and symmetric property of congruence. Consider reviewing algebraic proofs from Algebra I to lead into the structure of a geometric proof.		
Achievement Level Descriptors		
Cluster: Prove geometric theorems		
Concepts and Procedures	***Level 1:*** Students should be able to base arguments on concrete referents such as objects, drawings, diagrams, and actions and identify obvious flawed arguments in familiar contexts.	
	Level 2: Students should be able to find and identify the flaw in an argument by using examples or particular cases. Students should be able to break a familiar argument given in a highly scaffolded situation into cases to determine when the argument does or does not hold.	
	Level 3: Students should be able to use stated assumptions, definitions, and previously established results and examples to test and support their reasoning or to identify, explain, and repair the flaw in an argument. Students should be able to break an argument into cases to determine when the argument does or does not hold.	
	Level 4: Students should be able to use stated assumptions, definitions, and previously established results to support their reasoning or repair and explain the flaw in an argument. They should be able to construct a chain of logic to justify or refute a proposition or conjecture and to determine the conditions under which an argument does or does not apply.	