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.*

<table>
<tr><td colspan="2">Domain: Geometry</td><td>Grade Level: Geometry</td></tr>
<tr><td colspan="3">G.G.SRT.B Cluster: Prove theorems involving similarity

Learners continue to develop their ability to create proofs while incorporating similarity. They will prove the Pythagorean Theorem based on similar triangles. They will then apply similarity to a variety of real world situations.</td></tr>
<tr><td colspan="3">**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.SRT.B.4 Prove theorems about triangles involving similarity. Theorems must include but not limited to: a line parallel to one side of a triangle divides the other two proportionally, and its converse; the Pythagorean Theorem proved using triangle similarity.

G.G.SRT.B.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</td></tr>
<tr><td colspan="3">Aspects of Rigor: (Conceptual, Procedural, and/or Application)</td></tr>
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<tr><td>Conceptual Understanding</td><td>Procedural Fluency</td><td>Application</td></tr>
<tr><td>Two figures are similar if they can be made congruent by a dilation.

Similarity can be used to prove theorems about parallel lines and right triangles.</td><td>Apply the structure of geometric proofs.</td><td></td></tr>
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<tr><td>Conceptual Understanding</td><td>Procedural Fluency</td><td>Application</td></tr>
<tr><td>Congruence and similarity can be used to explore relationships and solve problems.

Corresponding sides of similar figures are proportional and corresponding angles are congruent.</td><td>Apply the structure of geometric proofs to use concepts of congruence and similarity to prove properties of geometric figures. For example: prove that opposite sides of a parallelogram are congruent or prove that diagonals of isosceles trapezoids are congruent.</td><td>Use similarity to calculate indirect measurements (height of a building, unknown distances, etc.)</td></tr>
</table>

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.
   - Learners reason quantitatively about the relationships among the sides of similar figures.
   - Learners will note relationships among the sides and angles of a right triangle in order to reason about their effect on the trigonometric ratios.
   - Use exploration of transformations to develop criteria for proving similarity.
3. **Construct viable arguments and critique the reasoning of others.**
   - Learners will construct informal and formal arguments (proofs) using properties, definitions, and theorems.
   - Learners should have an opportunity to compare their proofs to those created by their classmates (critique the reasoning of others).
   - Learners need to explain their reasoning for the patterns and relationships they find.
4. **Model with mathematics.**
   - Given its particular applicability in real world contexts, modeling is a particular focus throughout this cluster.
   - Solve contextual problems by modeling with right triangles and determine corresponding parts of similar figures when calculating indirect measurements.
   - Select appropriate similarity theorem(s) or trigonometric relationships to apply to a situation.
5. **Use appropriate tools strategically.**
   - Use a variety of tools, including graph paper, tracing paper, and geometry software to explore relationships and lead to general conclusions.
6. **Attend to precision.**
   - Learners use precise mathematical language to express their reasoning, formulate generalizations, and construct arguments.
   - Select appropriate level of precision (exact answer, rounding).
7. **Look for and make use of structure.**
   - Learners identify patterns in tables of values to formulate generalizations about relationships within and between trigonometric ratios.
   - Determine how complementary angles and their trigonometric functions are related.
   - Use auxiliary lines to design solutions and create arguments.
8. **Look for and express regularity in repeated reasoning.**
   - Look for patterns in explorations and apply them to make generalizations.

Vertical and Horizontal Coherence and Learning Progressions

Previous Learning Connections	***Current Learning Connections***	***Future Learning Connections***
In 8th grade, learners develop the idea of “same shape” and “scale factor” as a definition of similarity.	Having previously studied dilations, learners expand their definition of similarity to include congruence and dilation. These concepts lead to the criteria for triangle similarity. Learners use proportional reasoning to approach problems involving similar figures. Trigonometric ratios will be developed using similar right triangles.	The trigonometric ratios (sine, cosine, tangent) will be founded on right triangles and similarity in subsequent learning. The Pythagorean theorem is generalized to non-right triangles by the Law of Cosines and Law of Sines.

Vocabulary (key terms and definitions)

- similar
- proportionality

- corresponding angles
- criteria for triangle similarity (AA)
- similarity transformation

Relevance, Explanations, and Examples:

Learners should understand that congruence is a special case of similarity where the scale factor = 1.
There are many applications to real-world situations.

Achievement Level Descriptors

Cluster: Prove theorems involving similarity

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.