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.SRT.C Cluster: Define trigonometric ratios and solve problems involving right triangles This cluster builds on the concepts of similarity to define the trigonometric ratios. Using Pythagorean Theorem and trigonometric ratios, learners model and solve for unknown side lengths and angle measures in right triangles.	

**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.C.6 Define, using similarity, that side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios (sine, cosine, and tangent) for acute angles.

G.G.SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.

G.G.SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. *

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

G.G.SRT.C.6 Define, using similarity, that side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios (sine, cosine, and tangent) for acute angles.

Conceptual Understanding	*Procedural Fluency*	*Application*
Understand all angles of the same measure will have equivalent ratios of sides in right triangles. Understand triangles with the same angle measures are similar which leads to the values of the trigonometric ratios for each angle. Know definitions of the trigonometric ratios sine, cosine, and tangent.	Write the trigonometric ratios of a specified angle given the three side lengths of a right triangle.	

G.G.SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.

Conceptual Understanding	*Procedural Fluency*	*Application*
Show using concepts of trigonometric ratios that the sine and cosine ratio of complementary angles are always equal.		

G.G.SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. *		
Conceptual Understanding	*Procedural Fluency*	*Application*
	Find unknown side lengths and angle measures of right triangles using trigonometric ratios and the Pythagorean Theorem.	Model contextual situations with right triangles to calculate the measure of an angle or side of interest. Calculate the measure of a side of interest in a contextual situation when given information that includes an angle of elevation or depression.

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 apply the Pythagorean Theorem to find	Learners will continue to use trigonometric ratios throughout the	In future courses, trigonometric ratios are used to develop more complex

unknown side length in right triangles and distance between two points.	remainder of the course. A strong procedural fluency is necessary for individuals to apply these ratios to items within future clusters. Pythagorean Theorem and the trigonometric ratios are used to find lengths necessary for finding surface areas and volumes. Learners use similarity concepts when defining properties of circles, arc lengths, and sector areas.	concepts such as relationships within the unit circle. Learners will graph the trigonometric functions and observe the cyclic patterns that arise from the trigonometric ratio relationships.

Vocabulary (key terms and definitions)

● trigonometric ratio ● sine ● cosine ● tangent	● opposite leg ● adjacent leg ● hypotenuse	● inverse sine ● inverse cosine ● inverse tangent

Relevance, Explanations, and Examples:

Consider introducing the other three trigonometric ratios (secant, cosecant, and cotangent), as preparation for graphing in future courses.

Emphasize the conceptual understanding of the trigonometric ratios before applying the ratios to solving problems.

Emphasize that all angles of the same measure have the same sine, cosine, or tangent ratio regardless of the size of the triangle. Include activities that reinforce the similarity component of trigonometric ratios. Incorporate technology such as Desmos or Geogebra for precision.

Achievement Level Descriptors

Cluster: Define trigonometric ratios and solve problems involving right triangles

Concepts and Procedures	*Level 1:* Level 1 students should be able to identify trigonometric ratios and use the Pythagorean Theorem to solve for the missing side in a right triangle in familiar real-world or mathematical contexts with scaffolding.
	Level 2: Level 2 students should be able to define trigonometric ratios and should know the relationship between the sine and cosine of complementary angles. They should be able to use the Pythagorean Theorem in unfamiliar problems and trigonometric ratios in familiar problems to solve for the missing side in a right triangle with some scaffolding.
	Level 3: Level 3 students should be able to use the Pythagorean Theorem, trigonometric ratios, and the sine and cosine of complementary angles to solve unfamiliar problems with minimal scaffolding involving right triangles, finding the missing side or missing angle of a right triangle.
	Level 4: Level 4 students should be able to solve unfamiliar, complex, or multistep problems without scaffolding involving right triangles.