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: 4th Year

HS4.G.SRT.A Cluster: Apply trigonometry to general triangles.
Students learn to solve an oblique triangle, find the area of an oblique triangle, and use the Law of Sines and Law of Cosines to model and solve real-world problems.

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.SRT.9 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 and use the formula to solve problems.

G.SRT.10 Prove the Laws of Sines and Cosines and use them to solve problems involving right and non-right triangles.

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

G.SRT.9 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 and use the formula to solve problems.

Conceptual Understanding	*Procedural Fluency*	*Application*
Students use their knowledge of right triangles to derive an area formula for oblique triangles.	Students find the area of oblique triangles in situations where SAS information is provided.	Students use A = 1/2 ab sin(C) area formula to solve application problems.

G.SRT.10 Prove the Laws of Sines and Cosines and use them to solve problems involving right and non-right triangles.

Conceptual Understanding	*Procedural Fluency*	*Application*
Students use their knowledge of right triangles to derive the Law of Sines and Law of Cosines which allow students to find missing sides and angles of oblique triangles.	Students find side lengths and angles of oblique triangles	Students use the Law of Sines and Cosines to solve application problems.

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

1. **Make sense of problems and persevere in solving them.**
   - Students consider different techniques available to solve problems and recognize how these can be extended to more general solution strategies, such as the Law of Sines.
2. **Reason abstractly and quantitatively.**
   - Students reason about the relationships between sides and angle measures in oblique triangles to

determine the reasonableness of answers.
3. **Construct viable arguments and critique the reasoning of others.**
   ● Students justify solution strategies using informal and formal proofs.
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.**

Vertical and Horizontal Coherence and Learning Progressions

Previous Learning Connections	*Current Learning Connections*	*Future Learning Connections*
Students can solve a right triangle. Students can find the area of a right triangle.	Students learn to solve an oblique triangle, find the area of an oblique triangle, and use the Law of Sines and Law of Cosines to model and solve real-world problems.	Any context involving triangles can provide connections to these laws such as architecture and landscaping.

Vocabulary (key terms and definitions)

● Oblique triangle
● Law of Sines
● Law of Cosines

Relevance, Explanations, and Examples:

Example of a Law of Cosines and Law of Sines Application: You walk due east from your house for 400 m. Then you turn 50° to the north and walk for 650 m. You would like to walk directly back to your house. What direction should you turn and how far will you need to walk?

A triangular plot of land has two side lengths of 52 m and 90 m and an included angle of 102 degrees. What is the area of this triangular plot of land?

$$\text{Area} = \frac{1}{2}ab \sin C = \frac{1}{2}(90)(52)(\sin 102°) \approx 2288.87 \text{ square meters.}$$