

# 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.*

<b>Domain: Functions</b>		<b>Grade Level: Algebra 2</b>
<b>A2.F.TF.A Cluster: Extend the domain of trigonometric functions using the unit circle.</b>		
<i>Learners will be able to extend their knowledge of circle and trigonometric ratios (sine and cosine) to arc length, evaluating using a unit circle, and graphing trigonometric functions (sine and cosine).</i>		
<p><b>**This is a SUPPORTING cluster.</b> <i>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.</i></p> <p><b>A2.F.TF.A.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.</b></p> <p><b>A2.F.TF.A.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions (sine and cosine) to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle</b></p>		
<b>Aspects of Rigor for Students:</b> (Conceptual, Procedural, and/or Application)		
<b>A2.F.TF.A.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.</b>		
<b>Conceptual Understanding</b>	<b>Procedural Fluency</b>	<b>Application</b>
Learners understand the relationship between radian measure and arc length.  See example below in <b>Relevance, Explanation, and Examples</b>	Learners solve for arc length, radius, or an angle measure given the other pieces of information.	Learners use arc length to solve real world problems.  Examples: total number of revolutions of a tire given speed, determine a location on a Ferris Wheel, etc.
<b>A2.F.TF.A.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions (sine and cosine) to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.</b>		
<b>Conceptual Understanding</b>	<b>Procedural Fluency</b>	<b>Application</b>
Learners understand and explain how to evaluate trigonometric ratios using their knowledge of special angles on a coordinate plane (ie - unit circle). They will relate this knowledge of trigonometric ratios to graph	Learners will: <ul style="list-style-type: none"> <li>evaluate trigonometric ratios using their knowledge of special angles on a coordinate plane (ie - unit circle).</li> </ul>	

trigonometric functions (sine and cosine) and understand that the domain of these functions is all real numbers.	<ul style="list-style-type: none"> <li>graph trigonometric (sine and cosine) functions.</li> </ul>	
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**Enacting the Mathematical Practices - Evidence of Students Engaging in the Practices**

- 1. Make sense of problems and persevere in solving them.**
- 2. Reason abstractly and quantitatively.**
- 3. Construct viable arguments and critique the reasoning of others.**
  - Students are able to explain how the unit circle can extend a trigonometric function to all real numbers.
- 4. Model with mathematics.**
- 5. Use appropriate tools strategically.**
- 6. Attend to precision.**
  - Students will be able to understand when to give a rounded answer (typically in degrees) vs. an actual answer (typically in radians).
- 7. Look for and make use of structure.**
- 8. Look for and express regularity in repeated reasoning.**
  - Students will use their knowledge of special right triangles and relate it to the unit circle.

**Vertical and Horizontal Coherence and Learning Progressions**

<u>Previous Learning Connections</u>	<u>Current Learning Connections</u>	<u>Future Learning Connections</u>
<p><i>In Geometry, students learn the relationship of trigonometric ratios and special right triangles (which leads to evaluating on the unit circle). Students also learn about radian measure and how to convert to degree measure.</i></p>	<p><i>Students will use this knowledge of trigonometric functions (sine and cosine) and apply transformations and identify key features of these trigonometric functions. They will also be able to evaluate trig ratios on a coordinate plane (not on the unit circle).</i></p>	<p><i>In Precalculus and Calculus courses, students will connect this learning cluster to other trigonometric ratios and functions (tangent, cosecant, secant and cotangent) and inverse trigonometric functions.</i></p>

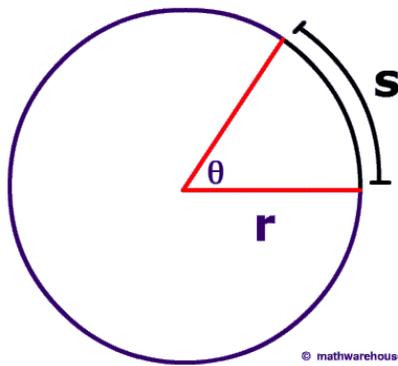
**Vocabulary (key terms and definitions)**

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>Arc length</li> <li>Cosine</li> <li>Degree measure</li> <li>Radian measure</li> <li>Sine</li> </ul> | <ul style="list-style-type: none"> <li>Special right triangles</li> <li>Trigonometric functions</li> <li>Trigonometric ratios</li> <li>Unit Circle</li> </ul> |
|--|---|

**Relevance, Explanations, and Examples:**

- In this cluster, you will also want to discuss how to convert between degree and radian measure (this was learned in Geometry, but students will need a refresher).

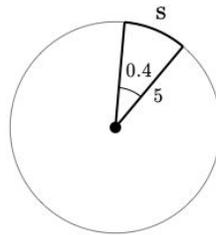
$$s = r\theta$$



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What is the length of arc  $S$  shown below?

units



The angle in the figure is a central angle in radians.

Arc length = radius  $\cdot$  angle  $\leftarrow$  in radians

$$S = 5 \cdot 0.4$$

$$S = 2 \text{ units}$$

\* Example taken from <https://goo.gl/TTNqh6>

### Achievement Level Descriptors

**Cluster:** *Extend the domain of trigonometric functions using the unit circle.*

#### 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.