# 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: Functions | Grade Level: 4th Year |
|---|---|

**HS4.F.TF.B Cluster: Model periodic phenomena with trigonometric functions.**
Students apply the concept of inverse functions to trigonometric functions and use that concept to solve problems.

**In a precalculus class 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.*

**F.TF.6** Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

**F.TF.7** Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

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

**F.TF.6** Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

| *Conceptual Understanding* | *Procedural Fluency* | *Application* |
|---|---|---|
| Inverse trigonometric functions have restricted domains and ranges and are one to one.. (Must pass the horizontal line test) | Students need to know the principal branch for each trigonometric function. | |

**F.TF.7** Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

| *Conceptual Understanding* | *Procedural Fluency* | *Application* |
|---|---|---|
| | Students can solve trigonometric equations to find the solution in the principal branch, and then use that solution to find all solutions. | Students can model a real world situation using trigonometric functions. Students can then use inverse trigonometric functions to find solutions. |

**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.**
4. **Model with mathematics.**

- Trigonometric functions can be used to model real-life periodic phenomena.
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.**
   - Trigonometric functions are periodic in nature and allow students to utilize patterns in problem solving.

## Vertical and Horizontal Coherence and Learning Progressions

| *Previous Learning Connections* | *Current Learning Connections* | *Future Learning Connections* |
|---|---|---|
| In Geometry and Algebra II, students have defined trigonometric ratios using the acute angles of right triangles.<br>In Algebra II, students define inverse functions and use them to solve equations. | Students apply the concept of inverse functions to trigonometric functions and use that concept to solve problems. | Understanding different characteristics of functions such as domain, range, rate of change, and asymptotes will assist students in making sense of, modeling, and predicting outcomes of real world situations.<br><br>Inverse trigonometric functions play a major role in Calculus, when using operations such as differentiation and integration. |

## *Vocabulary (key terms and definitions)*

- Principal branch
- Inverse Sine function
- Inverse Cosine function
- Inverse Tangent function
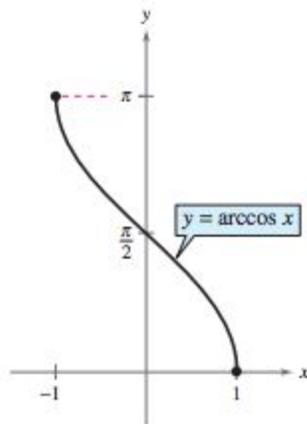
## *Relevance, Explanations, and Examples:*

The principal branch of a trigonometric function is the standard interval used to define the inverse trigonometric function. For example, the principal branch of sine is $[-\pi/2, \pi/2]$ which corresponds to the range of inverse sine.
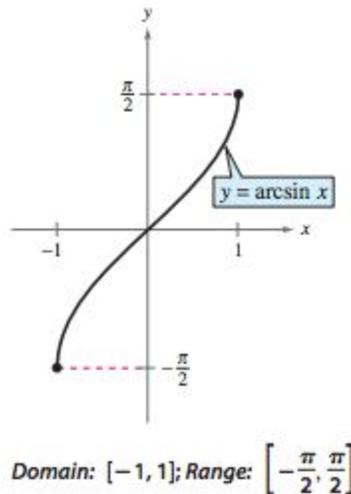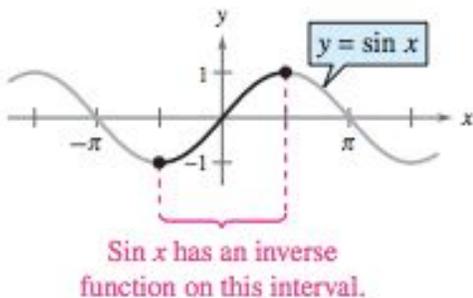
For cosine, the principal branch is $[0, \pi]$.



$y = \cos x$
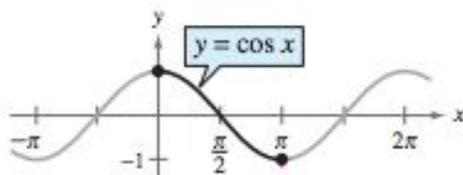
Cos $x$ has an inverse
function on this interval.

$y = \arccos x$

Domain: $[-1, 1]$; Range: $[0, \pi]$