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.IF.A Cluster: Analyze functions using different representations.
Students use multiple representations as they discover key features of functions.

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.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

- **d.** Graph rational functions, identify zeros and vertical, horizontal, and slant asymptotes, and determine end behavior.
- **e.** Graph exponential and logarithmic functions, showing relationships, intercepts, and end behavior.
- **f.** Graph all trigonometric functions, showing key features and applying transformations.

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

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Conceptual Understanding	***Procedural Fluency***	***Application***
Students should understand that each graph can be interpreted as a transformation of a parent function.	Students can identify key features such as domain, asymptotes, discontinuities, zeros, critical values, etc. of functions and use those to graph.	

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

1. **Make sense of problems and persevere in solving them.**
   - Students make sense of problems by comparing different representations of functions, discovering features of families of functions, and finding key features such as zeros or critical values.
2. **Reason abstractly and quantitatively.**
   - Students discover the features of families of graphs with different representations that require them to reason quantitatively**.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
   - Students use multiple representations flexibly**.**

6. **Attend to precision.**
7. **Look for and make use of structure.**
    - Students have the opportunity to consider structure when examining families of functions for key features.
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 extend their work with polynomials and the algebra of symbolic expressions from Algebra I and II to rational functions. Students have worked with factoring expressions.	Students use multiple representations as they discover key features of functions.	This is key concept for future study in calculus, college algebra, discrete math, and other general math classes.

Vocabulary (key terms and definitions)

- Rational function
- Exponential function
- Logarithmic function
- Asymptotes
- End behavior
- Critical values

Relevance, Explanations, and Examples: