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: Interpreting Functions	**Grade Level: Algebra I**

A1.F.IF.C Cluster: Analyze functions using different representations.

Given a linear, quadratic, and/or exponential functions, graph to identify key features, rewrite in different forms to reveal key features, and compare multiple types of functions represented in different forms.

****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.*

A1.F.IF.C.7: (i) Graph parent functions and their transformations expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
a. Graph linear, exponential, and quadratic functions and show intercepts, maxima, and minima.

A1.F.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
a. Use the process of graphing, factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
b. Interpret expressions for exponential growth and decay.

A1.F.IF.C.9: (i) Compare properties of two functions (linear, quadratic and exponential) each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

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

A1.F.IF.C.7: (i) Graph parent functions and their transformations expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
a. Graph linear, exponential, and quadratic functions and show intercepts, maxima, and minima.

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand how to identify a linear, quadratic, and exponential function from its equation. Understand the basic shape of a linear, quadratic, and exponential graph. Understand how to graph linear, quadratic, and exponential functions.	Given an equation, graph a linear, quadratic, and exponential function. Identify and label the key features on the graphs of linear, quadratic, and exponential functions.	

A1.F.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
a. Use the process of graphing, factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand that the zeros are located on the x-axis (as the x-intercepts). Understand the factors of a quadratic function reveal the zeros. Understand the process of completing the square can be used to rewrite a quadratic function in vertex form. Understand the extreme values and the axis of symmetry can be found from the vertex form of a quadratic function.	Graph a quadratic function to identify key features. Factor a quadratic function to identify zeros. Complete the square to identify the axis of symmetry, maxima, and/or minima. **Note:** maxima is plural for maximum, minima is plural for minimum.	When given an equation, identify the meaning of the key features within a contextual situation by graphing factoring, or completing the square. Identify a key feature to answer a question about a contextual situation.

A1.F.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

b. Interpret expressions for exponential growth and decay.

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand an exponential growth expression has a growth factor that is greater than 1. Understand an exponential decay expression has a decay factor that is between 0 and 1. Understand the growth factor of an exponential expression is one plus the percent rate of change. Understand the decay factor of an exponential expression is one minus the percent rate of change. Understand how to identify the initial value from an exponential expression.	Identify the growth or decay factor from an exponential expression. Identify the percent rate of change from the growth or decay factor. Identify the initial value of an exponential expression.	

A1.F.IF.C.9:. (i) Compare properties of two functions (linear, quadratic and exponential) each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand that all functions (linear, quadratic, exponential) have properties that can be compared to identify similarities and differences.	Identify the properties of a linear, quadratic, and exponential functions from its equation, graph, table, and/or verbal description and use them to compare their similarities and differences.	

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

1. **Make sense of problems and persevere in solving them.**
    - Rewrite quadratic equations in a variety of forms based on the information needed.
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**

4. **Model with mathematics.**
    - Utilize different methods to represent linear, quadratic, and exponential functions to help identify key features when appropriate.
5. **Use appropriate tools strategically.**
    - Use technology to graph linear, quadratic, and exponential functions to identify key features when appropriate.
6. **Attend to precision.**
7. **Look for and make use of structure.**
    - Compare the similarities and differences of linear, quadratic, and exponential functions.
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***
In middle school, learners: 1. graph linear functions 2. compare properties of linear functions represented in different ways 3. identify and use key features of linear functions 4. write linear equations.	In Algebra 1, learners: 1. write linear, quadratic, and exponential functions to describe relationships between quantities 2. analyze transformations of parent functions for linear, quadratic, and exponential functions.	In high school, learners: 1. graph all parent functions by hand and using technology and identify their key features 2. factor complete the square with quadratic functions with complex zeros.

Vocabulary *(Key Terms Used by Teachers and Students in this Cluster):*

- parent function
- factoring
- completing the square
- vertex form
- zeros
- growth factor
- decay factor

Relevance, Explanations, and Examples:

A1.F.IF.C.7: Options to graph: use a table, identify key features, and/or by using technology.

Achievement Level Descriptors

Cluster: Analyze functions using different representations.

Concepts and Procedures	***Level 1:*** Students should be able to graph a linear function by hand or by using technology. They should be able to compare properties of two linear functions represented in different ways. They should be able to identify equivalent forms of linear functions.
	Level 2: Students should be able to graph linear, exponential, and quadratic functions by hand or by using technology; compare properties of two quadratic or two other functions of the same type, i.e., linear to linear, represented in different ways; and understand equivalent forms of linear and quadratic functions.
	Level 3: Students should be able to analyze and compare properties of two functions of different types represented in different ways and understand equivalent forms of functions.

	Level 4: Students should be able to graph a variety of functions, including linear, quadratic, and exponential by hand and by using technology. They should be able to analyze and explain relationships between various types of functions and the behaviors of the functions and be able to determine which equivalent form is most appropriate for a given task.