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.B Cluster: Interpret functions that arise in applications in terms of the context.

Given a situation in context: identify key features of linear, quadratic, and exponential functions from a graph and table, sketch a graph from given key features, and limit the domain of a function to match the context.

**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.B.4: (i) For functions, including linear, quadratic, and exponential, that model a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing or decreasing, including using interval notation; maximums and minimums; symmetries.

A1.F.IF.B.5: (i) Relate the domain of a function to its graph and find an appropriate domain in the context of the problem.

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

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Conceptual Understanding	*Procedural Fluency*	*Application*
Understand that x-intercepts have a y-coordinate of zero. Understand that y-intercepts have a x-coordinate of zero. Understand an interval that increases is identified by y-values that increase as x-values increase. Understand an interval that decreases is identified by y-values that decrease as x-values increase. Understand how to write interval notation. Understand the maximum value has the highest y-value.	Sketch a graph using key features. Identify x- and y-intercepts from a table and a graph. Identify intervals of increasing and decreasing behavior using interval notation. Identify maximums and minimums from a table and a graph. Identify the axis of symmetry and write it as a linear equation (ex: x = 5). **Note:** ● **x-intercept: linear, quadratic** ● **y-intercept: linear,**	When given a graph, a table, and/or a verbal description, identify the meaning of the key features within a contextual situation. Identify a key feature to answer a question about a contextual situation.

Understand the minimum value has the lowest y-value. Understand the maximum and minimum values are located at the vertex of the graph. Understand the axis of symmetry of a quadratic function is a vertical line that is written as an equation. Understand that the axis of symmetry passes through the point where the y-values change from increasing to decreasing OR decreasing to increasing. **Note: The maximum and minimum will only relate to quadratics in Algebra 1. The students will see them again in polynomial functions in future math courses.**	**quadratic, exponential** ● **max/min: quadratic** ● **axis: quadratic**

A1.F.IF.B.5: (i) Relate the domain of a function to its graph and find an appropriate domain in the context of the problem.

Conceptual Understanding	*Procedural Fluency*	*Application*
Understand the domain is the x-values of a graph or table. Understand the domain can be restricted based on the contextual situation.		Identify the appropriate restricted domain based on the contextual situation.

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

1. **Make sense of problems and persevere in solving them.**
   ● Analyze context to relate key features of the function to the situation.
2. **Reason abstractly and quantitatively.**
   ● Find solutions to contextual questions by making sense of the numeric value of the key features of the function.
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
   ● Sketch a graph from the key features of a contextual situation.
   ● Identify the appropriate restricted domain of a contextual situation.
5. **Use appropriate tools strategically.**
   ● Use technology to locate key features of the graph of a function.
6. **Attend to precision.**
   ● Identify and include the measurements of key features.
7. **Look for and make use of structure.**
   ● Identify the axis of symmetry.
   ● Locate key features when given a table.
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. will interpret the equation $y = mx + b$ as a linear function and will use the equation to solve problems in context 2. will interpret key features of linear equations in relation to a contextual situation.	In Algebra 1, learners: 1. identify linear, quadratic, and exponential functions from tables and graphs 2. compare linear, quadratic, and exponential functions 3. distinguish between situations modeled by linear and exponential functions.	In high school, learners: 1. find key features of the entire family of functions.

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

- maximum value
- minimum value
- interval notation
- increasing interval
- decreasing interval

- vertex
- axis of symmetry
- domain

Relevance, Explanations, and Examples:

A1.F.IF.B.4:
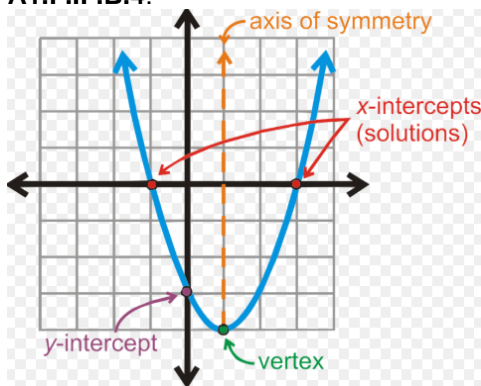
Quadratic functions can model time versus vertical height in a projectile motion:
- the maximum represents the highest height the object will reach
- the x-intercept represents the time that has elapsed until the object hits the ground
- the y-intercept represents the initial height of the object
- the appropriate restricted domain of the function would include the x-values from when the object leaves the ground to when it hits the ground

Quadratic functions can model horizontal distance versus vertical height in a projectile motion:
- the maximum represents the highest height the object will reach
- the x-intercept represents the horizontal distance the object hits the ground
- the y-intercept represents the initial height of the object

Exponential functions can model change in population over time:
- the y-intercept represents the initial population of the data (the year represented by x = 0).
- the shape of the graph indicates whether the population increases or decreases exponentially
- the appropriate restricted domain would include the x-values from the initial population to an indicated number of years (or infinity if the model continues indefinitely)

A1.F.IF.B.5:

• **Set Notation**	• **Inequality Notation**	• **Interval Notation**
Domain: {1,3,5,7}	Domain: {x I 10 < x < 21}	Domain: (10,21)

Achievement Level Descriptors

Cluster: Interpret functions that arise in applications in terms of the context.	
Concepts and Procedures	*Level 1:* Students should be able to interpret linear functions in context, and given the key features of a linear graph, they should be able to identify the appropriate graph*.*
	Level 2: Students should be able to interpret quadratic functions in two variables in context of the situation, and given the key features of a graph of a quadratic function, they should be able to identify the appropriate graph.
	Level 3: Students should be able to graph various types of functions and interpret and relate key features,including range and domain, in familiar or scaffolded contexts.
	Level 4: