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: Linear, Quadratic and Exponential Models	**Grade Level: Algebra I**

A1.F.LE.A Cluster: Construct and compare linear and exponential models and solve problems.

Examine sets of data to identify situations that model linear and exponential relationships and construct their functions. Compare models that grow at different rates over time including linear, exponential, and quadratic situations.

****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.LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
- **a.** Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
- **b.** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **c.** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

A1.F.LE.A.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). *

A1.F.LE.A.3. Recognize, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. *

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

A1.F.LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
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Conceptual Understanding	***Procedural Fluency***	***Application***
Understand both variables add or subtract at a constant rate in a linear function. Understand exponential functions change by a common factor.	Find the constant rate of change for a linear function (table, graph, equation and/or verbal description). Find the common factor for an exponential function (table, graph, equation and/or verbal description).	Identify when a situation exhibits a linear or exponential relationship.

	Identify when a table, graph, equation, and/or verbal description exhibits a linear or exponential relationship.	

A1.F.LE.A.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). *

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand how to construct a linear equation. Understand how to construct a linear equation to model an arithmetic sequence. Understand how to construct an exponential equation. Understand how to construct an exponential equation to model a geometric sequence.	After determining data to be linear or exponential, construct the appropriate function. **Note:** the function type must be given to students in order to write a function from two input-output pairs (two coordinates).	Identify and construct a linear or exponential function when given a contextual situation.

A1.F.LE.A.3. Recognize, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. *

Conceptual Understanding	***Procedural Fluency***	***Application***
Understand that over time, a quadratic function will grow faster than a linear function, and an exponential function will grow faster than both a linear and a quadratic function. **Note**: Students should complete exploration activities to discover the relationships between the rate of growth of linear, exponential, and quadratic relationships.		Given scenarios that give a choice between linear or exponential growth, determine the model that results in the greatest final values.

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

1. **Make sense of problems and persevere in solving them.**
    - Determine if a set of data represents a linear or exponential relationship.
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
    - Convince classmates when a set of data represents linear or exponential relationships.
4. **Model with mathematics.**
    - Use different equation types to model a given set of data.
5. **Use appropriate tools strategically.**
    - Use technology to explore linear, exponential, and quadratic models to look for trends in growth.
6. **Attend to precision.**
7. **Look for and make use of structure.**
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. determine the growth of a linear expression by taking the ratio of rise over run for any two distinct points on the same line 2. relate the information gathered by the ratio of rise over run to the linear equation in terms of input and output.	In Algebra 1, learners: 1. examine contextual information and distinguish if the solution can be modeled with linear or exponential functions 2. write arithmetic and geometric sequences both recursively and with an explicit formula to model situations 3. relate the knowledge of linear functions to exponential and polynomial functions and compare and contrast their behaviors.	In future math courses, learners: 1. extend their knowledge of linear and exponential situations to different types of functions (logarithmic, trigonometric, rational, etc.) and make comparisons.
Vocabulary *(Key Terms Used by Teachers and Students in this Cluster):*		
Relevance, Explanations, and Examples:		
A1.F.LE.A.3 Which plan will give you the most money after a two week period? Plan 1: $500 a day Plan 2: $1 the first day, doubled each day Plan 3: $0.01 the first day, tripled each day		
Achievement Level Descriptors		
Cluster: **Construct and compare linear and exponential models and solve problems.**		
Concepts and Procedures	***Level 1:*** Level 1 students should be able to apply mathematics to solve familiar problems arising in everyday life, society, and the workplace by identifying important quantities and by beginning to develop a model.	
	Level 2: Level 2 students should be able to apply mathematics to propose solutions by identifying important quantities, locating missing information from relevant external resources, beginning to construct chains of reasoning to connect with a model, producing partial justification and interpretations, and beginning to state logical assumptions.	
	Level 3: Level 3 students should be able to apply mathematics to solve unfamiliar problems arising in everyday life, society, and the workplace by identifying important quantities and mapping, displaying, explaining, or applying their relationship and by locating missing information from relevant external resources. They should be able to construct chains of reasoning to justify a model used, produce justification of interpretations, state logical assumptions, and compare and contrast multiple plausible solutions.	
	Level 4: Level 4 students should be able to apply mathematics to solve unfamiliar problems by constructing chains of reasoning to analyze a model, producing and analyzing justification of interpretations, stating logical assumptions, and constructing and comparing/contrasting multiple plausible solutions and approaches.	