

# 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.*

<b>Domain: Building Functions</b>		<b>Grade Level: Algebra I</b>
<b>A1.F.BF.A Cluster: Build a function that models a relationship between two quantities.</b>		
Given a relationship between two quantities, determine explicit and recursive patterns and write explicit and recursive formulas. Combine functions types using arithmetic operations.		
<p><b>**This is a MAJOR cluster.</b> <i>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.</i></p> <p><b>F.BF.A.1.</b> Write a function (linear, quadratic, and exponential) that describes a relationship between two quantities. *  <b>a.</b> Determine an explicit expression, a recursive process, or steps for calculation from a context. *  <b>b.</b> Determine an explicit expression from a graph. *  <b>c.</b> Combine standard function types using arithmetic operations. *</p> <p><b>F.BF.A.2.</b> Write arithmetic and geometric sequences both recursively and with an explicit formula and use them to model situations. *</p>		
<b>Aspects of Rigor for Student Learning:</b> (Conceptual, Procedural, and/or Application)		
<p><b>F.BF.A.1.</b> Write a function (linear, quadratic, and exponential) that describes a relationship between two quantities. *  <b>a.</b> Determine an explicit expression, a recursive process, or steps for calculation from a context. *</p>		
<b>Conceptual Understanding</b>	<b>Procedural Fluency</b>	<b>Application</b>
Understand an explicit expression is the equation for each form: linear, quadratic, exponential.  Understand that finding a pattern is identifying a recursive process.	Write an explicit expression given a context.	Recognize patterns from a contextual situation and communicate the patterns they observe.
<p><b>F.BF.A.1.</b> Write a function (linear, quadratic, and exponential) that describes a relationship between two quantities. *  <b>b.</b> Determine an explicit expression from a graph. *</p>		
<b>Conceptual Understanding</b>	<b>Procedural Fluency</b>	<b>Application</b>
Understand how to recognize the key features of a graph needed to build a function.  Understand how to recognize a linear, quadratic, or exponential pattern from a graph.	Write an explicit expression given a graph.	

<b>F.BF.A.1.</b> Write a function (linear, quadratic, and exponential) that describes a relationship between two quantities. * <b>c.</b> Combine standard function types using arithmetic operations. *		
<b>Conceptual Understanding</b>	<b>Procedural Fluency</b>	<b>Application</b>
Understand functions can be built by adding, subtracting, and multiplying other functions.	Add, subtract, and/or multiply functions to produce a new function.	
<b>F.BF.A.2.</b> Write arithmetic and geometric sequences both recursively and with an explicit formula and use them to model situations. *		
<b>Conceptual Understanding</b>	<b>Procedural Fluency</b>	<b>Application</b>
<p>Understand that an arithmetic recursive formula is addition of a repeated constant.</p> <p>Understand that a geometric recursive formula is multiplication of a repeated constant.</p> <p>Understand a recursive formula defines a term based on the previous term.</p> <p>Understand that an arithmetic explicit formula is a linear relationship.</p> <p>Understand that a geometric explicit formula is an exponential relationship.</p> <p>Understand an explicit formula determines a range value based upon its domain.</p>	<p>Write an explicit formula for arithmetic or geometric patterns.</p> <p>Write a recursive formula for arithmetic or geometric patterns.</p>	Write a recursive or explicit formula from information given in a contextual situation for arithmetic or geometric patterns.
<b>Enacting the Mathematical Practices - Evidence of Students Engaging in the Practices</b>		
<ol style="list-style-type: none"> <li>1. <b>Make sense of problems and persevere in solving them.</b></li> <li>2. <b>Reason abstractly and quantitatively.</b> <ul style="list-style-type: none"> <li>• Recognize patterns and represent them symbolically using recursive and explicit formulas.</li> </ul> </li> <li>3. <b>Construct viable arguments and critique the reasoning of others.</b></li> <li>4. <b>Model with mathematics.</b> <ul style="list-style-type: none"> <li>• Use recursive steps to model a context by writing the formula.</li> </ul> </li> <li>5. <b>Use appropriate tools strategically.</b></li> <li>6. <b>Attend to precision.</b></li> <li>7. <b>Look for and make use of structure.</b> <ul style="list-style-type: none"> <li>• Use the operations of math to combine functions.</li> </ul> </li> <li>8. <b>Look for and express regularity in repeated reasoning.</b> <ul style="list-style-type: none"> <li>• Use the recursive steps to recognize relationships between the pattern and the symbolic representation of the pattern.</li> </ul> </li> </ol>		
<b>Vertical and Horizontal Coherence and Learning Progressions</b>		
<b><u>Previous Learning Connections</u></b>	<b><u>Current Learning Connections</u></b>	<b><u>Future Learning Connections</u></b>
In middle school, learners: <ol style="list-style-type: none"> <li>1. will interpret the equation <math>y = mx + b</math> as defining a linear</li> </ol>	In Algebra 1, learners: <ol style="list-style-type: none"> <li>1. will identify patterns in the function's rate of change,</li> </ol>	In future math courses, learners: <ol style="list-style-type: none"> <li>1. will continue writing arithmetic and geometric sequences in</li> </ol>

<p>function</p> <p>2. will compare properties of two functions, each represented in a different way.</p>	<p>specify intervals of increase and decrease, and graph to model functions</p> <p>2. discuss the relative strengths and weaknesses of each representation and which are most efficient to be able to assist them in making symbolic functions</p> <p>3. recognize situations that grow by a constant rate or percent.</p>	<p>recursive and explicit forms and use them to model situations and translate between recursive and arithmetic forms of the function</p> <p>2. will use geometric and arithmetic series to find the sums</p> <p>3. will perform operations with all parent functions and compose functions.</p>
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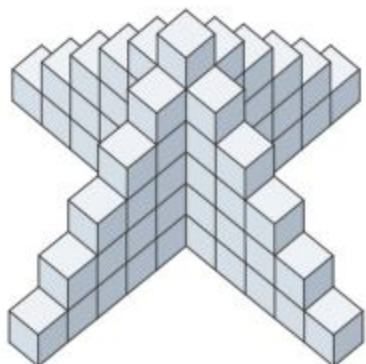
**Vocabulary** (Key Terms Used by Teachers and Students in this Cluster):

- explicit formula
- recursive formula
- arithmetic sequence
- geometric sequence

**Relevance, Explanations, and Examples:**

**A1.F.BF.A.1.a:** Skeleton Tower Task:

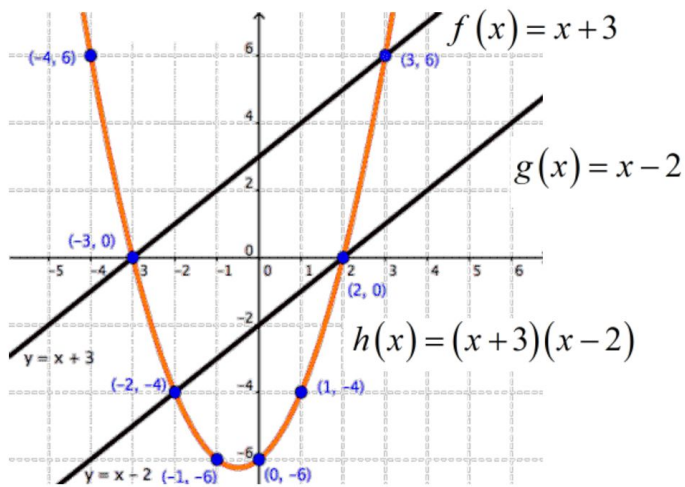
**Task**



- a. How many cubes are needed to build this tower?
- b. How many cubes are needed to build a tower like this, but 12 cubes high? Justify your reasoning.
- c. How would you calculate the number of cubes needed for a tower  $n$  cubes high?

**A1.F.BF.A.1.c.:**

A quadratic function can be built from the product of two linear functions.

**Canoe Trip Variation 1****Task**

Mike likes to canoe. He can paddle 150 feet per minute. He is planning a river trip that will take him to a destination about 30,000 feet upstream (that is, against the current). The speed of the current will work against the speed that he can paddle.

a.

Let  $s$  be the speed of the current in feet per minute. Write an expression for  $r(s)$ , the speed at which Mike is moving relative to the river bank, in terms of  $s$ .

b.

Mike wants to know how long it will take him to travel the 30,000 feet upstream. Write an expression for  $T(s)$ , the time in minutes it will take, in terms of  $s$ .

The walkway at a specific airport moves at a speed of about 6 km/hr. A person walking next to the walkway moves at a speed of about 4 km/hr.

- Write function  $w$  to represent the distance traveled on the walkway as a function of time.
- Write function  $p$  to represent the distance walked as a function of time.
- Add the two functions together to create function  $d$ . What does this function represent?

**Achievement Level Descriptors**

**Cluster:** *Build a function that models a relationship between two quantities.*

**Concepts and Procedures**

**Level 1:** *students should be able to identify an explicit or a recursive function and determine the steps for calculation from a context requiring up to two steps. They should be able to add and subtract two linear functions.*

**Level 2:** *students should be able to build an explicit or a recursive function to*

	<p><i>describe or model a relationship between two quantities and determine the steps for calculation from a context. They should be able to add, subtract, and multiply linear and quadratic functions.</i></p>
	<p><b>Level 3:</b> <i>students should be able to translate between explicit and recursive forms of a function. They should be able to add, subtract, and multiply functions.</i></p>
	<p><b>Level 4:</b> <i>students should be able to determine when it is appropriate to combine functions using arithmetic operations in context.</i></p>