# 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: Building Functions** | **Grade Level: Algebra I** |
|---|---|
| **A1.F.BF.B Cluster: Build new functions from existing functions.**<br><br>Given a graph or function, state the transformation from the parent function. | |
| ****This is a SUPPORTING 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.*<br><br>**F.BF.B.3.** (i) Identify the effect on the graph of f(x) (linear, exponential, quadratic) replaced with f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with contrasting cases and illustrate an explanation of the effects on the graph using technology. | |
| **Aspects of Rigor for Student Learning:** (Conceptual, Procedural, and/or Application) | |
| **F.BF.B.3.** (i) Identify the effect on the graph of f(x) (linear, exponential, quadratic) replaced with f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with contrasting cases and illustrate an explanation of the effects on the graph using technology. | |

| ***Conceptual Understanding*** | ***Procedural Fluency*** | ***Application*** |
|---|---|---|
| Understand each function has a parent function.<br><br>Understand that each parent function is transformed in the same manner regardless of its type.<br><br>Understand that f(x) + k translates the parent function vertically k units.<br><br>Understand that f(x+k) translates the parent function horizontally k units.<br><br>Understand that kf(x) and f(kx) dilates the parent function horizontally (horizontal stretch or shrink/compression).<br><br>Understand that if k is negative for kf(x) the function is reflected over the x-axis.<br><br>**Note:** Students build these conceptual understandings through experimentation. | Identify the transformation of the graph when compared to the parent function.<br><br>Identify the value of k for a transformation. | |

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

1. **Make sense of problems and persevere in solving them.**
    - Explain the relationships of a graph's transformation from its parent function
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
    - Explain and identify the transformation of a graph's function from its parent function.
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
    - Use technology to experiment with functions to discover transformation patterns.
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:<br>1. recognize and understand that all linear functions can be written in the $y = mx + b$ form<br>2. graph linear relationships. | In Algebra 1, learners:<br>1. graph linear, quadratic, and exponential relationships. | In future math courses, learners:<br>1. will extend transformation patterns to all parent functions<br>2. will write transformation rules for images graphed on a coordinate plane<br>3. will graph transformations and compositions of transformations on a coordinate plane. |

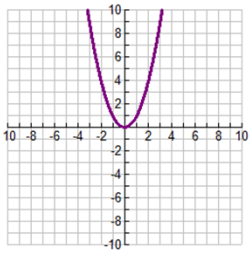
***Vocabulary*** *(Key Terms Used by Teachers and Students in this Cluster):*

- dilation
- reflection
- translation
- transformation

***Relevance, Explanations, and Examples:***

Experiment with transformations by creating tables and graphs and comparing the results to the parent function.

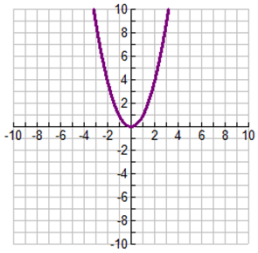
3. $f(x)=x^2-3$



| $x$ | $f(x)=x^2$ | $f(x)=x^2-3$ |
|---|---|---|
| -2 | | |
| -1 | | |
| 0 | | |
| 1 | | |
| 2 | | |
| 3 | | |

Compare to $f(x)=x^2$ :

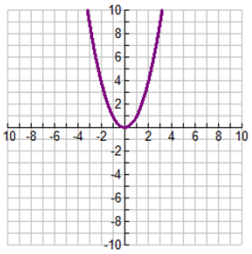
4. $f(x)=(x-1)^2$



| $x$ | $f(x)=x^2$ | $f(x)=(x-1)^2$ |
|---|---|---|
| -2 | | |
| -1 | | |
| 0 | | |
| 1 | | |
| 2 | | |
| 3 | | |

Compare to $f(x)=x^2$ :

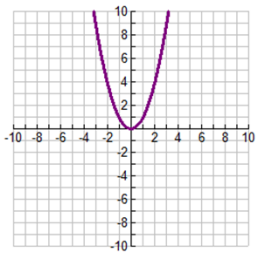
5. $f(x)=(x+4)^2$



| $x$ | $x^2$ | $f(x)=(x+4)^2$ |
|---|---|---|
| -2 | 4 | |
| -1 | 1 | |
| 0 | 0 | |
| 1 | 1 | |
| 2 | 4 | |
| 3 | 9 | |

Compare to $f(x)=x^2$ :

6. $f(x)=-x^2$



| $x$ | $x^2$ | $f(x)=-x^2$ |
|---|---|---|
| -2 | 4 | |
| -1 | 1 | |
| 0 | 0 | |
| 1 | 1 | |
| 2 | 4 | |
| 3 | 9 | |

Compare to $f(x)=x^2$ :

**Achievement Level Descriptors**

***Cluster:*** **Build new functions from existing functions.**

| | |
|---|---|
| ***Concepts and Procedures*** | **Level 1:** Students should be able to recognize a function |
| | **Level 2:** Understanding functional relationships as input and output values that have an associated graph |
| | **Level 3:** Students will describe and graphically represent what will happen if *f(x)* is replaced by *f(x)+k, kf(x), f(kx)* and *f(x+k)*, provided k is any real number. The function *f(x)* is linear, quadratic, and exponential. |
| | **Level 4:** Students should be able to analyze a graph for vertical or horizontal movement and recognize the parent function from the start point. Students will also connect the effects to related geometric transformations: translation and dilations. |