

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: Reasoning With Equations and Inequalities		Grade Level: Algebra I
A1.REI.B Cluster: Solve equations and inequalities in one variable.		
Solve linear equations and inequalities. Solve quadratic equations using a variety of methods.		
<p>**This is a MAJOR cluster. <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>A1.REI.B.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>A1.REI.B.4. (i) Solve quadratic equations in one variable.</p> <ol style="list-style-type: none"> Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form completing the square. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. 		
Aspects of Rigor for Student Learning: (Conceptual, Procedural, and/or Application)		
A1.REI.B.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.		
Conceptual Understanding	Procedural Fluency	Application
Understand how to use mathematical properties to solve equations and inequalities.	Solve equations in one variable. Solve inequalities in one variable. Solve equations with coefficients represented by letters.	
A1.REI.B.4 (i) Solve quadratic equations in one variable.		
a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions.		
Conceptual Understanding	Procedural Fluency	Application
Understand that any quadratic equation can be factored into a perfect square trinomial. Understand that a square root is the inverse operation of a square.	Rewrite quadratic equations by completing the square.	

Understand that a square root generates two values (positive and negative).		
Understand that an equation has to remain balanced.		
A1.REI.B.4 (i) Solve quadratic equations in one variable. b. Derive the quadratic formula from this form completing the square.		
Conceptual Understanding	Procedural Fluency	Application
Understand how to use the process of completing the square to derive the quadratic formula.		
A1.REI.B.4 (i) Solve quadratic equations in one variable. c. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation.		
Conceptual Understanding	Procedural Fluency	Application
Understand which method produces the most efficient form of solving. Understand that there are three solution options: <ul style="list-style-type: none"> • 2 <u>real</u> solutions • no <u>real</u> solution • 1 repeated <u>real</u> solution 	Solve quadratic equations using square roots. Solve quadratic equations by factoring. Solve quadratic equations by completing the square. Solve quadratic equations using the quadratic formula.	
Enacting the Mathematical Practices - Evidence of Students Engaging in the Practices		
<ol style="list-style-type: none"> 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. <ul style="list-style-type: none"> • Explain why a certain method is the most/least efficient method for solving a quadratic equation. 4. Model with mathematics. 5. Use appropriate tools strategically. <ul style="list-style-type: none"> • Use algebra tiles and/or area models to help foster the concept of completing the square and factoring. 6. Attend to precision. 7. Look for and make use of structure. <ul style="list-style-type: none"> • Factor quadratic expressions by recognizing patterns among the terms. • Complete the square by analyzing the terms of a quadratic expression. • Solve linear equations and inequalities by using inverse operations. 8. Look for and express regularity in repeated reasoning. <ul style="list-style-type: none"> • Identify over multiple examples where in the quadratic formula reveals whether they will get one repeated solution, two solutions, or no real solutions. • Identify and use the “shortcut” that completing the square results in finding half of “b”. <ul style="list-style-type: none"> ○ NOTE: It’s important for students to discover shortcuts on their own. 		

Vertical and Horizontal Coherence and Learning Progressions**Previous Learning Connections**

- In middle school, learners:
1. solve equations and inequalities in one variable
 2. solve equations involving squares and square roots

Current Learning Connections

- In Algebra 1, learners:
1. solve quadratic equations and relate solutions to the graph of the function
 2. use completing the square and factoring to rewrite quadratic functions in vertex and intercept form to identify key features of the graph.

Future Learning Connections

- In future math courses, learners:
1. solve additional types of nonlinear equations in future courses
 2. relate knowledge of solving quadratic equations to complex numbers, solving rational equations, trigonometric equations, and trigonometric form
 3. understand the need for a variety of methods (factoring, completing the square, and using quadratic formula) when solving other types of equations, such as parabolas, hyperbolas, and ellipses
 4. recognize when the solution to a quadratic equation produces a complex solution, but are not expected to write the solution in complex form until Algebra 2.

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

- quadratic equation
- completing the square
- quadratic formula
- factoring
- Inequality

Relevance, Explanations, and Examples:**A1.REI.B.3:****Solve $Ax + By = C$ for y**

$$Ax + By = C$$

$$Ax + By - Ax = C - Ax$$

$$By = C - Ax$$

$$\frac{By}{B} = \frac{C - Ax}{B}$$

$$y = \frac{C}{B} - \frac{Ax}{B}$$

A1.REI.B.4a: To complete the square, consider using algebra tiles and/or an area model to help students understand how completing the square works and how to transition into the algebraic methods.

Algebra tiles are useful to demonstrate the abstract process of completing the square for simple quadratic equations. Students can then transition to area models to represent the steps used in completing the square for more challenging equations.

Achievement Level Descriptors

Cluster: Solve equations and inequalities in one variable.

Concepts and Procedures

Level 1: Students should be able to solve one-step linear equations in one variable.

Level 2: Students should be able to solve one-step linear inequalities and quadratic equations in one variable with integer roots.

Level 3: Students should be able to solve multi-step linear equations and inequalities and quadratic equations in one variable with real roots.

Level 4: