
# Arizona Mathematics Standards

## Sixth Grade

ARIZONA DEPARTMENT OF EDUCATION
HIGH ACADEMIC STANDARDS FOR STUDENTS
December 2016

## Sixth Grade: Overview

1. **Develop competency of division of whole numbers and fractions and extend the notion of number to the system of rational numbers.**
2. **Develop understanding of ratio and rate and use multiplicative reasoning to solve ratio and rate problems.**
3. **Develop understanding of expressions, equations and inequalities.**

(1) Students develop fluency with division of whole numbers and extend their understanding to division of fractions. Students extend their previous understandings of number and the ordering of numbers to the system of rational numbers, which includes integers and negative fractions with denominators of 2, 3, 4, 5, 10. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

(2) Students use multiplicative reasoning to solve ratio and rate problems. This extends their knowledge of multiplication, division, and fractions as the foundation for proportional reasoning that begins in 7th grade. Students utilize multiple types of representations to demonstrate their understanding of the relationship between two quantities represented in a ratio or rate.

(3) Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

***The Standards for Mathematical Practice complement the content standards so that students increasingly engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years.***

**Content Emphasis of Arizona Mathematics Standards:**
The content emphasis provides planning guidance regarding the major and supporting clusters found within the standards. The Major and Supporting Clusters align with the Blueprint for AzMERIT. Please consider the following designations when planning an instructional scope for the academic year.

Arizona considers **Major Clusters** ● as groups of related standards that require greater emphasis than some of the other standards due to the depth of the ideas and the time it takes to master these groups of related standards.

Arizona considers **Supporting Clusters** ▲ as groups of related standards that support standards within the Major Cluster in and across grade levels. Supporting Clusters also encompass pre-requisite and extension of grade level content.

***Arizona is suggesting instructional time encompass a range of at least 65%-75% for Major Clusters and a range of 25%-35% for Supporting Cluster instruction. See introduction, page 12 for more information.***

## Sixth Grade: Standards Overview

**Grade level content emphasis indicated by: ● Major Cluster: ▲ Supporting Cluster**

Arizona is suggesting instructional time encompass a range of at least 65%-75% for Major Clusters and a range of 25%-35% for Supporting Cluster instruction. See Introduction, page 12 for more information.

**Ratio and Proportion (RP)**

● Understand ratio concepts and use ratio reasoning to solve problems.

**The Number System (NS)**

● Apply and extend previous understanding of multiplication and division to divide fractions by fractions.

● Compute fluently with multi-digit numbers and find common factors and multiples.

● Apply and extend previous understanding of numbers to the system of rational numbers. *(Note: Limit negative rational numbers to integers and fractions with denominators of 2,3,4,5,10.)*

**Expressions and Equations (EE)**

● Apply and extend previous understanding of arithmetic to algebraic expressions.

● Reason about and solve one-variable equations and inequalities.

● Represent and analyze quantitative relationships between dependent and independent variables.

**Geometry (G)**

▲ Solve mathematical problems and problems in real-world context involving area, surface area, and volume.

**Statistics and Probability (SP)**

▲ Develop understanding of statistical variability.

▲ Summarize and describe distributions.

**Standards for Mathematical Practices (MP)**

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.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

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| **Ratio and Proportion (RP)** | | |
| **6.RP.A**<br>**Understand ratio concepts and use ratio reasoning to solve problems.** | **6.RP.A.1** | Understand the concept of a ratio as comparing two quantities multiplicatively or joining/composing the two quantities in a way that preserves a multiplicative relationship. Use ratio language to describe a ratio relationship between two quantities. *For example, "There were 2/3 as many men as women at the concert."* |
| | **6.RP.A.2** | Understand the concept of a unit rate $a/b$ associated with a ratio $a : b$ with $b \neq 0$, and use rate language (e.g., for every, for each, for each 1, per) in the context of a ratio relationship. (Complex fraction notation is not an expectation for unit rates in this grade level.) |
| | **6.RP.A.3** | Use ratio and rate reasoning to solve mathematical problems and problems in real-world context (e.g., by reasoning about data collected from measurements, tables of equivalent ratios, tape diagrams, double number line diagrams, or equations).<br>a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.<br>b. Solve unit rate problems including those involving unit pricing and constant speed.<br>c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity). Solve percent problems with the unknown in all positions of the equation.<br>d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. |
| **The Number System (NS)** | | |
| **6.NS.A**<br>**Apply and extend previous understanding of multiplication and division to divide fractions by fractions.** | **6.NS.A.1** | Interpret and compute quotients of fractions to solve mathematical problems and problems in real-world context involving division of fractions by fractions using visual fraction models and equations to represent the problem. *For example, create a story context for 2/3 ÷ 3/4 and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that 2/3 ÷ 3/4 = 8/9 because 3/4 of 8/9 is 2/3. In general, a/b ÷ c/d = ad/bc.* |
| **6.NS.B**<br>**Compute fluently with multi-digit numbers and find common factors and multiples.** | **6.NS.B.2** | Fluently divide multi-digit numbers using a standard algorithm. |
| | **6.NS.B.3** | Fluently add, subtract, multiply, and divide multi-digit decimals using a standard algorithm for each operation. |
| | **6.NS.B.4** | Use previous understanding of factors to find the greatest common factor and the least common multiple.<br>a. Find the greatest common factor of two whole numbers less than or equal to 100.<br>b. Find the least common multiple of two whole numbers less than or equal to 12.<br>c. Use the distributive property to express a sum of two whole numbers 1 to 100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4(9+2).* |

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| **6.NS.C**<br>**Apply and extend previous understanding of numbers to the system of rational numbers.**<br>*Note: Limit negative rational numbers to integers and fractions with denominators of 2, 3, 4, 5, 10.* | **6.NS.C.5** | Understand that positive and negative numbers are used together to describe quantities having opposite directions or values. Use positive and negative numbers to represent quantities in real-world context, explaining the meaning of 0 in each situation. |
| | **6.NS.C.6** | Understand a rational number can be represented as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.<br><br>a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself and that 0 is its own opposite.<br><br>b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.<br><br>c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane. |
| | **6.NS.C.7** | Understand ordering and absolute value of rational numbers.<br><br>a. Interpret statements of inequality as statements about the relative position of two numbers on a number line.<br><br>b. Write, interpret, and explain statements of order for rational numbers in real-world context.<br><br>c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in real-world context.<br><br>d. Distinguish comparisons of absolute value from statements about order in mathematical problems and problems in real-world context. |
| | **6.NS.C.8** | Solve mathematical problems and problems in real-world context by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. |

| Expressions and Equations (EE) | | |
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| **6.EE.A**<br>**Apply and extend previous understanding of arithmetic to algebraic expressions.** | **6.EE.A.1** | Write and evaluate numerical expressions involving whole-number exponents. |
| | **6.EE.A.2** | Write, read, and evaluate algebraic expressions.<br>a. Write expressions that record operations with numbers and variables.<br>b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, and coefficient); view one or more parts of an expression as a single entity.<br>c. Evaluate expressions given specific values of their variables. Include expressions that arise from formulas used to solve mathematical problems and problems in real-world context. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). |
| | **6.EE.A.3** | Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x.* |
| | **6.EE.A.4** | Identify when two expressions are equivalent. *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.* |
| **6.EE.B**<br>**Reason about and solve one-variable equations and inequalities.** | **6.EE.B.5** | Understand solving an equation or inequality as a process of reasoning to find the value(s) of the variables that make that equation or inequality true. Use substitution to determine whether a given number in a specified set makes an equation or inequality true. |
| | **6.EE.B.6** | Use variables to represent numbers and write expressions when solving mathematical problems and problems in real-world context; understand that a variable can represent an unknown number or any number in a specified set. |
| | **6.EE.B.7** | Solve mathematical problems and problems in real-world context by writing and solving equations of the form $x + p = q$, $x - p = q$, $px = q$, and $x/p$ = q for cases in which $p$, $q$ and $x$ are all non-negative rational numbers. |
| | **6.EE.B.8** | Write an inequality of the form $x > c$, $x < c$, $x \geq c$, or $x \leq c$ to represent a constraint or condition to solve mathematical problems and problems in real-world context. Recognize that inequalities have infinitely many solutions; represent solutions of such inequalities on number lines. |
| **6.EE.C**<br>**Represent and analyze quantitative relationships between dependent and independent variables.** | **6.EE.C.9** | Use variables to represent two quantities that change in relationship to one another to solve mathematical problems and problems in real-world context. Write an equation to express one quantity (the dependent variable) in terms of the other quantity (the independent variable). Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. |

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| **Geometry (G)** | | |
| **6.G.A**<br>**Solve mathematical problems and problems in real-world context involving area, surface area, and volume.** | **6.G.A.1** | Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques to solve mathematical problems and problems in real-world context. |
| | **6.G.A.2** | Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Understand and use the formula $V = B \cdot h$, where in this case, $B$ is the area of the base ($B = l \times w$) to find volumes of right rectangular prisms with fractional edge lengths in mathematical problems and problems in real-world context. |
| | **6.G.A.3** | Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques to solve mathematical problems and problems in a real-world context. |
| | **6.G.A.4** | Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques to solve mathematical problems and problems in real-world context. |
| **Statistics and Probability (SP)** | | |
| **6.SP.A**<br>**Develop understanding of statistical variability.** | **6.SP.A.1** | Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for variability in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.* |
| | **6.SP.A.2** | Understand that a set of data collected to answer a statistical question has a distribution whose general characteristics can be described by its center, spread, and overall shape. |
| | **6.SP.A.3** | Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation uses a single number to describe the spread of the data set. |
| **6.SP.B**<br>**Summarize and describe distributions.** | **6.SP.B.4** | Display and interpret numerical data by creating plots on a number line including histograms, dot plots, and box plots. |
| | **6.SP.B.5** | Summarize numerical data sets in relation to their context by:<br>a. Reporting the number of observations.<br>b. Describing the nature of the attribute under investigation including how it was measured and its units of measurement.<br>c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.<br>d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. |

| Standards for Mathematical Practice | |
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| **6.MP.1** | **Make sense of problems and persevere in solving them.**<br>Mathematically proficient students explain to themselves the meaning of a problem, look for entry points to begin work on the problem, and plan and choose a solution pathway. While engaging in productive struggle to solve a problem, they continually ask themselves, “Does this make sense?" to monitor and evaluate their progress and change course if necessary. Once they have a solution, they look back at the problem to determine if the solution is reasonable and accurate. Mathematically proficient students check their solutions to problems using different methods, approaches, or representations. They also compare and understand different representations of problems and different solution pathways, both their own and those of others. |
| **6.MP.2** | **Reason abstractly and quantitatively.**<br>Mathematically proficient students make sense of quantities and their relationships in problem situations. Students can contextualize and decontextualize problems involving quantitative relationships. They contextualize quantities, operations, and expressions by describing a corresponding situation. They decontextualize a situation by representing it symbolically. As they manipulate the symbols, they can pause as needed to access the meaning of the numbers, the units, and the operations that the symbols represent. Mathematically proficient students know and flexibly use different properties of operations, numbers, and geometric objects and when appropriate they interpret their solution in terms of the context. |
| **6.MP.3** | **Construct viable arguments and critique the reasoning of others.**<br>Mathematically proficient students construct mathematical arguments (explain the reasoning underlying a strategy, solution, or conjecture) using concrete, pictorial, or symbolic referents. Arguments may also rely on definitions, assumptions, previously established results, properties, or structures. Mathematically proficient students make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. Mathematically proficient students present their arguments in the form of representations, actions on those representations, and explanations in words (oral or written). Students critique others by affirming or questioning the reasoning of others. They can listen to or read the reasoning of others, decide whether it makes sense, ask questions to clarify or improve the reasoning, and validate or build on it. Mathematically proficient students can communicate their arguments, compare them to others, and reconsider their own arguments in response to the critiques of others. |
| **6.MP.4** | **Model with mathematics.**<br>Mathematically proficient students apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. When given a problem in a contextual situation, they identify the mathematical elements of a situation and create a mathematical model that represents those mathematical elements and the relationships among them. Mathematically proficient students use their model to analyze the relationships and draw conclusions. They interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose. |

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| **6.MP.5** | **Use appropriate tools strategically.**<br>Mathematically proficient students consider available tools when solving a mathematical problem. They choose tools that are relevant and useful to the problem at hand. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful; recognizing both the insight to be gained and their limitations. Students deepen their understanding of mathematical concepts when using tools to visualize, explore, compare, communicate, make and test predictions, and understand the thinking of others. |
| **6.MP.6** | **Attend to precision.**<br>Mathematically proficient students clearly communicate to others using appropriate mathematical terminology, and craft explanations that convey their reasoning. When making mathematical arguments about a solution, strategy, or conjecture, they describe mathematical relationships and connect their words clearly to their representations. Mathematically proficient students understand meanings of symbols used in mathematics, calculate accurately and efficiently, label quantities appropriately, and record their work clearly and concisely. |
| **6.MP.7** | **Look for and make use of structure.**<br>Mathematically proficient students use structure and patterns to assist in making connections among mathematical ideas or concepts when making sense of mathematics. Students recognize and apply general mathematical rules to complex situations. They are able to compose and decompose mathematical ideas and notations into familiar relationships. Mathematically proficient students manage their own progress, stepping back for an overview and shifting perspective when needed. |
| **6.MP.8** | **Look for and express regularity in repeated reasoning.**<br>Mathematically proficient students look for and describe regularities as they solve multiple related problems. They formulate conjectures about what they notice and communicate observations with precision. While solving problems, students maintain oversight of the process and continually evaluate the reasonableness of their results. This informs and strengthens their understanding of the structure of mathematics which leads to fluency. |