Core Content Connectors

Sixth Grade

ARIZONA DEPARTMENT OF EDUCATION
HIGH ACADEMIC STANDARDS FOR STUDENTS
December, 2016

Sixth Grade Overview

Ratios and Proportional Relationships (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.

Sixth Grade: Critical Areas

In sixth grade, instructional time should focus on three critical areas:

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

(1) 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.

(2) 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.

(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.

Ratio and Proportion (RP)		
6.RP.A **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.NO.1f2 Write or select a ratio to match a given statement and representation.** **6.NO.1f3 Select or make a statement to interpret a given ratio.** **6.PRF.1c1 Describe the ratio relationship between two quantities for a given situation.** **6.PRF.2b3 Complete a statement that describes the ratio relationship between two quantities.**
	6.RP.A.2	Understand the concept of a unit rate *a/b* associated with a ratio *a* : *b* with *b* ≠ 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.PRF.1c2 Represent proportional relationships on a line graph.** **6.PRF.2b4 Determine the unit rate in a variety of contextual situations.** **6.NO.1f4 Find a missing value (representations, whole numbers, common fractions, decimals to hundredths place, percent) for a given ratio.**
	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). 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. b. Solve unit rate problems including those involving unit pricing and constant speed. 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. d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. **6.PRF.2b5 Use ratios and reasoning to solve real-world mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations).** **6.NO.1f5 Solve unit rate problems involving unit pricing.** **6.ME.2a2 Solve one-step real world measurement problems involving unit rates with ratios of whole numbers when given the unit rate (3 inches of snow falls per hour, how much in 6 hours).** **6.NO.1f1 *Calculate a percent of a quantity as rate per 100.* part b** **6.ME.1b4 Complete a conversion table for length, mass, time, volume.** **6.ME.1b5 Analyze table to answer questions.**

<table>
<tr><th colspan="3">The Number System (NS)</th></tr>
<tr><td rowspan="1">6.NS.A
Apply and extend previous understanding of multiplication and division to divide fractions by fractions.</td><td>6.NS.A.1</td><td>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.NO.2c3 Solve one step, addition, subtraction, multiplication, or division problems with fractions or decimals.</td></tr>
<tr><td rowspan="3">6.NS.B
Compute fluently with multi-digit numbers and find common factors and multiples.</td><td>6.NS.B.2</td><td>Fluently divide multi-digit numbers using a standard algorithm.
No CCC developed for this standard.</td></tr>
<tr><td>6.NS.B.3</td><td>Fluently add, subtract, multiply, and divide multi-digit decimals using a standard algorithm for each operation.
No CCC developed for this standard.</td></tr>
<tr><td>6.NS.B.4</td><td>Use previous understanding of factors to find the greatest common factor and the least common multiple.
a. Find the greatest common factor of two whole numbers less than or equal to 100.
b. Find the least common multiple of two whole numbers less than or equal to 12.
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).
No CCC developed for this standard.</td></tr>
<tr><td rowspan="2">6.NS.C
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.</td><td>6.NS.C.5</td><td>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.NO.1d4 Select the appropriate meaning of a negative number in a real-world situation.</td></tr>
<tr><td>6.NS.C.6</td><td>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.
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.
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.
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.NO.1d1 Identify numbers as positive or negative.
6.NO.1d2 Locate and plot positive and negative numbers on a number line.
6.NO.2e1 Determine the difference between two integers using a number line.</td></tr>
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		6.NO.1d5 Find given points between -10 and 10 on both axis of a coordinate plane. **6.NO.1d6 Label points between -10 and 10 on both axis of a coordinate plane.**
	6.NS.C.7	Understand ordering and absolute value of rational numbers. a. Interpret statements of inequality as statements about the relative position of two numbers on a number line. b. Write, interpret, and explain statements of order for rational numbers in real-world context. 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. d. Distinguish comparisons of absolute value from statements about order in mathematical problems and problems in real-world context. **6.NO.2e2 Compare two numbers on a number line (e.g., -2 > -9).** **6.NO.1e1 Determine the absolute value of a rational number.**
	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. **No CCC developed for this standard.**

Expressions and Equations (EE)		
6.EE.A **Apply and extend previous understanding of arithmetic to algebraic expressions.**	**6.EE.A.1**	Write and evaluate numerical expressions involving whole-number exponents. **6.NO.1i1 Identify what an exponent represents (e.g., 8^3= 8 x 8 x 8).** **6.NO.1i2 Solve numerical expressions involving whole number exponents.**
	6.EE.A.2	Write, read, and evaluate algebraic expressions. a. Write expressions that record operations with numbers and variables. 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. 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.SE.1a2 Given a real-world problem, write an equation using 1 set of parentheses.**
	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.* **No CCC developed for this standard.**
	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.* **No CCC developed for this standard**.
6.EE.B **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. **No CCC developed for this standard.**
	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.PRF.2a2 Use a variable to represent numbers and write expressions when solving real world problems.** **6.SE.1a3 Write expressions for real-world problems involving one unknown number.**
	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.NO.2a6 Solve problems or word problems using up to three digit numbers and any of the four operations.**

		6.PRF.1d1 Solve real world, single step linear equations.
	6.EE.B.8	Write an inequality of the form *x > c, x < c, x ≥ c, or x ≤ 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. **No CCC developed for this standard.**
6.EE.C **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. **6.PRF.2a3 Use variables to represent two quantities in a real-world problem that change in relationshi to one another.** **6.PRF.2a4 Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation**

Geometry (G)		
6.G.A **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.ME.1a2 Identify the appropriate formula (i.e., perimeter, area, volume) to use when measuring for different purposes in a real life context.** **6.ME.2a3 Apply the formula to find the area of triangles.** **6.ME.2b2 Decompose complex shapes (polygon, trapezoid, pentagon) into simple shapes (rectangles, squares, triangles) to measure area.** **6.GM.1d1 Find area of quadrilaterals.** **6.GM.1d2 Find area of triangles**
	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.ME.1a2 Identify the appropriate formula (i.e., perimeter, area, volume) to use when measuring for different purposes in a real-life context.** **6.ME.1c1 Find the area of a 2-dimensional figure and the volume of a 3-dimensional figure.**
	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.GM.1c7 Use coordinate points to draw polygons.** **6.GM.1c8 Use coordinate points to find the side lengths of polygons that are horizontal or vertical.**
	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. **No CCC developed for this standard.**

Statistics and Probability (SP)		
6.SP.A **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.DPS.1a2 Identify statistical questions and make a plan for data collection.**
	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.DPS.1d4 Find the range of a given data set. **6.DPS.1d6 Explain or identify what the mode represents in a set of data.**
	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. **5.DPS.1d1 Select an appropriate statement about the range of the data for a given graph (bar graph, line plot) (i.e. range of data) up to 10 points.** **5.DPS.1e1 Use measures of central tendency to interpret data including overall patterns in the data.** **6.DPS.1d2 Solve for mean of a given data set.** **6.DPS.1d5 Explain or identify what the mean represents in a set of data.**
6.SP.B **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.DPS.1c2 Collect and graph data: bar graph, line plots, dot plots, histograms.**
	6.SP.B.5	Summarize numerical data sets in relation to their context by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation including how it was measured and its units of measurement. 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. 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. **6.DPS.1d3 Select statement that matches mean, mode, and spread of data for 1 measure of central tendency for a given data set.** **6.DPS.1d7 Explain or identify what the median represents in a set of data.** **6.DPS.1e2 Use measures of central tendency to interpret data including overall patterns in the data.**

Standards for Mathematical Practice

6.MP.1	**Make sense of problems and persevere in solving them.** 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.**

	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.** 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.** 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.

6.MP.5	**Use appropriate tools strategically.** 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.** 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.** 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.** 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.

Core Content Connectors

Seventh Grade

ARIZONA DEPARTMENT OF EDUCATION
HIGH ACADEMIC STANDARDS FOR STUDENTS
December, 2016

Seventh Grade Overview

Ratios and Proportional Relationships (RP)

- Analyze proportional relationships and use them to solve mathematical problems and problems in real-world context.

The Number System (NS)

- Apply and extend previous understanding of operations with fractions to add, subtract, multiply, and divide rational numbers except division by zero.

Expressions and Equations (EE)

- Use properties of operations to generate equivalent expressions.
- Solve mathematical problems and problems in real-world context using numerical and algebraic expressions and equations.

Geometry (G)

- Draw, construct, and describe geometrical figures, and describe the relationships between them.
- Solve mathematical problems and problems in real-world context involving angle measure, area, surface area, and volume.

Statistics and Probability (SP)

- Use random sampling to draw inferences about a population.
- Draw informal comparative inferences about two populations.
- Investigate chance processes and develop, use, and evaluate probability models.

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.

Seventh Grade: Critical Areas

In seventh grade, instructional time should focus on two critical areas:

1. **Develop understanding of proportional relationships.**
2. **Develop understanding of operations with rational numbers and work with expressions, inequalities, and linear equations.**

(1) Students extend their understanding of ratios and rates to develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line. They distinguish proportional relationships as the foundation for rate of change.

(2) Students develop a unified understanding of number by recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. Students are able to use variables to represent quantities and construct simple equations and inequalities to solve problems. Students fluently solve one variable equations of the forms $px + q = r$ and $p(x + q) = r$.

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.

Ratio and Proportion (RP)		
7.RP.A **Analyze proportional relationships and use them to solve mathematical problems and problems in real-world context.**	**7.RP.A.1**	Compute unit rates associated with ratios involving both simple and complex fractions, including ratios of quantities measured in like or different units. **7.NO.2f3 Find unit rates given a ratio.** **7.PRF.1e1 Determine unit rates associated with ratios of lengths, areas, and other quantities measured in like units.** **7.ME.2e2 Solve one step problems involving unit rates associated with ratios of fractions.**
	7.RP.A.2	Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship (e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin). b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point (*x, y*) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r*) where *r* is the unit rate. **7.NO.2f1 Identify the proportional relationship between two quantities.** **7.NO.2f2 Determine if two quantities are in a proportional relationship using a table of equivalent ratios or points graphed on a coordinate plane.** **7.PRF.1e2 Represent proportional relationships on a line graph.** **7.NO.2f4 Use a rate of change or proportional relationship to determine the points on a coordinate plane.**
	7.RP.A.3	Use proportional relationships to solve multi-step ratio and percent problems (e.g., simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error). **7.NO.2f5 Use proportions to solve ratio problems.** **7.NO.2f6 Solve word problems involving ratios. part b** **7.NO.2h 1 Find percent in real world contexts.** **7.NO.2h2 Solve one step percentage increase and decrease problems** **7.PRF.1f1 Use proportional relationships to solve multistep percent problems.**
The Number System (NS)		

7.NS.A **Apply and extend previous understanding of operations with fractions to add, subtract, multiply, and divide rational numbers except division by zero.**	**7.NS.A.1**	Add and subtract integers and other rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. b. Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world context. c. Understand subtraction of rational numbers as adding the additive inverse, $p – q = p + (–q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world context. d. Apply properties of operations as strategies to add and subtract rational numbers. **7.NO.1g1 Identify the additive inverse of a number (e.g., -3 and +3).** **7.NO.1g2 Identify the difference between two given numbers on a number line using absolute value.**

7.NS.A (cont.)	**7.NS.A.2**	Multiply and divide integers and other rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world context. b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world context. c. Apply properties of operations as strategies to multiply and divide rational numbers. d. Convert a rational number to decimal form using long division; know that the decimal form of a rational number terminates in 0's or eventually repeats. **7.NO.2i1 Solve multiplication problems with positive/negative numbers.** **7.NO.2i2 Solve division problems with positive/negative numbers.**
	7.NS.A.3	Solve mathematical problems and problems in real-world context involving the four operations with rational numbers. Computations with rational numbers extend the rules for manipulating fractions to complex fractions where $a/b \div c/d$ when $a,b,c,$and d are all integers and b,c, and $d \neq 0$. **No CCC developed for this standard.**
Expressions and Equations (EE)		
7.EE.A **Use properties of operations to generate equivalent expressions.**	**7.EE.A.1**	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. **No CCC developed for this standard.**
	7.EE.A.2	Rewrite an expression in different forms, and understand the relationship between the different forms and their meanings in a problem context. *For example, $a + 0.05a = 1.05a$ means that "increase by 5%" is the same as "multiply by 1.05."* **No CCC developed for this standard.**
7.EE.B **Solve mathematical problems and problems in real-world context using numerical and algebraic expressions and equations.**	**7.EE.B.3**	Solve multi-step mathematical problems and problems in real-world context posed with positive and negative rational numbers in any form. Convert between forms as appropriate and assess the reasonableness of answers. *For example, If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50 per hour.* **7.PRF.1g1 Solve real world multi step problems using whole numbers.**
	7.EE.B.4	Use variables to represent quantities in mathematical problems and problems in real-world context, and construct simple equations and inequalities to solve problems.

		a. Solve word problems leading to equations of the form *px+q = r* and *p*(*x+q*) = *r*, where *p*, *q*, and *r* are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. **7.NO.3c5 Explain how to solve a multi-step equation.** b. Solve word problems leading to inequalities of the form *px+q > r* or *px+q < r*, where *p*, *q*, and *r* are rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. **7.SE.1f1 Set up equations with 1 variable based on real world problems.** **7.SE.1f2 Solve equations with 1 variable based on real world problems.** **7.PRF.1g2 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.** **7.PRF.2d Use a calculator to solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q, and rare specific rational numbers.**
Geometry (G)		
7.G.A **Draw, construct, and describe geometrical figures, and describe the relationships between them.**	**7.G.A.1**	Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. **7.ME.1d1 Solve problems that use proportional reasoning with ratios of length and area.** **7.ME2e1 Solve one step real world problems related to scaling**.
	7.G.A.2	Draw geometric shapes with given conditions using a variety of methods. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. **7.GM.1e1 Construct or draw plane figures using properties.**
	7.G.A.3	Describe the two-dimensional figures that result from slicing three-dimensional figures. **No CCC developed for this standard.**
7.G.B **Solve mathematical problems and problems in real-world context involving angle measure, area, surface area, and volume.**	**7.G.B.4**	Understand and use the formulas for the area and circumference of a circle to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. **7.NO.2f1 Apply formula to measure area and circumference of circles.**
	7.G.B.5	Use facts about supplementary, complementary, vertical, and adjacent angles in multi-step problems to write and solve simple equations for an unknown angle in a figure. **8.GM.1i1 Identify supplementary angles** **8.GM.1i2 Identify complimentary angles.** **8.GM.1i3 Identify adjacent angles.** **8.GM.1i4 Use angle relationships to find the value of a missing angle.**
	7.G.B.6	Solve mathematical problems and problems in a real-world context involving area of two-dimensional objects composed of triangles, quadrilaterals, and other polygons. Solve mathematical problems and problems in real-

		world context involving volume and surface area of three-dimensional objects composed of cubes and right prisms. **7.GM.1h1 Add the area of each face of a prism to find surface area of three dimensional objects.** **7.GM.1h2 Find the surface area of three-dimensional figures using nets of rectangles or triangles.** **7.GM.1h3 Find area of plane figures and surface area of solid figures (quadrilaterals).** **7.GM.1h4 Find area of an equilateral, isosceles, and scalene triangle.** **7.ME.2c 1 Solve one step real world measurement problems involving area, volume, or surface area of two- and three-dimensional objects.**
Statistics and Probability (SP)		
7.SP.A **Use random sampling to draw inferences about a population.**	**7.SP.A.1**	Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. **7.DPS.1b1 Determine sample size to answer a given question.**
	7.SP.A.2	Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.* **No CCC developed for this standard.**
7.SP.B **Draw informal comparative inferences about two populations.**	**7.SP.B.3**	Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.* **7.DPS.1j1 Make or select a statement to compare the distribution of 2 data sets.**

7.SP.B (cont.)	**7.SP.B.4**	Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.* **7.DPS.1i2 Identify the range (high/low), median(middle), mean, or mode of a given data set.** **7.DPS.1k1 Analyze graphs to determine or select appropriate comparative inferences about two samples or populations.** **8.DPS.1j2 Make or select an appropriate statements based upon two unequal data sets using measure of central tendency and shape.**
7.SP.C **Investigate chance processes and develop, use and evaluate probability models.**	**7.SP.C.5**	Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. **7.DPS.2d1 Describe the probability of events as being certain or impossible, likely, less likely or equally likely.** **7.DPS.2d2 State the theoretical probability of events occurring in terms of ratios (words, percentages, decimals).**
	7.SP.C.6	Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* **7.DPS.2a1 Conduct simple probability experiments** **7.DPS.2d4 Make a prediction regarding the probability of an event occurring; conduct simple probability experiments.**
	7.SP.C.7	Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies. If the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* **7.DPS.2b1 Identify sample space for a single event (coin, spinner, die).** b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* **7.DPS.2d3 Using an appropriate graphic or tactile representation, find all possible outcomes for a compound event.**

		7.DPS.2d5 Compare actual results of simple experiment with theoretical probabilities.

Standards for Mathematical Practice	
7.MP.1	**Make sense of problems and persevere in solving them.** 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.
7.MP.2	**Reason abstractly and quantitatively.** 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.
7.MP.3	**Construct viable arguments and critique the reasoning of others.** 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.
7.MP.4	**Model with mathematics.** 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.

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

Core Content Connectors

Eighth Grade

ARIZONA DEPARTMENT OF EDUCATION
HIGH ACADEMIC STANDARDS FOR STUDENTS
December, 2016

Eighth Grade Overview

The Number System (NS)

- Understand that there are irrational numbers, and approximate them using rational numbers.

Expressions and Equations (EE)

- Work with radicals and integer exponents.
- Understand the connections between proportional relationships, lines, and linear equations.
- Analyze and solve linear equations, inequalities, and pairs of simultaneous linear equations.

Functions (F)

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities.

Geometry (G)

- Understand congruence and similarity.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

Statistics and Probability (SP)

- Investigate patterns of association in bivariate data.
- Investigate chance processes and develop, use, and evaluate probability models.

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.

Eighth Grade: Critical Areas

In eighth grade, instructional time should focus on four critical areas:

1. **Develop understanding of expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations.**
2. **Develop understanding of the concept of a function and use functions to describe quantitative relationships.**
3. **Analyzing two- and three-dimensional space and figures using distance, angle, similarity, congruence, and understanding and applying the Pythagorean Theorem.**
4. **Develop understanding of irrational numbers.**

(1) Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m – A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

Students strategically choose and efficiently implement procedures to fluently solve linear equations and inequalities in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

(2) Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

(3) Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds true; for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

(4) Students use their knowledge of rational numbers to develop understanding of irrational numbers. Students use their understanding of multiplication and apply properties to develop understanding of radicals and integer exponents.

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.

The Number System (NS)		
8.NS.A **Understand that there are irrational numbers, and approximate them using rational numbers.**	**8.NS.A.1**	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion. Know that numbers whose decimal expansions do not terminate in zeros or in a repeating sequence of fixed digits are called irrational. No CCC developed for this standard.
	8.NS.A.2	Use rational approximations of irrational numbers to compare the size of irrational numbers. Locate them approximately on a number line diagram, and estimate their values. **8.NO.1k1 Identify π as an irrational number.** **8.NO.1k2 Round irrational numbers to the hundredths place.** **8.NO.1k3 Use approximations of irrational numbers to locate them on a number line.**
	8.NS.A.3	Understand that given any two distinct **rational** numbers, $a < b$, there exist a rational number c and an irrational number d such that $a < c < b$ and $a < d < b$. Given any two distinct **irrational** numbers, $a < b$, there exist a rational number c and an irrational number d such that $a < c < b$ and $a < d < b$. **No CCC developed for this standard.**
Expressions and Equations (EE)		
8.EE.A **Work with radicals and integer exponents.**	**8.EE.A.1**	Understand and apply the properties of integer exponents to generate equivalent numerical expressions. **No CCC developed for this standard.**
	8.EE.A.2	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Know that $\sqrt{2}$ is irrational. a. Evaluate square roots of perfect squares less than or equal to 225. b. Evaluate cube roots of perfect cubes less than or equal to 1000. **No CCC developed for this standard.**
	8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and express how many times larger or smaller one is than the other. **8.NO.1i1 Convert a number expressed in scientific notation up to 10,000.**
	8.EE.A.4	Perform operations with numbers expressed in scientific notation including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. **No CCC developed for this standard.**
8.EE.B **Understand the connections**	**8.EE.B.5**	Graph proportional relationships interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a*

between proportional relationships, lines, and linear equations.		*distance-time equation to determine which of two moving objects has greater speed.* **8.PRF.1e2 Represent proportional relationships on a line graph.**
	8.EE.B.6	Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane. Derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $(0, b)$. **No CCC developed for this standard.**

8.EE.C **Analyze and solve linear equations, inequalities, and pairs of simultaneous linear equations.**	**8.EE.C.7**	Fluently solve linear equations and inequalities in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solution. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form *x = a, a = a, or a = b* results (where *a* and *b* are different numbers). **8.PRF.1g3 Solve linear equations with 1 variable.** b. Solve linear equations and inequalities with rational number coefficients, including solutions that require expanding expressions using the distributive property and collecting like terms. **No CCC developed for this standard.**
	8.EE.C.8	Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations including cases of no solution and infinite number of solutions. Solve simple cases by inspection. c. Solve mathematical problems and problems in real-world context leading to two linear equations in two variables. **No CCC developed for this standard.**
Functions (F)		
8.F.A **Define, evaluate, and compare functions.**	**8.F.A.1**	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (Function notation is not required in Grade 8.) **No CCC developed for this standard.**
	8.F.A.2	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* **No CCC developed for this standard.**
	8.F.A.3	Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear. *For example, the function* $A = s^2$ *giving the area of a square as a function of its side length in not linear because its graph contains the points (1,1), (2,4), and (3,9) which are not on a straight line.* **8.PRF.2c1 Given two graphs, describe the function as linear and not linear.**
8.F.B **Use functions to model**	**8.F.B.4**	Given a description of a situation, generate a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two

relationships between quantities.		(x, y) values, including reading these from a table or a graph. Track how the values of the two quantities change together. Interpret the rate of change and initial value of a linear function in terms of the situation it models, its graph, or its table of values. **8.PRF.2e2 Identify the rate of change (slope) and initial value (y-intercept) from graphs.**
	8.F.B.5	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. **8.PRF.2c1 Given two graphs, describe the function as linear and not linear.** **8.PRF.2e3 Given a verbal description of a situation, create or identify a graph to model the situation.** **8.PRF.2e4 Given a graph of a situation, generate a description of the situation.** **8.PRF.1f2 describe or select the relationship between the two quantities given a line graph of a situation.** **8.NO.3c3 Analyze provided information (e.g., a graph) to describe the relationship between two quantities.**
Geometry (G)		
8.G.A **Understand congruence and similarity.**	**8.G.A.1**	Verify experimentally the properties of rotations, reflections, and translations. Properties include: lines are taken to lines, line segments are taken to line segments of the same length, angles are taken to angles of the same measure, parallel lines are taken to parallel lines. **8.GM.1f1 Recognize a rotation, reflection, or translation of a figure.** **H.GM.1d1 Use the reflections, rotations, or translations in the coordinate plane to solve problems wit right angles.**
	8.G.A.2	Understand that a two-dimensional figure is congruent to another if one can be obtained from the other by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that demonstrates congruence. **No CCC developed for this standard.**
	8.G.A.3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. **8.GM.1f2 Identify a rotation, reflection, or translation of a plane figure when given coordinates.**
	8.G.A.4	Understand that a two-dimensional figure is similar to another if, and only if, one can be obtained from the other by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that demonstrates similarity. **8.GM.1g1 Recognize congruent and similar figures.** **8.ME.1e1 Describe the changes in surface area, area, and volume when the figure is changed in some (e.g., scale drawings).**

		8.ME.1e2 Compare area and volume of similar figures.
	8.G.A.5	Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* **8.GM.1i4 Use angle relationships to find the value of a missing angle.**
8.G.B **Understand and apply the Pythagorean Theorem.**	**8.G.B.6**	Understand the Pythagorean Theorem and its converse. No CCC developed for this standard.
	8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world context and mathematical problems in two and three dimensions. **8.ME.2f1 Apply the Pythagorean theorem to determine lengths/distances in real-world situations.** **8.GM.1j1 Find the hypotenuse of a two-dimensional right triangle (Pythagorean Theorem).** **8.GM.1j2 Find the missing side lengths of a two-dimensional right triangle (Pythagorean Theorem).** **H.GM.1a1 Find the hypotenuse of a two-dimensional right triangle (Pythagorean Theorem).** **H.GM.1a2 Find the missing side lengths of a two-dimensional right triangle (Pythagorean Theorem).**
	8.G.B.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. *No CCC developed for this standard.*
8.G.C **Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.**	**8.G.C.9**	Understand and use formulas for volumes of cones, cylinders and spheres and use them to solve real-world context and mathematical problems. **8.ME.2d2 Apply the formula to find the volume of 3 dimensional shapes (i.e., cubes, spheres, and cylinders).**

Statistics and Probability (SP)		
8.SP.A **Investigate patterns of association in bivariate data.**	**8.SP.A.1**	Construct and interpret scatter plots for bivariate measurement data to investigate and describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **8.SP.1a Recognize a pattern of association using existing data.** **8.DPS.1g2 Graph data using line graphs, histograms, or box plots.** **8.DPS.1h1 Graph bivariate data using scatter plots and identify possible associations between the variables.** **8.DPS.1i3 using box plots and scatter plots, identify data points that appear to be outliers.**
	8.SP.A.2	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. **8.DPS.2g1 Distinguish between a linear and non-linear association when analyzing bivariate data on a scatter plot**
	8.SP.A.3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. **8.DPS.2g2 Interpret the slope and the y-intercept of a line in the context of a problem.**
	8.SP.A.4	Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. **8.DPS.1k2 Analyze displays of bivariate data to develop or select appropriate claims about those data.** **8.DPS.1f3 Construct a two-way table summarizing data on two categorical variables collected from the same subjects; identify possible association between the two variables.**
8.SP.B **Investigate chance processes and develop, use, and evaluate probability models.**	**8.SP.B.5**	Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. a. Understand that the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. b. Represent sample spaces for compound events using organized lists, tables, tree diagrams and other methods. Identify the outcomes in the sample space which compose the event. c. Design and use a simulation to generate frequencies for compound events. No CCC developed for this standard.

Standards for Mathematical Practice	
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8.MP.2	**Reason abstractly and quantitatively.** 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.
8.MP.3	**Construct viable arguments and critique the reasoning of others.** 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.
8.MP.4	**Model with mathematics.** 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.

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