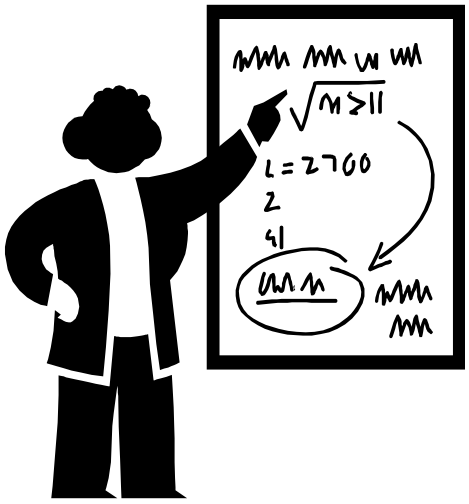
Mathematics

Curriculum

Grade Eight



Grade 8 Mathematics

Overview:
This curriculum is aligned to the Common Core State Standards for Mathematics.
Standards are coded (see below). For each standard, or cluster of standards, activities are listed that are specific to those standards. Extensions, technology and other support materials (including those found in the teachers' manuals) are listed to help with differentiation of math instruction.

Standards for Mathematical Practice: The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. The Mathematical Practices should be used when planning lessons. (See Appendix A for a full description of each standard with explanations and examples for your grade level.)

Standards for Mathematical Content: Examples and Explanations of each content standard can be found in Appendix A in a document titled *MATHEMATICS: Arizona Academic Content Standards.*

Glossary of Terms: Key terms needed to understand the units of study can be found in Appendix A.

Vocabulary:
A list of important mathematical vocabulary can be found at the end of each unit. Students need to become fluent with vocabulary so that they can communicate effectively in mathematics. It is suggested that math vocabulary be posted for each unit, and that students have opportunities to "define" terms using words, numbers, pictures, examples and by making connections to their lives or other areas of mathematics.

Pacing Guide: Refer to the pacing guide for a sequence of units of study.

Key to Coding:

Standards define what students should understand and be able to do.

Clusters are groups of related standards. Note that standards from different clusters may sometimes be closely related, because mathematics is a connected subject.

Domains are larger groups of related standards. Standards from different domains may sometimes be closely related

Example:

CC.8.EE.1 refers to Common Core, Grade 8, Expressions and Equations, standard 1.

Domain and clusters for Grade 8 can be found on the next page. Standards are listed in the text of the curriculum.

*Adapted from the Arizona Academic Content Standards.

Grade 8 Mathematics

Domains	The Number System	Expressions and Equations	Functions	Geometry	Statistics and Probability
Clusters	• Know that there are numbers that are not rational, and approximate them by rational numbers	• Work with radicals and integer exponents • Understand the connections between proportional relationships, lines, and linear equations • Analyze and solve linear equations and pairs of simultaneous linear equations	• Define, evaluate, and compare functions • Use functions to model relationships between quantities	• Understand congruence and similarity using physical models, transparencies, or geometry software • Understand and apply the Pythagorean Theorem • Solve real-world and mathematical problems involving volume of cylinders, cones and spheres	• Investigate patterns of association in bivariate data
Mathematical Practices	1. Make sense of problems and persevere in solving them. 3. Construct viable arguments and critique the reasoning of others. 5. Use appropriate tools strategically. 7. Look for and make use of structure.			2. Reason abstractly and quantitatively. 4. Model with mathematics 6. Attend to precision. 8. Look for and express regularity in repeated reasoning.	

In Grade 8, instructional time should focus on three critical areas:

1. Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations

- Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. 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 solve linear equations 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. Grasping the concept of a function and using functions to describe quantitative relationships

- 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. Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem

- 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, 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.

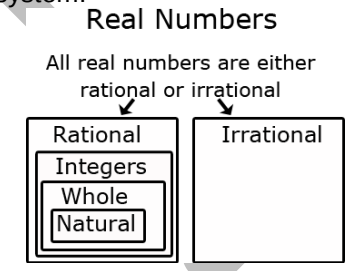
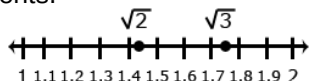
*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 1: Real Numbers

Pacing: 15 days (plus 5 days for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* 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.**
Domain and Standards Overview
Number Systems • Know that there are numbers that are not rational, and approximate them by rational numbers. **Expressions and Equations** • Work with radicals and integer exponents.

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.NS.1. KNOW that numbers that are not rational are called irrational. UNDERSTAND informally that every number has a decimal expansion; for rational numbers SHOW that the decimal expansion repeats eventually, and CONVERT a decimal expansion which repeats eventually into a rational number.	**8.NS.1.** Students can use graphic organizers to show the relationship between the subsets of the real number system. 
8.NS.2. USE rational approximations of irrational numbers to COMPARE the size of irrational numbers, LOCATE them approximately on a number line diagram, and ESTIMATE the value of expressions (e.g., √2). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*	8.NS.2. Students can approximate square roots by iterative processes. Examples: • Approximate the value of √5 to the nearest hundredth. Solution: Students start with a rough estimate based upon perfect squares. √5 falls between 2 and 3 because 5 falls between $2^2 = 4$ and $3^2 = 9$. The value will be closer to 2 than to 3. Students continue the iterative process with the tenths place value. √5 falls between 2.2 and 2.3 because 5 falls between $2.2^2 = 4.84$ and $2.3^2 = 5.29$. The value is closer to 2.2. Further iteration shows that the value of √5 is between 2.23 and 2.24 since 2.23^2 is 4.9729 and 2.24^2 is 5.0176. • Compare √2 and √3 by estimating their values, plotting them on a number line, and making comparative statements.  Solution: Statements for the comparison could include: √2 is approximately 0.3 less than √3 √2 is between the whole numbers 1 and 2 √3 is between 1.7 and 1.8

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.EE.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 to EXPRESS how many times as much one is than the other. *For example, estimate the population of the United States as 3 × 10^8 and the population of the world as 7 × 10^9, and determine that the world population is more than 20 times larger.* 8.EE.1. KNOW and APPLY the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.* 8.EE.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. EVALUATE square roots of small perfect squares and cube roots of small perfect cubes. KNOW that √2 is irrational.	8.EE.1. Examples: • $\frac{4^3}{5^2} = \frac{64}{25}$ • $\frac{4^3}{4^7} = 4^{3-7} = 4^{-4} = \frac{1}{256}$ • $\frac{4^{-3}}{5^2} = 4^{-3} \times \frac{1}{5^2} = \frac{1}{4^3} \times \frac{1}{5^2} = \frac{1}{64} \times \frac{1}{25} = \frac{1}{16{,}000}$ 8.EE.2 Examples • $3^2 = 9$ and $\sqrt{9} = \pm 3$ • $\left(\frac{1}{3}\right)^3 = \left(\frac{1^3}{3^3}\right) = \frac{1}{27}$ and $\sqrt[3]{\frac{1}{27}} = \frac{\sqrt[3]{1}}{\sqrt[3]{27}} = \frac{1}{3}$ • Solve $x^2 = 9$ Solution: $x^2 = 9$ $\sqrt{x^2} = \pm\sqrt{9}$ $x = \pm 3$ • Solve $x^3 = 8$ Solution: $x^3 = 8$ $\sqrt[3]{x^3} = \sqrt[3]{8}$ $x = 2$

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.EE.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 (e.g., use millimeters per year for seafloor spreading). INTERPRET scientific notation that has been generated by technology.	8.EE.4. Students can convert decimal forms to scientific notation and apply rules of exponents to simplify expressions. In working with calculators or spreadsheets, it is important that students recognize scientific notation. Students should recognize that the output of 2.45E+23 is 2.45×10^{23} and 3.5E-4 is 3.5×10^{-4}. Students enter scientific notation using E or EE (scientific notation), * (multiplication), and ^ (exponent) symbols.

Concepts **What Students Need to Know**	**Skills** **What Students Need To Be Able To Do**	**Bloom's Taxonomy Levels**
• Rational number	• KNOW (rational and irrational numbers)	2
• Irrational number	• UNDERSTAND (decimal expansion)	2
• Decimal expansion	• SHOW (decimal expansion repeats)	2
• Integer power of 10	• CONVERT (repeating decimal expansion to a rational number)	3
• Scientific notation	• USE (rational approximations of irrational numbers)	3
• Properties of integer exponents	• COMPARE (size of irrational numbers)	3
• Square root	• LOCATE (rational approximations of irrational numbers on number line)	1
• Perfect square	• ESTIMATE (value of expressions e.g. $\sqrt{2}$)	2
• Cube root	• USE	3
• Perfect cube	(integer power of 10)	
• Properties of integer exponents	▪ ESTIMATE (large or small quantities)	3
	▪ EXPRESS (magnitude of numbers using powers of 10)	2
	(rational approximations of irrational numbers)	
	• KNOW/APPLY (properties of integer exponents)	3
	• USE (Square root/cube root symbols)	3
	• EVALUATE	3
	(square roots of perfect squares)	
	(cube roots of perfect cubes)	
	• PERFORM (operations – scientific notation)	3
	• USE (scientific notation)	3
	• CHOOSE (units of appropriate size)	2
	• INTERPRET (scientific notation generated by technology)	4

*Adapted from the Arizona Academic Content Standards.

Essential Questions
In what ways can rational numbers be useful? How can algebraic expressions and equations be used to model, analyze, and solve mathematical situations?
Corresponding Big Ideas
Rational numbers can be represented in multiple ways and are useful when examining situations involving numbers that are not whole. Algebraic expressions and equations are used to model real-life problems and represent quantitative relationships, so that the numbers and symbols can be manipulated to reach a solution or make a sense of the quantitative relationships.

Learning Activities

Objective	Resource/page	Notes
8.NS.1. KNOW that numbers that are not rational are called irrational. UNDERSTAND informally that every number has a decimal expansion; for rational numbers SHOW that the decimal expansion repeats eventually, and CONVERT a decimal expansion which repeats eventually into a rational number.		3 days
8.NS.1.1 UNDERSTAND that every number has a decimal expansion and the decimal expansion of a rational numbers must terminate or repeat	MC3 2-1; Coach Lesson 1	0.5 days
8.NS.1.2 CONVERT rational numbers between fractions of integers and decimal expansions	MC3 2-1; Coach Lesson 1	1.5 days

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.NS.1.1 CLASSIFY numbers as rational or irrational	MC3 3-4; Pizzazz PA p81	1 days
8.NS.2. USE rational approximations of irrational numbers to COMPARE the size of irrational numbers, LOCATE them approximately on a number line diagram, and ESTIMATE the value of expressions (e.g., √2). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*		3 days
8.NS.2.1 ESTIMATE the value of an irrational square root to the nearest tenth	MC3 3-2; Coach Lesson 2; Pizzazz PA p161	1.5 days
8.NS.2.2 UNDERSTAND how an iterative process can be used to refine the approximation of a square root	none	0.5 days
8.NS.2.3 COMPARE the sizes of irrational numbers	MC3 3-4; Coach Lesson 3	0.5 days
8.NS.2.4 LOCATE irrational numbers on a number line	MC3 3-4; Coach Lesson 2	0.5 days
8.EE.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. EVALUATE square roots of small perfect squares and cube roots of small perfect cubes. KNOW that √2 is irrational.		4 days incl assessment
8.EE.2.1 EVALUATE square roots of small perfect squares and cube roots of small perfect cubes	MC3 3-1; MC3 LA 14; Coach Lesson 6	1 day
8.EE.2.2 USE square root symbols to represent solution to equations of the form $x^2 = p$	none	.5 day
8.EE.2.3 USE cube root symbols to represent solutions to equations of the form $x^3 = p$	none	.5 day

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.EE.1. KNOW and APPLY the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.*		6 days
8.EE.1.1 KNOW and APPLY the rule for zero as an exponent	MC3 2-9	.5 day
8.EE.1.2 KNOW and APPLY the rule for negative exponents	MC3 2-9	.5 day
8.EE.1.3 KNOW and APPLY the product of powers rule (add exponents)	MC3 10-5; Punchline 5.16	1 day
8.EE.1.4 KNOW and APPLY the quotient of powers rule (subtract exponents)	MC3 10-6	1 day
8.EE.1.5 KNOW and APPLY the power of a power rule (multiply exponents)	MC3 10-7; Punchline 5.17	1 day
8.EE.1.5 SIMPLIFY exponential expressions using all of the exponent rules	MS Lesson 11 p 299; Coach Lesson 5; Punchline 5.18	2 days
8.EE.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 to EXPRESS how many times as much one is than the other. *For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.*		1 day
8.EE.3.1 USE numbers expressed in the form of a single digit times an integer power of 10 to ESTIMATE very large or very small quantities	none	.5 day
8.EE.3.2 Given estimated quantities in single digit times integer power of ten, EXPRESS how many times as much one is than the other	MC2 Looking Ahead p2-5; CCSS Supp Lesson 1; Punchline 5.15 (partial)	.5 days

*Adapted from the Arizona Academic Content Standards.

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Objective	Resource/page	Notes
8.EE.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 (e.g., use millimeters per year for seafloor spreading). INTERPRET scientific notation that has been generated by technology.		10 days incl unit assessment
8.EE.4.1 CONVERT between standard and scientific notation	MC3 2-10; Coach Lesson 7; Pizzazz PA 75-77; Punchline 5.14	2 days
8.EE.4.2 APPLY exponent rules to multiply and divide numbers expressed in scientific notation	CCSS Supp Lesson 1; Coach Lesson 7; Pizzazz PA 78-79; Punchline 5.15	2 days
8.EE.4.3 USE scientific notation and CHOOSE units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading).	Coach Lesson 8;	1 day
8.EE.4.4 INTERPRET scientific notation that has been generated by technology	CCSS Supp Lesson 2	1 day

*Adapted from the Arizona Academic Content Standards.

Standardized Assessment Correlations (State, College and Career)
Grade 8 Mathematics **Expectations for Learning (in development)** This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

UNIT 1 VOCABULARY:
bar notation, base, calculator notation, cubed root, decimal expansion, exponent, irrational number, monomial, perfect cube, perfect square, power, radical symbol, rational number, real number, repeating decimal, scientific notation, square root, standard notation, terminating decimal

Assessment
Ledyard Assessment Unit 1 Performance Task for Unit 1 TBD (possible task) **Giantburgers** **http://map.mathshell.org/materials/tasks.php?taskid=266#task266** **Source: Mathematics Assessment Project (Shell Center/MARS, University of Nottingham & UC Berkeley)**

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategies

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

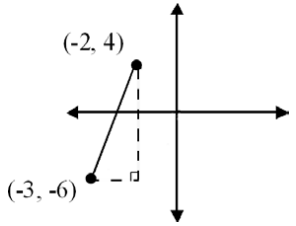
*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 2: Pythagorean Theorem

Pacing: 20 days (plus 5 days for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* **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.**
Domain and Standards Overview
Geometry • Understand and apply the Pythagorean Theorem. • Work with radicals and integer exponents.

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.G.7. APPLY the Pythagorean Theorem to DETERMINE unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	**8.G.7.** Through authentic experiences and exploration, students should use the Pythagorean Theorem to solve problems. Problems can include working in both two and three dimensions. Students should be familiar with the common Pythagorean triplets.
8.G.6. EXPLAIN a proof of the Pythagorean Theorem and its converse.	8.G.6. Students should verify, using a model, that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Students should also understand that if the sum of the squares of the 2 smaller legs of a triangle is equal to the square of the third leg, then the triangle is a right triangle.
8.G.8. APPLY the Pythagorean Theorem to FIND the distance between two points in a coordinate system.	8.G.8. Example: • Students will create a right triangle from the two points given (as shown in the diagram below) and then use the Pythagorean Theorem to find the distance between the two given points. 
8.EE.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. EVALUATE square roots of small perfect squares and cube roots of small perfect cubes. KNOW that $\sqrt{2}$ is irrational.	8.EE.2. Examples: • $3^2 = 9$ and $\sqrt{9} = \pm 3$ • $\left(\frac{1}{3}\right)^3 = \left(\frac{1^3}{3^3}\right) = \frac{1}{27}$ and $\sqrt[3]{\frac{1}{27}} = \frac{\sqrt[3]{1}}{\sqrt[3]{27}} = \frac{1}{3}$ • Solve $x^2 = 9$ Solution: $x^2 = 9$ $\sqrt{x^2} = \pm\sqrt{9}$ $x = \pm 3$ • Solve $x^3 = 8$ Solution: $x^3 = 8$ $\sqrt[3]{x^3} = \sqrt[3]{8}$ $x = 2$

*Adapted from the Arizona Academic Content Standards.

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Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• Pythagorean Theorem
  ○ Proof of and its converse
• Right triangles
• Coordinate system
• Square root
• Perfect square
• Cube root
• Perfect cube
	• APPLY (Pythagorean Theorem)
	  ○ DETERMINE (unknown side lengths in right triangles)
	  ○ FIND (distance between two points in a coordinate system)
	• EXPLAIN (a proof of the Pythagorean Theorem and its converse)
	• USE
	  ○ (square root and cube root symbols)
	  ▪ REPRESENT (solutions to equations)
	• EVALUATE
	  ○ (square roots of perfect squares)
	  ○ (cube roots of perfect cubes)
		3
		3
		1
		4
		2
		2
		3

Essential Questions
How does geometry better describe objects?
Corresponding Big Ideas
Geometric attributes (such as shapes, line, angles, figures and planes) provide descriptive information about an object's properties and position in space and support visualization and problem solving.

Learning Activities		
Objective	**Resource/page**	**Notes**
8.G.6. EXPLAIN a proof of the Pythagorean Theorem and its converse.		4 days
8.G.6.1 Explore the relationships between the lengths of sides of triangles to discover the special relationship of $a^2+b^2=c^2$ for right triangles	Geometer Sketchpad pg 71	2 days

*Adapted from the Arizona Academic Content Standards.

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Objective	Resource/page	Notes
8.G.6.2 Prove the Pythagorean Theorem and its converse using a model	CCSS Supplement Lesson 14	2 days
8.G.7. APPLY the Pythagorean Theorem to DETERMINE unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.		5 days (incl assessment)
8.G.7.1 USE the Pythagorean Theorem to determine the length of the hypotenuse of a right triangle, given the lengths of the legs	MC3 3-5 Coach Lesson 29 Pizzazz D-73 Punchline p115-116	1 day
8.G.7.2 USE the Pythagorean Theorem to determine the length of a leg of a right triangle, given the length of one leg and the hypotenuse	MC3 3-5 Coach Lesson 29 Pizzazz D-75 Punchline p 115-116	1 day
8.G.7.3 APPLY the Pythagorean Theorem to SOLVE real-world problems.	MC3 3-6 Punchline p 115-116 Pizzazz D-74,76 Coach Lesson 31 Math 8 DVD Rock-climbing and Kite flying	2 days
8.G.8. APPLY the Pythagorean Theorem to FIND the distance between two points in a coordinate system.		6 days (incl unit assessment)
8.G.8.1 FIND the distance between two points in a coordinate system using the Pythagorean Theorem	MC3 3-7	4 day
8.G.8.2 USE the distance formula to FIND the distance between two points in a coordinate system	**Prealgebra 9-5** **Coach Lesson 30**	2 days

*Adapted from the Arizona Academic Content Standards.

UNIT 2 VOCABULARY:
Converse of the Pythagorean Theorem, coordinate system, distance formula, hypotenuse, legs, Pythagorean Theorem, right triangle

Standardized Assessment Correlations (State, College and Career)
Expectations for Learning (in development) This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

Assessment
Ledyard Assessment Unit 2 Performance Task for Unit 2 TBD

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategie

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

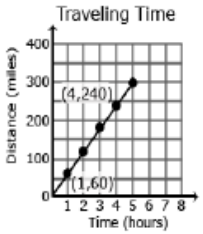
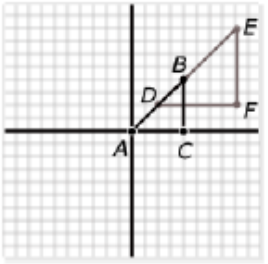
*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 3: Linear Relationships

Pacing: 30 days (plus 5 days for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* **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.
Domain and Standards Overview
Expressions and Equations • Understand the connections between proportional relationships, lines, and linear equations. • Analyze and solve linear equations **Functions** • Define, evaluate, and compare functions. • Use functions to model relationships between quantities.

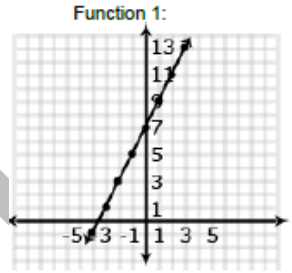
*Adapted from the Arizona Academic Content Standards.

Priority and Supporting CCSS	Explanations and Examples*
8.EE.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 distance-time equation to determine which of two moving objects has greater speed.*	**8.EE.5.** Using graphs of experiences that are familiar to students increases accessibility and supports understanding and interpretation of proportional relationship. Students are expected to both sketch and interpret graphs. Example: • Compare the scenarios to determine which represents a greater speed. Include a description of each scenario including the unit rates in your explanation. Scenario 1:  Scenario 2: $y = 50x$ x is time in hours y is distance in miles
8.EE.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 b**.**	8.EE.6. Example: • Explain why ΔACB is similar to ΔDFE, and deduce that $\overline{AB}$ has the same slope as $\overline{BE}$. Express each line as an equation. 

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.EE.7. SOLVE linear equations in one variable. **a. GIVE examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. 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).** **b. SOLVE linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.**	**8.EE.7.** As students transform linear equations in one variable into simpler forms, they discover the equations can have one solution, infinitely many solutions, or no solutions. When the equation has one solution, the variable has one value that makes the equation true as in 12 - 4*y* =16. The only value for y that makes this equation true is -1. When the equation has infinitely many solutions, the equation is true for all real numbers as in 7*x* + 14 = 7(*x*+2). As this equation is simplified, the variable terms cancel leaving 14 = 14 or 0 = 0. Since the expressions are equivalent, the value for the two sides of the equation will be the same regardless which real number is used for the substitution. When an equation has no solutions it is also called an inconsistent equation. This is the case when the two expressions are not equivalent as in 5*x* - 2 = 5(*x*+1). When simplifying this equation, students will find that the solution appears to be two numbers that are not equal or -2 = 1. In this case, regardless which real number is used for the substitution, the equation is not true and therefore has no solution. Examples: • Solve for x: ○ $-3(x+7)=4$ ○ $3x-8=4x-8$ ○ $3(x+1)-5=3x-2$ • Solve: ○ $7(m-3)=7$ ○ $\frac{1}{4}-\frac{2}{3}y=\frac{3}{4}-\frac{1}{3}y$

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.F.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.***	**8.F.2.** Examples: • Compare the two linear functions listed below and determine which equation represents a greater rate of change.  Function 2: The function whose input x and output y are related by $y = 3x + 7$ • Compare the two linear functions listed below and determine which has a negative slope. Function 1: Gift Card Samantha starts with $20 on a gift card for the book store. She spends $3.50 per week to buy a magazine. Let y be the amount remaining as a function of the number of weeks. Function 2: The school bookstore rents graphing calculators for $5 per month. It also collects a non-refundable fee of $10.00 for the school year. Write the rule for the total cost (c) of renting a calculator as a function of the number of months (*m*). Solution: Function 1 is an example of a function whose graph has negative slope. Samantha starts with $20 and spends money each week. The amount of money left on the gift card decreases each week. The graph has a negative slope of -3.5, which is the amount the gift card balance decreases with Samantha's weekly magazine purchase. Function 2 is an example of a function whose graph has positive slope. Students pay a yearly nonrefundable fee for renting the calculator and pay $5 for each month they rent the calculator. This function has a positive slope of 5 which is the amount of the monthly rental fee. An equation for Example 2 could be $c = 5m + 10$.

x	*y*
0	20
1	16.50
2	13.00
3	9.50
4	6.00

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.F.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. 8.F.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 is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* **8.F.4. CONSTRUCT 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 (*x*, *y*) values, including reading these from a table or from a graph. INTERPRET the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.**	8.F.1. For example, the rule that takes x as input and gives x^2+5x+4 as output is a function. Using y to stand for the output we can represent this function with the equation $y = x^2+5x+4$, and the graph of the equation is the graph of the function. Students are not yet expected use function notation such as $f(x) = x^2+5x+4$. 8.F.3. Example: • Determine which of the functions listed below are linear and which are not linear and explain your reasoning. o $y = -2x^2 + 3$ non linear o $y = 2x$ linear o $A = \pi r^2$ non linear o $y = 0.25 + 0.5(x - 2)$ linear 8.F.4. Examples: • The table below shows the cost of renting a car. The company charges $45 a day for the car as well as charging a one-time $25 fee for the car's navigation system (GPS).Write an expression for the cost in dollars, *c,* as a function of the number of days, *d*. Students might write the equation $c = 45d + 25$ using the verbal description or by first making a table. Days (*d*) | Cost (*c*) in dollars 1 | 70 2 | 115 3 | 160 4 | 205 Students should recognize that the rate of change is 45 (the cost of renting the car) and that initial cost (the first day charge) also includes paying for the navigation system. Classroom discussion about one time fees vs. recurrent fees will help students model contextual situations. • When scuba divers come back to the surface of the water, they need to be careful not to ascend too quickly. Divers should not come to the surface more quickly than a rate of 0.75 ft per second. If the divers start at a depth of 100 feet, the equation $d = 0.75t - 100$ shows the relationship between the time of the ascent in seconds (*t)* and the distance from the surface in feet (*d*). o Will they be at the surface in 5 minutes? How long will it take the divers to surface from their dive? • Make a table of values showing several times and the corresponding distance of the divers from the surface. Explain what your table shows. How do the values in the table relate to your equation?

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	Explanations and Examples*
8.F.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.F.5. Example: • The graph below shows a student's trip to school. This student walks to his friend's house and, together, they ride a bus to school. The bus stops once before arriving at school. Describe how each part A-E of the graph relates to the story. 

*Adapted from the Arizona Academic Content Standards.

Grade 8 Mathematics

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
• Proportional relationships • Unit rate • Slope (*m*) • Y-intercept (*b*) • Linear equations ($y = mx$ and $y = mx + b$) ○ Rational Number Coefficients ○ One variable ▪ One solution ▪ Infinitely many solutions ▪ No solutions • Equations into simple forms ○ Expanding Expressions ○ Distributive property ○ Combining Like terms • Functions ○ Properties ▪ Linear ▪ Non-linear ○ Input/Output ○ Ordered pairs • Linear/functional relationship • rate of change • initial value (function) • table • graph Similar triangles	• GRAPH (proportional relationships) • INTERPRET (unit rate as slope) • COMPARE (proportional relationships) • EXPLAIN (why slope is the same between any two points on a non-vertical line) • DERIVE (linear equations ($y = mx$ and $y = mx + b$) • SOLVE (linear equations) • GIVE (example of linear equations) • TRANSFORM (equations) • EXPAND (expressions) ○ Use (distributive property) ○ Collect (like terms) • UNDERSTAND (function is a rule) ○ GRAPH (sets of ordered pairs) • COMPARE (functions) ○ Algebraically ○ Graphically ○ Numerically in tables ○ Verbal descriptions • CONSTRUCT (function) ○ Model (linear relationship) • DETERMINE (rate of change and initial value of function) • READ (table or graph) • INTERPRET ○ $y = mx + b$ ○ rate of change and initial value of function • GIVE (examples of non-linear functions) • DESCRIBE (functional relationship between two quantities) • DRAW/SKETCH (graph from a verbal description)	4 2 2 3 3 3 2 3 3 2 4 3 3 2 2 3 2 2 3

*Adapted from the Arizona Academic Content Standards.

Essential Questions
How can algebraic expressions and equations be used to model, analyze and solve mathematical situations? How are functions useful?
Corresponding Big Ideas
Algebraic expressions and equations are used to model real-life problems and represent quantitative relationships, so that the numbers and symbols can me manipulated to reach a solution or make sense of the quantitative relationships. The characteristics of functions and their representations are useful in making sense of patterns and solving problems involving quantitative relationships.

Learning Activities

Objective	Resource/page	Notes
Standard 8.EE.7. SOLVE linear equations in one variable.		10 days (incl assessment)
8.EE.7.1 Solve two-step one-variable equations using properties of equality	MC3 8-2 Solving Two-Step Equations	1 day
8.EE.7.2 Solve one-variable equations requiring combining like terms	MC3 8-2 Solving Two-Step Equations	1 day
8.EE.7.3 Solve one-variable equations requiring the distributive property	MC3 8-2 Solving Two-Step Equations	1 day
8.EE.7.4 Solve one-variable equations with rational number coefficients by clearing fractions (multiply by common denominator) and decimals (multiply by power of 10)	MC3 2-7 Solving Equations with Rational NumbersMC3 CCSS Supp. Lesson 4 Solve Equations with Rational Coefficients	MC3 2-7 is only one-step equations 2 days

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.EE.7.5 Solve one-variable equations with the variable on both sides.	MC3 8-4 Solving Equations with Variables on Both Sides MC3 CCSS Supp. Lesson 3 Solve Multi-step Equations Coach Lesson 9 Pre-Algebra w/ Pizzazz Algebra w/ Pizzazz	CCSS Supplement Lesson 3, Coach Lesson 9 and Pizzazz worksheets cover equations requiring ALL steps 3 days (including mixed)
8.EE.7.6 Identify special cases of one-variable equations with variable on both sides resulting in no solution or infinitely many solutions.	MC3 CCSS Supp. Lesson 3 Solve Multi-step Equations	
8.EE.7.7 Check the solutions to one-variable equations by substitution		Included with the objective for each individual type of equation as appropriate
8.EE.7.8 Model and solve real world problems (applications) using one-variable equations.	MC3 8-3 Writing Two Step Equations Coach Lesson 10	Included with the objective for each individual type of equation as appropriate
Standard 8.F.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.		6 days (incl assessment)
8.F.1.1 Determine whether a relation is a function from a table of values or a graph	MC3 9-2 Functions MC3 Extend 9-2 Relations and Functions MC3 CCSS Supp Lesson 19 MathScape Family Portraits Lesson 1	.5 day
8.F.1.2 Determine the range of a function for a given domain	MC3 9-2 Functions	.5 day
8.F.1.3 Graph a function from a table of values or a function rule	MC3 9-2 Functions	1 day
8.F.1.4 Write a function rule from a verbal description	PH Algebra Worksheets 5-4 Reteaching and Practice	1 day

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.F.1.5 Match functions represented algebraically, graphically, numerically or with a verbal description	MC3 9-2 Functions Coach Lesson 22	1 day
Objective 8.F.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.F.5.1 Describe qualitatively the relationship between two quantities by analyzing a graph or sketch a graph to match a verbal description.	MC3 CCSS Supp Lesson 9	1 day
Objective 8.EE.5. GRAPH proportional relationships, interpreting the unit rate as the slope of the graph. COMPARE two different proportional relationships represented in different ways.		14 days (incl assessment)
Objective 8.F.2. COMPARE properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).		
8.EE.5.1 Determine the rate of change between two related quantities given two sets of values (x,y) or from a graph	MC3 4-3 Rate of Change	1 day
8.EE.5.2 Identify whether a relationship is linear or not from a table of values or a graph.	MC3 4-4 Constant Rate of Change	1 day
8.EE.5.3 Describe the constant rate of change of a linear relationship as the slope and determine slope from two sets of values (x,y) or from a graph.	MC3 9-4 Slope	.5 day
8.EE.5.4 or 8.F.2.1 Compare two different proportional relationships represented in different ways (algebraical, graphical, numerical or verbal).	MC3 CCSS Supp Lesson 7 Coach Lesson 23	1 day
Objective 8.EE.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 *b*..		
8.EE.6.1 Use similar triangles to explain why the slope of a straight line is constant throughout the coordinate plane.	MC3 Extend 9-5 Slope Triangles	.5 day
8.EE.6.2 Interpret the equation *y=mx+b* as a line with slope *m* and y-intercept *b*	MC3 9-6 Slope-Intercept Form TI-84 Graphing Calculator	2 days

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.EE.6.3 Determine the slope-intercept equation of a line from a graph and draw the graph of a line given its slope-intercept equation.	MC3 9-6 Slope-Intercept Form	2 days
8.F.4. CONSTRUCT 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 (*x*, *y*) values, including reading these from a table or from a graph. INTERPRET the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.		
8.F.4.1 Construct a function to model a linear relationship between two quantities by determining rate of change (slope) and initial value (y-intercept) from two (x,y) values, including from a table, or from a graph	MC3 CCSS Supp Lesson 8 Coach Lesson 21	2 days
8.F.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.		
8.F.3.1 Determine whether a function is linear or non-linear	MC3 10-1 Linear and Non-Linear Functions Coach Lesson 20 TI-84 Graphing Calculator	1 day

UNIT 3 VOCABULARY:
constant rate of change, Distributive Property, domain, function, function rule, identity, input, like terms, linear function, non-linear function, no solution, output, range, rate of change, rise, run, slope, slope-intercept form, slope triangle, solution, two-step equation, unit rate, Y-Intercept

*Adapted from the Arizona Academic Content Standards.

Standardized Assessment Correlations (State, College and Career)
Expectations for Learning (in development) This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

Assessment
Ledyard Assessment Unit 3 Performance Task for Unit 3 TBD (possible tasks) • *Multiple Solutions* task. Students are given various equations and inequalities and are asked to find 2 sample solutions to each. Next, students identify whether the equation/inequality falls into the category of: exactly 2 solutions, more than 2 solutions, but not infinitely many solutions, or infinitely many solutions. The task ties into several standards, including those from Number Systems and Expressions and Equations, and may be best used formatively to assess student understanding of prerequisite knowledge. http://map.mathshell.org/materials/tasks.php?taskid=263&subpage=apprentice Source: Mathematics Assessment Project (Shell Center/MARS, University of Nottingham & UC Berkeley) • Interpreting Distance-Time Graphs http://map.mathshell.org/materials/lessons.php?taskid=208

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategie

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 4: Systems of Linear Relationships

Pacing: 12 days (plus 5 days for reteaching/enrichment)

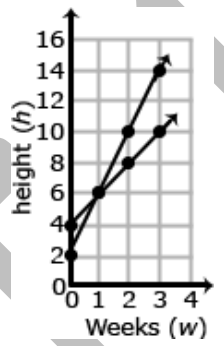
Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* 1. **Make sense of problems and persevere in solving them.** 2. Reason 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.
Domain and Standards Overview
Expressions and Equations • Analyze and solve linear equations and pairs of simultaneous linear equations. **Functions** • Use functions to model relationships between quantities. .

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.EE.7.SOLVE linear equations in one variable. **c.** GIVE examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. 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). **d.** SOLVE linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. **8.EE.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. SOLVE simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.*** **c. SOLVE real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.***	**8.EE.8.** Systems of linear equations can also have one solution, infinitely many solutions or no solutions. Students will discover these cases as they graph systems of linear equations and solve them algebraically. A system of linear equations whose graphs meet at one point (intersecting lines) has only one solution, the ordered pair representing the point of intersection. A system of linear equations whose graphs do not meet (parallel lines) has no solutions and the slopes of these lines are the same. A system of linear equations whose graphs are coincident (the same line) has infinitely many solutions, the set of ordered pairs representing all the points on the line. By making connections between algebraic and graphical solutions and the context of the system of linear equations, students are able to make sense of their solutions. Students need opportunities to work with equations and context that include whole number and/or decimals/fractions. Examples: • Find x and y using elimination and then using substitution. $3x + 4y = 7$ $-2x + 8y = 10$ • Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same. Let W = number of weeks Let H = height of the plant after W weeks Plant A W H 0 4 (0,4) 1 6 (1,6) 2 8 (2,8) 3 10 (3,10) Plant B W H 0 2 (0,2) 1 6 (1,6) 2 10 (2,10) 3 14 (3,14) Given each set of coordinates, graph their corresponding lines.

*Adapted from the Arizona Academic Content Standards.

Solution:



Write an equation that represent the growth rate of Plant A and Plant B.

Solution:
Plant A $H = 2W + 4$
Plant B $H = 4W + 2$

• At which week will the plants have the same height?

Solution:
The plants have the same height after one week.
Plant A: $H = 2W + 4$ Plant B: $H = 4W + 2$
Plant A: $H = 2(1) + 4$ Plant B: $H = 4(1) + 2$
Plant A: $H = 6$ Plant B: $H = 6$
After one week, the height of Plant A and Plant B are both 6 inches.

*Adapted from the Arizona Academic Content Standards.

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• Linear Equations (Simultaneous/system of)
  ○ Rational Number Coefficients
  ○ One variable
  ▪ One solution
  ▪ Many solutions
  ▪ No solutions
• Equations into simpler forms
  ○ Expanding Expressions
  ○ Distributive Property
  ○ Combining Like Terms
• Function
  ○ Rate of change
  ○ Initial value (of a linear function)
  ○ Representation
  ▪ Algebraically
  ▪ Graphically
  ▪ Numerically in table
  ▪ Verbal description
	• SOLVE (linear equations)
	• GIVE (examples of linear equations)
	One solution
	Many solutions
	No solutions
	• SHOW (simpler forms)
	• SOLVE (with rational number coefficients)
	• ANALYZE (pairs of simultaneous linear equations)
	• UNDERSTAND (solutions)
	• SOLVE (systems of two linear equations)
	• ESTIMATE (solutions)
	• GRAPH (equations)
	• SOLVE
	  ○ (simple cases by inspection)
	  ○ In context
	• CONSTRUCT (function)
	• DETERMINE (rate of change and initial value of the function)
	• READ (table and graph)
	• INTERPRET (rate of change and initial value of a linear function
	• COMPARE (functions represented differently)
		3
		2
		
		2
		3
		4
		2
		3
		3
		3
		3
		
		3
		3
		2
		2
		2
		2

Essential Questions
How can algebraic expressions and equations be used to model, analyze and solve mathematical situations?
Corresponding Big Ideas
Algebraic expressions and equations are used to model real-life problems and represent quantitative relationships, so that the numbers and symbols can be manipulated to reach a solution or make sense of the quantitative relationships.

*Adapted from the Arizona Academic Content Standards.

Learning Activities		
Objective	**Resource/page**	**Notes**
Objective 8.EE.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. SOLVE simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.*** **c. SOLVE real-world and mathematical problems leading to two linear equations in two variables.**		11 days (incl assessment)
8.EE.8.1 Understand that the solution to a system of two linear equations in two variables is the set of values for the two variables that make both equations true.	MC 9-7 Systems of Equations	.5 day
8.EE.8.2 Understand that the solution to a system of two linear equations in two variables is the coordinates of the point of intersection	MC 9-7 Systems of Equations Coach Lesson 16	1.5 days
8.EE.8.3 Understand that a system of two linear equations can have one solution (lines intersect) , no solution (lines are parallel) or infinitely many solutions (lines are coincident).	MC 9-7 Systems of Equations Pizzazz Algebra p 161 TI-84 Graphing Calculator	1 day
8.EE.8.4 Solve a system of two linear equations using algebraically (using substitution)	MC CCSS Supp Lesson 5 Coach Lesson 15, 17 Pizzazz Algebra p 162	2 days

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.EE.8.5 Understand how the three types of solutions to systems of linear equations (one solution, no solution, infinitely many solutions) are represented when solving the system algebraically	Coach Lesson 15 Algebra Text Practice 7-2 Worksheet	1 day
8.EE.8.6 Model and solve real world situations using systems of linear equations.	MC3 9-7 Systems of Equations MC3 CCSS Supp Lesson 5 Pizzazz Algebra pp 169-171 Algebra Text Lesson 7-2 and 7-4	3 days

UNIT 4 VOCABULARY:
coefficient, infinitely many solutions – coincident line, intersection, like terms, linear equation, no solution –parallel lines, one solution –intersecting lines, rational number, solution, substitution, system of equations

Standardized Assessment Correlations (State, College and Career)
Expectations for Learning (in development) This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

*Adapted from the Arizona Academic Content Standards.

Assessment
Ledyard Assessment Unit 4 Performance Task for Unit 4 TBD (possible task): • *Notebooks and Pens* and *Cash Registers* (Students compare two equations with two variables in two separate but similar contexts. Each problem is done individually, but students are also asked to describe and analyze sample student work containing different strategies for completing problems of this type. They are then encouraged to revise their work on the problems based on their findings. http://map.mathshell.org/materials/download.php?fileid=669

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategie

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

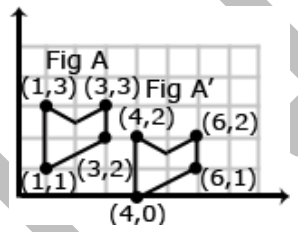
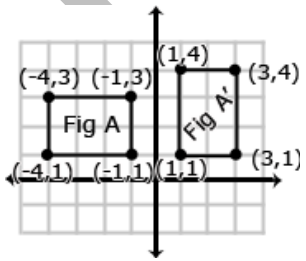
*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 5: Congruence and Similarity

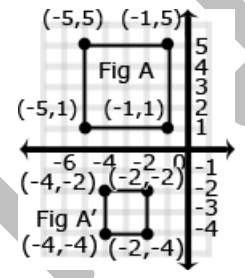
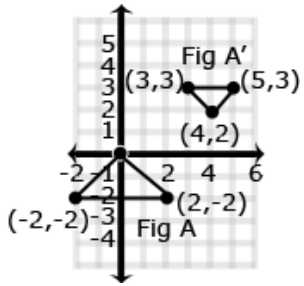
Pacing: 25 days (plus 5 days for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* 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.
Domain and Standards Overview
Geometry • Understand congruence and similarity using physical models, transparencies, or geometry software.

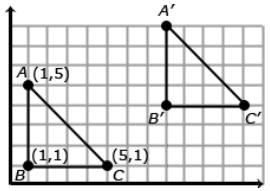
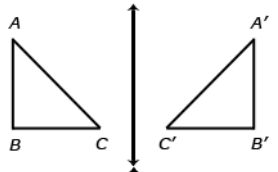
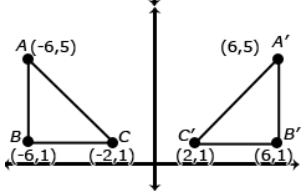
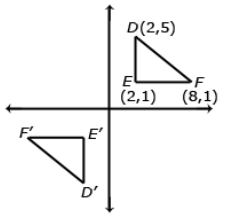
*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.G.2. UNDERSTAND that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections and translations; given two congruent figures, DESCRIBE a sequence that exhibits the congruence between them.	**8.G.2.** Examples: • Is Figure A congruent to Figure A'? Explain how you know.  • Describe the sequence of transformations that results in the transformation of Figure A to Figure A'. 
8.G.1 VERIFY experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines.	8.G.1 Examples: Students need multiple opportunities to explore the transformation of figures so that they can appreciate that points stay the same distance apart and lines stay at the same angle after they have been rotated, reflected, and/or translated. Students are not expected to work formally with properties of dilations until high school.

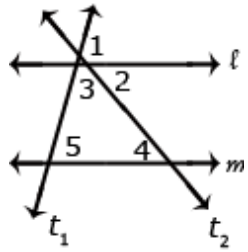
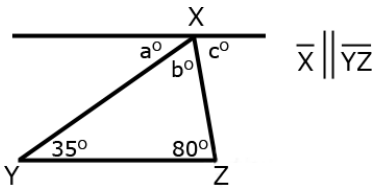
*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.G.4. UNDERSTAND that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, DESCRIBE a sequence that exhibits the similarity between them.	**8.G.4.** Examples: • Is Figure A similar to Figure A'? Explain how you know.  • Describe the sequence of transformations that results in the transformation of Figure A to Figure A'. 

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.G.3. DESCRIBE the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	8.G.3. examples Dilation: A dilation is a transformation that moves each point along a ray emanating from a fixed center, and multiplies distances from the center by a common scale factor. In dilated figures, the dilated figure is *similar* to its pre-image.  Translation: A translation is a transformation of an object that moves the object so that every point of the object moves in the same direction as well as the same distance. In a translation, the translated object is *congruent* to its pre-image. Δ*ABC* has been translated 7 units to the right and 3 units up. To get from A (1,5) to A' (8,8), move A 7 units to the right (from $x = 1$ to $x = 8$) and 3 units up (from $y = 5$ to $y = 8$). Points B + C also move in the same direction (7 units to the right and 3 units up). Reflection: A reflection is a transformation that flips an object across a line of reflection (in a coordinate grid the line of reflection may be the x or y axis). In a rotation, the rotated object is *congruent* to its pre-image.  When an object is reflected across the y axis, the reflected x coordinate is the opposite of the pre-image x coordinate.  Rotation: A rotated figure is a figure that has been turned about a fixed point. This is called the center of rotation. A figure can be rotated up to 360˚. Rotated figures are congruent to their pre-image figures. Consider when Δ*DEF* is rotated 180˚ clockwise about the origin. The coordinates of Δ*DEF* are D(2,5), E(2,1), and F(8,1). When rotated 180˚, Δ*D'E'F'* has new coordinates D'(-2,-5), E'(-2,-1) and F'(-8,-1). Each coordinate is the opposite of its pre-image. 

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.G.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.G.5. Examples: Students can informally prove relationships with transversals. Show that $m\angle 3 + m\angle 4 + m\angle 5 = 180^\circ$ if *l* and *m* are parallel lines and t1 & t2 are transversals. $\angle 1 + \angle 2 + \angle 3 = 180^\circ$. Angle 1 and Angle 5 are congruent because they are corresponding angles ($\angle 5 \cong \angle 1$). $\angle 1$ can be substituted for $\angle 5$. $\angle 4 \cong \angle 2$ because alternate interior angles are congruent. $\angle 4$ can be substituted for $\angle 2$. Therefore $m\angle 3 + m\angle 4 + m\angle 5 = 180^\circ$  Students can informally conclude that the sum of a triangle is 180º (the angle-sum theorem) by applying their understanding of lines and alternate interior angles. In the figure below, line x is parallel to line *yz*:  $\overline{X} \parallel \overline{YZ}$ Angle *a* is 35º because it alternates with the angle inside the triangle that measures 35º. Angle *c* is 80º because it alternates with the angle inside the triangle that measures 80º. Because lines have a measure of 180º, and angles *a* + *b* + *c* form a straight line, then angle *b* must be 65 º (180 – 35 + 80 = 65). Therefore, the sum of the angles of the triangle are 35º + 65 º + 80 º

*Adapted from the Arizona Academic Content Standards.

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• Rotation
• Reflection
• Translation
• Dilation
• Congruence
• Similarity
• Informal proof
• Angle sum and exterior angle of triangles
• Parallel lines cut by a transversal
  ○ Angles formed
• Angle-angle criterion for similar triangles
	• UNDERSTAND (Congruence)
	  ○ DESCRIBE (Sequence of rotations, reflections, translations)
	• VERIFY (Experimentally properties of)
	  ○ Rotations
	  ○ Reflections
	  ○ Translations
	  ○ Dilations
	• UNDERSTAND (Similarity)
	  ○ DESCRIBE (Sequence of rotations, reflections, translations, dilations)
	• DESCRIBE (effect of dilations, translations, rotations and reflections using coordinates)
	• USE(informal arguments)
	  ○ angle relationships in parallel lines cut by a transversal
	  ○ sum of angles in a triangle = 180°
		2
		2
		2
		2
		2
		2
		5

Essential Questions
How does geometry better describe objects?
Corresponding Big Ideas
Geometric attributes (such as shapes, line, angles, figures and planes) provide descriptive information about an object's properties and position in space and support visualization and problem solving.

*Adapted from the Arizona Academic Content Standards.

Learning Activities		
Objective	**Resource/page**	**Notes**
8.G.1 VERIFY experimentally the properties of rotations, reflections, and translations:		3 days
8.G.1.1 IDENTIFY and APPLY translations (slides)	CCSS Supplement Lesson 10 Geometer Sketchpad pg 145	1 day
8.G.1.2 IDENTIFY and APPLY reflections (flips)	CCSS Supplement Lesson 10	1 day
8.G.1.3 IDENTIFY and APPLY rotations (turns)	CCSS Supplement Lesson 10 Geometer Sketchpad pg 147 Geometer Sketchpad pg 149	1 day
8.G.2. UNDERSTAND that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections and translations; given two congruent figures, DESCRIBE a sequence that exhibits the congruence between them.		3 days (incl assessment)
8.G.2.1 IDENTIFY congruent two-dimensional figures	MC3 6-4	1 day
8.G.2.2 DESCRIBE the sequence of transformations required to show the congruence of two figures	CCSS Supplement Lesson 11	1 day
8.G.3. DESCRIBE the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		8 days (incl assessment)
8.G.3.1 GRAPH a translation on a coordinate plane and IDENTIFY coordinates for the translated image	MC3 6-7 Geometer Sketchpad pg 150-153	1 day
8.G.3.2 GRAPH a reflection across a line on a coordinate plane and IDENTIFY coordinates for the reflected image	MC3 6-6 Geometer Sketchpad pg 150-153	1day

*Adapted from the Arizona Academic Content Standards.

Objectives	Resources/pages	Notes
8.G.3.3 GRAPH a rotation on a coordinate plane and IDENTIFY coordinates for the reflected image	CCSS Supplement Lesson 12 Geometer Sketchpad pg 150-153 Coach Lesson 24	2 days
8.G.3.4 USE a scale factor and center of dilation to GRAPH a dilation (reduction or enlargement) on a coordinate plane	MC3 4-8 Coach Lesson 25 Geometer Sketchpad pg 155-157	3 days
8.G.4. UNDERSTAND that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, DESCRIBE a sequence that exhibits the similarity between them.		3 days
8.G.4.5 IDENTIFY similar polygons	MC3 4-7 Coach Lesson 26 Punchline 144 Geometer Sketchpad pg 158-159	2 days
8.G.4.6 USE a series of transformations to create or confirm similar figures	CCSS Supplement Lesson 13 Geometer Sketchpad pg 168-170	1 day
8.G.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.		6 days (incl assessment)
8.G.5.1 IDENTIFY vertical, supplementary and complimentary angles and use their relationships to find missing angle measurements	MC3 6-1 Punchline 137	.5 day

*Adapted from the Arizona Academic Content Standards.

Objectives	Resources/pages	Notes
8.G.5.2 IDENTIFY the special pairs of angles formed by two parallel lines cut by a transversal and USE their relationships to FIND missing angle measurements.	MC3 6-1 Coach Lesson 28 Pizzazz D33 Punchline 139 Geometer Sketchpad pg 42-43	1.5 days
8.G.5.3 IDENTIFY the interior and exterior angles of a triangle and FIND missing angle measures.	Coach Lesson 24 Punchline 138	1.5 days
8.G.5.4 DETERMINE if two triangles are similar using the angle-angle similarity postulate	Coach Lesson 26	.5 day

UNIT 5 VOCABULARY:
AA triangle similarity postulate, alternate exterior angle, alternate interior angle, axis of reflection, center of dilation, center of rotation, clockwise, complementary angles, congruence, coordinate plane, corresponding angles, counter-clockwise, dilation enlargement, exterior angles, exterior angle of a polygon, image, interior angles, interior angle of a polygon, parallel, pre-image, perpendicular, reduction, reflection, rotation, scale factor, similar, supplementary angles, transformation, translation, transversal, triangle sum theorem, vertical angles

Assessment
Ledyard Assessment Unit 5 Performance Task for Unit 5 TBD

*Adapted from the Arizona Academic Content Standards.

Standardized Assessment Correlations (State, College and Career)
Expectations for Learning (in development) This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategie

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

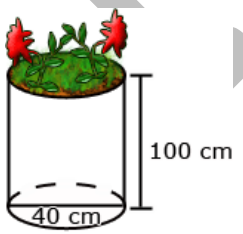
*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 6: Volume

Pacing: 15 days (plus 5 days for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* **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.
Domain and Standards Overview
Geometry • Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.G.9. KNOW the formulas for the volumes of cones, cylinders and spheres and USE them to SOLVE real-world and mathematical problems.	**8.G.9. Example:** • **James wanted to plant pansies in his new planter. He wondered how much potting soil he should buy to fill it. Use the measurements in the diagram below to determine the planter's volume.**  cylindrical planter

Concepts **What Students Need to Know**	**Skills** **What Students Need To Be Able To Do**	**Bloom's Taxonomy Levels**

• Formulas (volume)
  ○ Cones
  ○ Cylinders
  ○ Spheres
	• KNOW (formulas for volumes)
	• USE (formulas for volumes)
	• SOLVE (in context)
		2
		3
		3

Essential Questions
How can I solve real world problems involving volume?
Corresponding Big Ideas
Some attributes of objects are measureable and can be quantified using unit amounts.

*Adapted from the Arizona Academic Content Standards.

Grade 8 Mathematics

Objective	Resource/page	Notes
8.G.9. KNOW the formulas for the volumes of cones, cylinders and spheres and USE them to SOLVE real-world and mathematical problems.		**14 days (incl assessment)**
8.G.9.1 KNOW that volume equals area of the base times the height (V = Bh)and USE the formula to calculate the volume of a prism	MC 7-5 Pizzazz D-69 Punchline 161 MATH8 DVD "Camping and Cars"	**1 day**
8.G.9.2 KNOW the formula for the area of a circle ($A = \pi r^2$) and USE it to SOLVE real-world circle area problems	MC 7-1 Pizzazz D-59 Punchline 155	**1 day**
8.G.9.3 KNOW the formula for the volume of a cylinder ($V=\pi r^2 h$) and USE it to SOLVE real-world cylinder volume problems.	MC 7-5 Pizzazz D-70 Punchline 162 Pizzazz PA 157 Coach Lesson 32 http://people.stu.ca/~pheeney/5873ManipVolumeCylinder09.pdf	**2 days**
8.G.9.4 KNOW the formula for the volume of a cone ($V = \frac{1}{3}\pi r^2 h$) and USE it to SOLVE real-world cone volume problems	MC 7-6 Pizzazz PA 157 Coach Lesson 32 Clear GeoModel solids http://people.stu.ca/~pheeney/5873ManipVolumeCone09.pdf	**3 days**
8.G.9.5 KNOW the formula for the volume of a sphere ($\frac{4}{3}\pi r^3$) and USE it to SOLVE real-world sphere volume problems	MC pg 741 Punchline 164 Pizzazz PA 157 Coach Lesson 32 Clear GeoModel solids http://people.stu.ca/~pheeney/5873ManipVolumeSphere09.pdf	**2 days**
8.G.9.6 USE the volume formulas to SOLVE real-world volume problems for composite figures made up of whole and fractional parts of prisms, cylinders, cones, spheres.	MC 7-5, 7-6 Punchline 165 Clear GeoModel solids	**2 days**

*Adapted from the Arizona Academic Content Standards.

UNIT 6 VOCABULARY:
area, base, circle, composite figure, cone, cylinder, height, prism, radius, sphere, volume

Assessment
Ledyard Assessment Unit 6 Performance Task for Unit 6 TBD

Standardized Assessment Correlations (State, College and Career)
Expectations for Learning (in development) This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategie

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

*Adapted from the Arizona Academic Content Standards.

UNIT OF STUDY 6: Patterns in Data

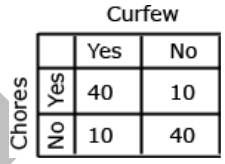
Pacing: 15 days (plus 5 days for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* **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.
Domain and Standards Overview
Statistics and Probability • Investigate patterns of association in bivariate data.

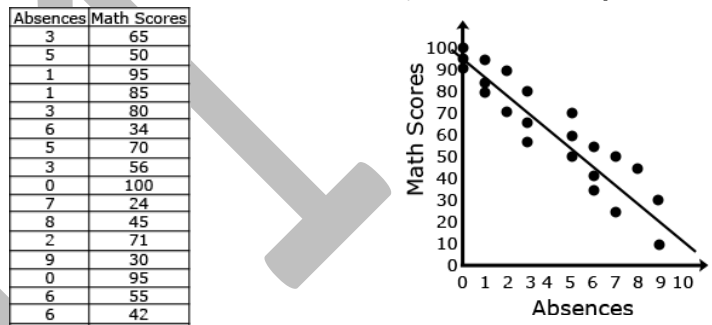
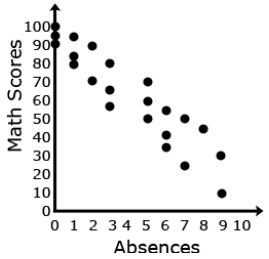
*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.SP.1. CONSTRUCT and INTERPRET scatter plots for bivariate measurement data to INVESTIGATE patterns of association between two quantities. DESCRIBE patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	**8.SP.1. Students build on their previous knowledge of scatter plots examine relationships between variables. They analyze scatter plots to determine positive and negative associations, the degree of association, and type of association. Students examine outliers to determine if data points are valid or represent a recording or measurement error. Students can use tools such as those at the National Center for Educational Statistics to create a graph or generate data sets. (http://nces.ed.gov/nceskids/createagraph/default.aspx)** **Examples:** **• Data for 10 students' Math and Science scores are provided in the chart. Describe the association between the Math and Science scores.** Student: 1 2 3 4 5 6 7 8 9 10 Math: 64 50 85 34 56 24 72 63 42 93 Science: 68 70 83 33 60 27 74 63 40 96 **• Data for 10 students' Math scores and the distance they live from school are provided in the table below. Describe the association between the Math scores and the distance they live from school.** Student: 1 2 3 4 5 6 7 8 9 10 Math score: 64 50 85 34 56 24 72 63 42 93 Dist from school (miles): 0.5 1.8 1 2.3 3.4 0.2 2.5 1.6 0.8 2.5 **• Data from a local fast food restaurant is provided showing the number of staff members and the average time for filling an order are provided in the table below. Describe the association between the number of staff and the average time for filling an order.** Number of staff: 3 4 5 6 7 8 Average time to fill order (seconds): 180 138 120 108 96 84 **• The chart below lists the life expectancy in years for people in the United States every five years from 1970 to 2005. What would you expect the life expectancy of a person in the United States to be in 2010, 2015, and 2020 based upon this data? Explain how you determined your values.** Date: 1970 1975 1980 1985 1990 1995 2000 2005 Life Expectancy (in years): 70.8 72.6 73.7 74.7 75.4 75.8 76.8 77.4

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.SP.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. *For example, collect data from students in your class on whether or not they have a curfew.*	**8.SP.4. Example:** **• The table illustrates the results when 100 students were asked the survey questions: Do you have a curfew? and Do you have assigned chores? Is there evidence that those who have a curfew also tend to have chores?**  Curfew Chores Yes / No Yes: 40, 10 No: 10, 40 **Solution: Of the students who answered that they had a curfew, 40 had chores and 10 did not. Of the students who answered they did not have a curfew, 10 had chores and 40 did not. From this sample, there appears to be a positive correlation between having a curfew and having chores.**

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.SP.3. USE the equation of a linear model to SOLVE problems in the context of bivariate measurement data, INTERPRETing the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*	**8.SP.3. Examples:** **1. Given data from students' math scores and absences, make a scatter plot.**  **2. Draw a line of best fit, paying attention to the closeness of the data points on either side of the line.**  **3. From the line of best fit, determine an approximate linear equation that models the given data (about $y = -\frac{25}{2}x + 95$)** **4. Students should recognize that 95 represents the y-intercept and $-\frac{25}{2}$ represents the slope of the line.** **5. Students can use this linear model to solve problems. For example, through substitution, they can use the equation to determine that a student with 4 absences should expect to receive a math score of about 62. They can then compare this value to their line.**

*Adapted from the Arizona Academic Content Standards.

Priority and Supporting **CCSS**	**Explanations and Examples***
8.SP.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.SP.2 Examples:** • **The capacity of the fuel tank in a car is 13.5 gallons. The table below shows the number of miles traveled and how many gallons of gas are left in the tank. Describe the relationship between the variables. If the data is linear, determine a line of best fit. Do you think the line represents a good fit for the data set? Why or why not? What is the average fuel efficiency of the car in miles per gallon?** Miles Traveled: 0, 75, 120, 160, 250, 300 Gallons Used: 0, 2.3, 4.5, 5.7, 9.7, 10.7

Concepts **What Students Need to Know**	**Skills** **What Students Need To Be Able To Do**	**Bloom's Taxonomy Levels**
• Scatter Plots	• CONSTRUCT (scatter plots)	3
• Patterns	• INTERPRET (scatter plots)	2
○ Clustering	• INVESTIGATE (patterns)	4
○ Outliers	• DESCRIBE (patterns)	1
○ Positive or Negative	• UNDERSTAND (patterns of association in data)	2
○ Linear	• CONSTRUCT (two-way table)	3
○ Nonlinear	• INTERPRET (two-way table)	2
• Frequencies	• USE (relative frequencies calculated for rows and columns)	3
• Two-way table	• DESCRIBE (association between variables)	2
○ variables	• USE (equation of a linear model)	3
• Equation of Linear Model	• SOLVE (in context)	4
○ Slope and Intercept	• INTERPRET (slope and intercept)	2
Line of best fit	• KNOW (straight lines model relationships between two quantitative variables)	1
	• FIT (informally, draw line of best fit)	3
	• ASSESS (informally, fit by judging closeness of data points to line	5

*Adapted from the Arizona Academic Content Standards.

Essential Questions
How probability is used to make informed decisions about uncertain events?
Corresponding Big Ideas
The rules of probability can lead to more valid and reliable predictions about the likelihood of an event occurring.

Learning Activities

Objective	Resource/page	Notes
8.SP.1. CONSTRUCT and INTERPRET scatter plots for bivariate measurement data to INVESTIGATE patterns of association between two quantities. DESCRIBE patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.		**3 days**
8.SP.1.1 CONSTRUCT a scatter plot for bivariate data	Mathscape pg 18	**2 days**
8.SP.1.2 INTEPRET a scatter plot and DESCRIBE patterns (clustering, outliers, positive or negative correlation, linear or non-linear)	MC3 9-9 Mathscape pg 20 Coach Lesson 33	**1 day**
8.SP.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.		**6 days (incl assessment)**
8.SP.2.1 DRAW a trend line on a scatter plot and ASSESS the fit	MC3 9-9 Mathscape pg 22 Coach Lesson 34	**1 day**

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.SP.2.2 USE the TI-84 Graphing Calculator to create a scatter plot and DESCRIBE the patterns shown (clustering, outliers, positive or negative correlation, linear or non-linear)	CCSS Supplement Lesson 15	**2 days**
8.SP.2.3 CONDUCT a linear regression with the TI-84 Graphing Calculator and INTERPRET the fit to a linear model visually and with the correlation coefficient	CCSS Supplement Lesson 15	**2 days**
8.SP.3. USE the equation of a linear model to SOLVE problems in the context of bivariate measurement data, INTERPRETing the slope and intercept.		**2 days**
8.SP.3.1 USE the trend line or line of best fit on a graph to make predictions	CCSS Supplement Lesson 15 Coach Lesson 35	**.5 day**
8.SP.3.2 INTERPRET the meaning of the slope and y-intercept of the trend line or line of best fit	Coach Lesson 35 CCSS Supplement Lesson 15	**.5 day**
8.SP.3.3 USE the graphing calculator linear regression equation to SOLVE problems	CCSS Supplement Lesson 15	**1 day**
8.SP.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.		**5 days (incl assessment)**
8.SP.4.1 CONSTRUCT a two-way table for bivariate categorical data	CCSS Supplement Lesson 16 Coach Lesson 36	**1 day**

*Adapted from the Arizona Academic Content Standards.

Objective	Resource/page	Notes
8.SP.4.2 DETERMINE relative frequencies for a two-way table	CCSS Supplement Lesson 16 Coach Lesson 36	**1 day**
8.SP.4.3 INTERPRET a two-way table to determine relationships between the two variables	CCSS Supplement Lesson 16 Coach Lesson 36	**1 day**

UNIT 7 VOCABULARY:
association (positive, negative, linear, non-linerar), cluster, correlation coefficient, line of best fit, outlier, regression, relative frequency, scatter plot, trend line, two-way table.

Assessment
Ledyard Assessment Unit 7 Performance Task for Unit 7 TBD

Standardized Assessment Correlations (State, College and Career)
Expectations for Learning (in development) This information will be included as it is developed at the national level. CT is a governing member of the Smarter Balanced Assessment Consortium (SBAC) and has input into the development of the assessment.

*Adapted from the Arizona Academic Content Standards.

Differentiated Instruction: Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See Appendix A for research-based Instructional and Differentiated Strategie

21st Century Learning Skills: See Appendix A for explanations.

Technology and Electronic Resources:

*Adapted from the Arizona Academic Content Standards.

Ratios and Proportional Relationships

Grade 6

Understand ratio concepts and use ratio reasoning to solve problems.

6.RP.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."*

6.RP.2: Understand the concept of a unit rate a/b associated with a ratio a:b with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."* (Note: Expectations for unit rates in this grade are limited to non-complex fractions.)

6.RP.3: Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about 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. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*
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 problems involving finding the whole, given a part and the percent.
d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Grade 7

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

7.RP.1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction (1/2)/(1/4) miles per hour, equivalently 2 miles per hour.*

7.RP.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.RP.3: Use proportional relationships to solve multi-step ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

Grade 8

*Adapted from the Arizona Academic Content Standards.

The Number System		
Grade 6	Grade 7	Grade 8
Apply and extend previous understandings of multiplication and division to divide fractions by fractions. 6.NS.1: Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by 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.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?* **Compute fluently with multi-digit numbers and find common factors and multiples.** 6.NS.2: Fluently divide multi-digit numbers using the standard algorithm. 6.NS.3: Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. 6.NS.4: Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1-100 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).	**Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.** 7.NS.1: Apply and extend previous understandings of addition and subtraction to add and subtract 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. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.* b. Understand $p + q$ as the number located a distance $\lvert q \rvert$ 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 contexts. 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 contexts. d. Apply properties of operations as strategies to add and subtract rational numbers.	**Know that there are numbers that are not rational, and approximate them by rational numbers.** 8.NS.1: Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational. 8.NS.2: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*

*Adapted from the Arizona Academic Content Standards.

Apply and extend previous understandings of numbers to the system of rational numbers. 6.NS.5: Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.		

6.NS.6: Understand a rational number 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, e.g., -(-3) = 3, 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.NS.7: Understand ordering and absolute value of rational numbers.	7.NS.2: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide 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 contexts. 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 contexts. c. Apply properties of operations as strategies to multiply and divide rational numbers.	

*Adapted from the Arizona Academic Content Standards.

a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret -3 >-7 as a statement that -3 is located to the right of -7 on a number line oriented from left to right.* b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write -3℃ > -7℃ to express the fact that -3℃ is warmer than -7℃.* 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 a real-world situation. *For example, for an account balance of -30 dollars, write ⎪-30⎪ = 30 to describe the size of the debt in dollars.* d. Distinguish comparisons of absolute value from statements about order. For example, recognize that an account balance less than -30 dollars represents a debt greater than 30 dollars. 6.NS.8: Solve real-world and mathematical problems 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.	d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats. 7.NS.3: Solve real-world and mathematical problems involving the four operations with rational numbers. (NOTE: Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)	

*Adapted from the Arizona Academic Content Standards.

Expressions and Equations

Grade 6

Apply and extend previous understandings of arithmetic to algebraic expressions.

6.EE.1: Write and evaluate numerical expressions involving whole-number exponents.

6.EE.2: Write, read, and evaluate expressions in which letters stand for numbers.

a. Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.*
b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.*
c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. 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). *For example, use the formulas $V = s^3$ and $A = 6 s^2$ to find the volume and surface area of a cube with sides of length s = 1/2.*

Grade 7

Use properties of operations to generate equivalent expressions

7.EE.1: Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients

7.EE.2: Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05.*

Grade 8

Work with radicals and integer exponents.

8.EE.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.*

8.EE.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. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

8.EE.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 to express how many times as much one is than the other. *For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.*

8.EE.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 (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

*Adapted from the Arizona Academic Content Standards.

6.EE.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; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6(4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.* 6.EE.4: Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.*	**Solve real-life and mathematical problems using numerical and algebraic expressions and equations.** 7.EE.3: Solve multi-step real-life and mathematical problems posed with positive and negative numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *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. If you want to place a towel bar 9 ¾ inches long in the center of a door that is 27 ½ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.*	**Analyze and solve linear equations and pairs of simultaneous linear equations.** 8.EE.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 distance-time equation to determine which of two moving objects has greater speed.* 8.EE.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 *b*.

*Adapted from the Arizona Academic Content Standards.

Expressions and Equations (continued)		
Grade 6	Grade 7	Grade 8
Reason about and solve one-variable equations and inequalities. 6.EE.5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true. 6.EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. 6.EE.7: Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers. 6.EE.8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.	7.EE.4: 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. 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. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a*	**Understand the connections between proportional relationships, lines, and linear equations.** 8.EE.7: Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. 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). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. 8.EE.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

*Adapted from the Arizona Academic Content Standards.

<u>Represent and analyze quantitative relationships between dependent and independent variables.</u> 6.EE.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.*	*salesperson, you are paid $50 per week plus $4 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.*	simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*

*Adapted from the Arizona Academic Content Standards.

Functions		
Grade 6	Grade 7	Grade 8
		Define, evaluate, and compare functions. 8.F.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. (Note: Function notation is not required in Grade 8.) 8.F.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.* 8.F.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 is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* **Use functions to model relationships between quantities.**

*Adapted from the Arizona Academic Content Standards.

		8.F.4: Construct 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 (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. 8.F.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.

*Adapted from the Arizona Academic Content Standards.

Geometry		
Grade 6	Grade 7	Grade 8
Solve real-world and mathematical problems involving area, surface area, and volume. 6.G.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 in the context of solving real-world and mathematical problems. 6.G.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. Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	**Draw, construct, and describe geometrical figures and describe the relationships between them.** 7.G.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. 7.G.2: Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. 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.G.3: Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. **Solve real-life and mathematical problems involving angle measure, area, surface area,**	**Understand congruence and similarity using physical models, transparencies, or geometry software.** 8.G.1: Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines. 8.G.2: Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. 8.G.3: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. 8.G.4: Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. 8.G.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

*Adapted from the Arizona Academic Content Standards.

6.G.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 in the context of solving real-world and mathematical problems. 6.G.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 in the context of solving real-world and mathematical problems.	**and volume.** 7.G.4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. 7.G.5: Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. 7.G.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	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. **Understand and apply the Pythagorean Theorem.** 8.G.6: Explain a proof of the Pythagorean Theorem and its converse. 8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. 8.G.8: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.** 8.G.9: Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

*Adapted from the Arizona Academic Content Standards.

Statistics and Probability		
Grade 6	Grade 7	Grade 8
Develop understanding of statistical variability. 6.SP.1: Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it 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.2: Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. 6.SP.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 describes how its values vary with a single number. **Summarize and describe distributions.** 6.SP.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots.	**Use random sampling to draw inferences about population.** 7.SP.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.SP.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.* **Draw informal comparative inferences about two populations.** 7.SP.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	**Investigate patterns of association in bivariate data.** 8.SP.1: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. 8.SP.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.SP.3: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is*

*Adapted from the Arizona Academic Content Standards.

6.SP.5: Summarize numerical data sets in relation to their context, such as 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.	(mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable. 7.SP.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. **Investigate chance processes and develop, use, and evaluate probability models.** 7.SP.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 ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	*associated with an additional 1.5 cm in mature plant height.* 8.SP.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. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

*Adapted from the Arizona Academic Content Standards.

Statistics and Probability (continued)		
Grade 6	Grade 7	Grade 8
	7.SP.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.SP.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 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.* 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.SP.8: Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the	

*Adapted from the Arizona Academic Content Standards.

	sample space for which the compound event occurs. b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event. c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*	

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