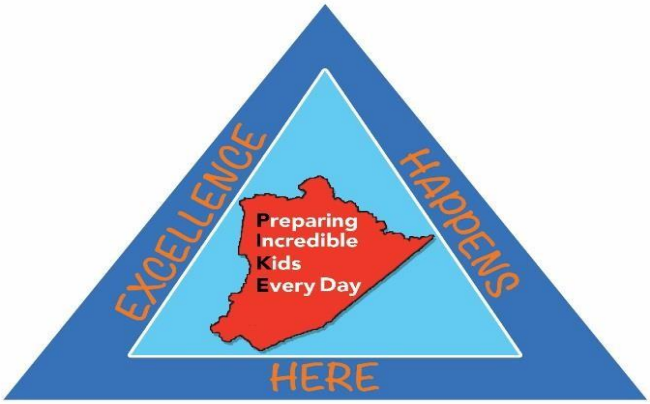
Pike County School District

Standards Mastery Document

8th Grade Mathematics
Revised 2019



Pike County School District
Standards Mastery Document – Revised 2019
8th Grade Math Standards

The Standards Mastery Document is designed for educators by educators as a resource and tool to help educators increase their depth of understanding of the Common Core Standards. This document will enable teachers to plan College & Career Ready curriculum and classroom instruction that promotes inquiry and higher levels of cognitive demand.

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education.

8 Mathematical Practices (MP):

MP 1. Make sense of problems and persevere in solving them.
MP 2. Reason abstractly and quantitatively.
MP 3. Construct viable arguments and critique the reasoning of others.
MP 4. Model with mathematics.
MP 5. Use appropriate tools strategically.
MP 6. Attend to precision.
MP 7. Look for and make use of structure.
MP 8. Look for and express regularity in repeated reasoning.

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8th Grade Math Standards

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Grade 8 Overview

The Number System (NS)

- Know that there are numbers that are not rational and approximate them by rational numbers.

Expressions and Equations (EE)

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

Functions (F)

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

Geometry (G)

- Understand congruence and similarity 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.

Statistics and Probability (SP)

- Investigate patterns of association in bivariate data.

Grade 8 Overview

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

1. **In the Number System, the Expressions, Equations and Inequalities, and the Probability and Statistics domains, students will:**
   - 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 throughout the origin;
   - understand that the slope (m) of a line is a constant rate of change, as well as how the input and output changes as a result of the constant rate of change;
   - interpret a model in the context of the data by expressing a linear relationship between the two quantities in question and interpret components of the relationship (such as slope and y-intercept) in terms of the situation;
   - 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;
   - use linear equations, systems of linear equations, linear functions and their understanding of slope of a line to represent, analyze, and solve a variety of problems.

2. **In the Functions and the Expressions, Equations and Inequalities domains, students will:**
   - grasp the concept of a function as a rule that assigns to each input exactly one output;
   - understand that functions describe situations where one quantity determines another;
   - translate among representations and partial representations of functions (nothing that tabular and graphical representations may be partial representations of the function) and describe how aspects of the function are reflected in the different representations.

3. **In the Geometry domain, students will:**
   - 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 to solve problems;
   - 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;
   - understand the statement of the Pythagorean Theorem and its converse, and why the Pythagorean Theorem holds;
   - apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths and to analyze polygons.

Table 1
Common Addition and Subtraction Situations[1]

	Result Unknown	Change Unknown	Start Unknown
Add To	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = **?**	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + **?** = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? **?** + 3 = 5
Take From	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 - 2 = **?**	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 - **?** = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? **?** - 2 = 3
	Total Unknown	**Addend Unknown**	**Both Addends Unknown[3]**
Put Together/ Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = **?**	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + **?** = 5, 5 – 3 = **?**	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
	Difference Unknown	**Bigger Unknown**	**Smaller Unknown**
Compare	**(“How many more?” version):** Lucy has two apples. Julie has five apples. How many more apples does Lucy have than Julie?	**(Version with “more”):** Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have?	**(Version with “more”):** Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have?
	(“How many fewer?” version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + **?** = 5, 5 – 2 = **?**	**(Version with “fewer”):** Lucy has three fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = **?**, 3 + 2 = **?**	**(Version with “fewer”):** Lucy has three fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = **?**, **?** + 3 = 5

Blue shading indicates the four Kindergarten problem subtypes. Students in grades 1 and 2 work with all subtypes and variants (blue and green). Yellow indicates problems that are the difficult four problem subtypes students in grade 1 work with but do not need to master until grade 2.

[1] Adapted from Box 2-4 of National Research Council (2009, op. cit., pp. 32, 33).

[2] These *take apart* situations can be used to show all the decompositions of a given number. The associated equations, which have the total on the left of the equal sign, help children understand that the = sign does not always mean *makes* or *results in* but always does mean *is the same number as*.

[3] Either addend can be unknown, so there are three variations of these problem situations. Both Addends Unknown is a productive extension of this basic situation especially for small numbers less than or equal to 10.

[4] For the Bigger Unknown or Smaller Unknown situations, one version directs the correct operation (the version using *more* for the bigger unknown and using *less* for the smaller unknown). The other versions are more difficult.

Table 2
Common Multiplication and Division Situations[1]

	Unknown Product	Group Size Unknown	Number of Groups Unknown
	3 × 6 = **?**	**3 × ? = 18 and 18 ÷ 3 = ?**	**? × 6 = 18 and 18 ÷ 6 = ?**
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? Measurement example: you need 3 lengths of string, each 6 inches long. How much string will you need all together?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? Measurement example: you have 18 inches of string which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? Measurement example: you have 18 inches of string which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays[2] Area[3]	There are three rows of apples with 6 apples in each row. How many apples are there? Area example: what is the area of a 3 cm by 6 cm triangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? Area example: a rectangle has area of 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? Area example: a rectangle has area of 18 square centimeters. If one side is 6 cm long, how long is the side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? Measurement example: a rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? Measurement example: a rubber band is stretched to be 18 cm long and is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue? Measurement example: a rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	***a* × *b* = *?***	***a* × *?* = *p* and *p* ÷ *a* = *?***	***?* × *b* = *p* and *p* ÷ *b* = *?***

[1] The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.

[2] The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns: the apples in the grocery window are in 3 rows and 6 columns. How many apples are in there? Both forms are valuable.

[3] Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations.

Table 3
Properties of Operations

The variables *a*, *b* and *c* stand for arbitrary numbers in a given number system.
The properties of operations apply to the rational number system, the real number system and the complex number system.

Associative property of addition	$(a + b) + c = a + (b + c)$
Commutative property of addition	$a + b = b + a$
Additive identity property of 0	$a + 0 = 0 + a = a$
Existence of additive inverses	For every a there exists –a so that a + (-a) = (-a) + a = 0
Associative property of multiplication	$(a \times b) \times c = a\ x\ (b \times c)$
Commutative property of multiplication	$a \times b = b \times a$
Multiplicative identity property of 1	$a \times 1 = 1 \times a = a$
Existence of multiplicative inverses	For every $a \neq 0$ there exists 1/a so that $a \times 1/a = 1/a \times a = 1$
Distributive property of multiplication over addition	$a \times (b + c) = a \times b + a \times c$

Table 4
Properties of Equality

The variables *a*, *b* and *c* stand for arbitrary numbers in the rational, real or complex number systems.

Reflexive property of equality	$a = a$
Symmetric property of equality	If $a = b$, then $b = a$
Transitive property of equality	If $a = b$ and $b = c$, then a = c
Addition property of equality	If a = b, then a + c = b + c
Subtraction property of equality	If a = b, then a – c = b – c
Multiplication property of equality	If a = b, then a x c = b x c
Division property of equality	If a = b and c ≠ 0, then a ÷ c = b ÷ c
Substitution property of equality	If a = b, then b may be substituted for a in any expression containing a.

Table 5
Properties of Inequality

The variables *a*, *b* and *c* stand for arbitrary numbers in the rational or real number systems.

Exactly one of the following is true: a < b, a = b, a > b
If a > b and b > c then a > c
If a > b, then b < a
If a > b, then –a < -b
If a > b, then a ± c > b ± c
If a > b and c > 0, then a x c > b x c
If a > b and c < 0, then a x c < b x c
If a > b and c > 0, then a ÷ c > b ÷ c
If a > b and c < 0, then a ÷ c < b ÷ c

Table 6
Fluency Standards across All Grade Levels

Grade	Coding	Fluency Standards
K	**KY.K.OA.5**	Fluently add and subtract within 5.
1	**KY.1.OA.6**	Fluently add and subtract within 10.
2	**KY.2.OA.2 KY.2.NBT.5**	Fluently add and subtract within 20. Fluently add and subtract within 100.
3	**KY.3.OA.7 KY.3.NBT.2**	Fluently multiply and divide within 100. Fluently add and subtract within 1000.
4	**KY.4.NBT.**	Fluently add and subtract multi-digit whole numbers using an algorithm.
5	**KY.5.NBT.5**	Fluently multiply multi-digit whole numbers (not to exceed four-digit by two-digit multiplication) using an algorithm.
6	**KY.6.NS.2 KY.6.NS.3 KY.6.EE.2**	Fluently divide multi-digit numbers using an algorithm. Fluently add, subtract, multiply and divide multi-digit decimals using an algorithm for each operation. Write, read and evaluate expressions in which letters stand for numbers.

The Number System (8.NS)

Standard: 8.NS.1 Understand informally that every number has a decimal expansion; that rational numbers are those with decimal expansions that terminate in 0's or eventually repeat. Know that other numbers are called irrational.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.6: Attend to precision.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
The set of real numbers consists of rational numbers and irrational numbers. Students know the definition of rational numbers and irrational numbers. What is a decimal expansion?	Recognize and identify numbers as rational or irrational. Identify terminating and repeating decimals as rational numbers. Identify numbers that cannot be written in the form of a/b, where a and b are rational and b is not zero as irrational.	Recognize and identify numbers as rational or irrational. Complete decimal expansions and classify them as terminating or repeating rational numbers. Emphasis is placed on how all rational numbers can be written as equivalent decimals. The decimal determines the classification of the number. Students look for structure in repeating decimals, recognize repeating blocks, and know every fraction is equal to a repeating decimal.

Coherence KY.7.NS.2 → KY.8.NS.1 → KY.HS.N.3

Standard: 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., π2).

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.7: Look for and make use of structure.
MP.8: Look for and express regularity in repeated reasoning.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is an irrational number? Understand how to truncate a decimal expansion. Know, for example, by shortening the decimal expansion of $\sqrt{2}$ by dropping all decimals past a certain point and showing √2, is between 1 and 2, then between 1.4 and 1.5 and so on.	Identify irrational numbers. Estimate the value of irrational numbers to the nearest integer and tenth. Compare and order irrational numbers on a number line. Students recognize when a decimal expansion of a number does not repeat or terminate , the number is irrational and can be represented with a method of rational approximation using a sequence of rational numbers to get closer and closer to the given number.	Identify irrational numbers and estimate their value to the nearest integer and tenth without using a calculator. Compare and order irrational numbers on a number line. Order irrational numbers from least to greatest and vice versa. Clarify the difference value and an exact value of an irrational number compared to the decimal approximation of an irrational number.

Coherence KY.8.NS.2 → KY.HS.N.3

Expressions and Equations (8.EE)

Standard: 8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.
MP.7: Look for and make use of structure.
MP.8: Look for and express regularity in repeated reasoning.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to multiple and divide powers with the same base. How to simplify exponential expressions with negative and zero exponents. Product of Powers $a^m * a^n = a^{m+n}$ Quotient of Powers $\frac{a^m}{a^n} = a^{m-n}$ Power of a Product $(a * b)^n = a^n * b^n$ Power of a Quotient $(\frac{a}{b})^n = \frac{a^n}{b^n}$ Power of a Power $(a^m)^n = a^{mn}$ Negative Exponent $a^{-n} = \frac{1}{a^n}$	Identify the base and exponent of an exponential expression. Multiple and divide powers with the same base. Simplify expressions using a single exponent or simplify expressions with negative and zero exponents.	Multiply and divide powers with the same base and simplify various exponential expressions including those with negative and zero exponents without technology.

Coherence KY.8.EE.1 → KY.HS.N.1

Standard: 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 perfect squares and perfect cubes are rational.

Enduring Skills:

MP.5: Use appropriate tools strategically.
MP.6: Attend to precision.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What are a perfect square, square root, perfect cube, and cube root? Square roots of imperfect squares are irrational numbers. How to find solutions to equations like x2 =n and x3 =n.	Find the square root of a perfect square and the cube root of a perfect cube. Identify square roots of imperfect squares as irrational. Solve square root and cube root equations. Use informal methods, such as guess and check. For example, $\sqrt{64} = \sqrt{8^2} = 8$ and $\sqrt[3]{5^3} = 5$. Construct mathematical arguments and reasoning emphasized as students learn the properties of exponents.	Find square roots and cube roots and identify square roots of imperfect squares as irrational. Solve square root and cube root equations with and without calculators. Since $\sqrt{p}$ is defined to mean the positive solution to the equation $x^2 = p$ (when it exists), it is not correct to say (as is common) $\sqrt{64} = \pm 8$. In describing the solutions to $x^2 = 64$, students write $x = \pm\sqrt{64} = \pm 8$.

Coherence KY.8.EE.2 → KY.HS.A.12

Standard: 8.EE.3 Use numbers expressed in the form of a single digit times an integer power of 10 (Scientific Notation) to estimate very large or very small quantities and express how many times larger or smaller one is than the other.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.
MP.5: Use appropriate tools strategically.
MP.6: Attend to precision.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to express numbers in both standard form and scientific notation. How to multiply and divide numbers that are written in scientific notation.	Write numbers in both standard form and scientific notation. Multiply and divide numbers written in scientific notation in order to solve real world problems involving very large or small numbers. Compare and interpret scientific notation quantities in the context of the situation, recognizing the powers of 10 indicated in quantities expressed in scientific notation.	Convert between standard form and scientific notation and multiply and divide numbers written in scientific notation without calculators. Conceptualize why a number could be written in scientific notation and the beliefs of doing so and connect exponent rules learned earlier to the methods of writing a quantity in scientific notation.

Coherence KY.8.EE.3 → KY.HS.N.6

Standard: 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. Interpret scientific notation that has been generated by technology.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.5: Use appropriate tolls strategically.
MP.6: Attend to precision.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to translate between scientific notation and standard form. How to perform operations with numbers expressed in scientific notation, including operations involving decimals and numbers in scientific notation. How to choose appropriate units of measurement for very small and large quantities.	Perform operations using numbers expressed in scientific notations. Use scientific notation to express very large and very small quantities. Choose appropriate units for real-life situations. When solving problems and using technology, it is possible solutions are given that take the form of $1.2x10^{00}$ or $3.4x10^{-07}$. Some technologies also use a capital *E* when denoting numbers such as $1.45E07$ or $4.665E-11$.	Perform operations using numbers expressed in scientific notation. Interpret scientific notation that has been generated by technology.

Coherence KY.8.EE.4 → KY.HS.N.4

Standard: 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.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP. 3: Construct viable arguments and critique the reasoning of others.
MP. 4: Model with mathematics

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Graph proportional relationships. Interpret the unit rate of proportional relationships as the slope of the graph. Compare two different proportional relationships represented in different ways.	Graph proportional relationships. Relate previous knowledge of unit rate to slope in tables, graphs, equations and sets of ordered pairs and comparing the slopes of two different proportional relationships.	Compare two different proportional relationships represented in different ways. Interpret the unit rate of proportional relationships as the slope of the graph. Represent proportional relationships through tables, graphs, equations, or sets of ordered pairs.

Coherence KY.7.RP.2 → KY.8.EE.5 and KY.8.F.2 → KY.HS.A.23

Standard: 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; know 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*.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.
MP.4: Model with mathematics.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to use similar triangles to explain why the slope 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 thee origin and the equation *y=mx+b* for a line intercepting the y-axis at *b*. Understand y=mx and y=mx+b differ in that y=mx only has the possibility of 0 being the y-intercept and that y=mx+b has infinite possibilities, including 0, for the y-intercept depending on the value of b.	Identify characteristics of similar triangles. Find the slope of a line. Determine the y-intercept of a line. Using the properties of similar triangles, demonstrate the slope between any two pairs of points on a non-vertical line create the same rise-run ratio when simplified. Represent real world situations symbolically. For example, students write an equation to represent the constant rate of motion for a person walking.	Analyze patterns for points on a line through the origin. Derive an equation of the form y = mx for a line through the origin. Analyze patterns for points on a line that do not pass through or include the origin. Derive an equation of the form y=mx + b for a line intercepting the vertical axis at b (the y-intercept).

Coherence KY.7.RP.2 → KY.8.EE.6 → KY.HS.A.23 and KY.HS.G.22

Standard: 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 combining like terms.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.3: Construct viable arguments and critique the reasoning of others.
MP.7: Look for and make use of structures.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to solve two-step and multistep equations in one variable and equations with variables on both sides. How to recognize solutions to equations as: one solution x=a, infinitely many solutions a=a, or no solution a=b.	Solve linear equations in one variable, including cases with one solution, and infinite number of solutions, and no solutions. Show examples of each of these cases by successfully transforming an equation into simpler forms. Combine like terms on the same side of the equality and use the distributive property to simplify the equation when solving.	Give examples of linear equations in one variable with one solution, infinitely many solutions, and no solution. Emphasis in this standard is also on using rational number coefficients.

Coherence KY.7.EE.1 → KY.8.EE.7 → KY.HS.A.18

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Standard: 8.EE.8a 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; understand that a system of two linear equations may have one solution, no solution, or infinitely solution.

Enduring Skills:

MP.1: Make sense of problems and persevere in solving them.
MP.3: Construct viable arguments and critique the reasoning of others.
MP.4: Model with mathematics.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is a system of equations? Understand that solutions to a system of equations in two variables is the point of intersection of their graphs that satisfies both equations. A system of two linear equations can be both mathematical and in real-life contexts; examples should be both.	Identify the solution(s) to a system of two linear equations in two variables as the point(s) of intersection of their graphs. Use tables, graphs, and equations to explain why a graphed system has infinitely many or no solutions. Describe the point(s) of intersection between two lines as points that satisfy both equations simultaneously.	Solve a system of equations in two variables by graphing. Understand that the solution to a system of equations is the point of intersection that satisfies both equations. Emphasis on determining what types of context leads to having no solution or infinitely many solutions.

Coherence KY.7.EE.2 → KY.8.EE.8 → KY.HS.A.20

Standard: 8.EE.8b Analyze and solve pairs of simultaneous linear equations.

b. Solve systems of two linear equations in two variables algebraically by using substitution where at least one equation contains at least one variable whose coefficient is 1 and by inspection for simple cases.
c. Solve real-world and mathematical problems leading to two linear equations in two variables.

Enduring Skills:

MP.1: Make sense of problems and persevere in solving them.
MP.3: Construct viable arguments and critique the reasoning of others.
MP.4: Model with mathematics.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Solving pairs of simultaneous linear equations may also have one solution, an infinite number of solutions, or no solutions. Solving systems algebraically will be limited to at least one equation containing at least one variable with a coefficient; for example, ____ = 3____ ____ = -12____ + 6 ____ = 2 _____ = 2_____ + 1	Solve cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be five and six and select from the other approaches, based on the numbers in the problem. Solve a system of two equations (linear) in two unknowns algebraically. Solve simple cases of systems of two linear equation.	Evaluate and interpret systems of equations in two variables algebraically, by using substitution and elimination. Determine the best method to solve a system of equations. Discover these cases as they gave systems of linear equations and solve algebraically.

Coherence KY.7.EE.2 → KY.8.EE.8 → KY.HS.A.20

Note: Elimination and/or matrices are not required for grade 8. Emphasis is on choosing one method.

Functions (8.F)

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.

Enduring Skills:

MP.7: Look for and make use of structure.
MP.8: Look for and express regularity in repeated reasoning.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is a relation? What is a function? What is an input and what is an output?	Examine the correspondence or relationship between input and output values in a set of ordered pairs and identify functions as those for which each input has only one output. Recognize the graph of a function as a set of ordered pairs consisting of an input value and the corresponding output value.	Identify functions from tables, graphs, equations, and verbal descriptions. Explain why not all relations are functions. Make sense of values as they relate to the total cost of items purchased or a phone bill based on usage in a particular interval.

Coherence KY.8.F.1 → KY.HS.F.1

Note: Function notation is not required in grade 8.

Standard: 8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Enduring Skills:

MP.1: Make sense of problems and persevere in solving them.
MP.2: Reason abstractly and quantitatively.
MP.4: Model with mathematics.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to identify a function in different ways (algebraically, graphically, in tables, or by verbal descriptions). How to find rate of change and initial value of functions in different representations.	Examine, interpret, and represent functions symbolically. Identify functions algebraically including slope and y intercept. Identify functions using graphs. Identify functions using tables. Identify functions using verbal descriptions.	Draw conclusions based on different representations of functions. Given a linear function represented using one method listed and another linear function represented by different method listed, determine which function has the greater or lesser rate of change or greater or lesser initial value. Make sense of quantities and their relationships in problem situations.

Coherence KY.7.RP.2 → KY.8.F.2 → KY.HS.F.1

Standard: 8.F.3 Understand properties of linear functions.

a. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line.
b. Identify and give examples of functions that are not linear.

Enduring Skills:

MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How to identify linear and nonlinear functions. Understand that the equation y = mx+b defines a linear function whose graph is a straight line. For example, the equation c = 3g + 5 models the linear function for the cost, c, of bowling, where g represents the number of games played and shoe rental is $5.	Recognize that a linear function is graphed as a straight line. Recognize the equation y=mx+b is the equation of a function whose graph is a straight line where m is the slope and b is the y-intercept. Identify and provide examples of nonlinear functions using multiple representations.	Use what they know about rate of change to distinguish between linear and nonlinear functions. Explain, for example, that 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. Contextualize information gained from the comparison of two functions.

Coherence KY.7.EE.4 → KY.8.F.3 → KY.HS.F.11

Standard: 8.F.4 Construct a function to model a linear relationship between two quantities.

a. 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.
b. Interpret the rate of change and initial value of a linear function in terms of a situation it models and in terms of its graph or a table of values.

Enduring Skills:

MP.4: Model with mathematics.
MP.5: Use appropriate tools strategically.
MP.8: Look for and express regularity in repeated reasoning.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Write a function from a table, graph, and a verbal description. Interpret rate of change and initial value of a linear function in different forms. Examining a relationship between two quantities yields a function rule. Know that there are many real-world problems that can be modeled with linear functions, including instances of constant payment plans (phone plans), costs associated with running a business and relationships between associated bivariate data.	Recognize that slope is determined by the constant rate of change. Recognize that the y-intercept is the initial value where x=0. Determine the rate of change from two (x, y) values, a verbal description, values in a table, or graph. Determine the initial value from two (x, y) values, a verbal description, values in a table, or graph. Model relationships between variables using linear and nonlinear functions.	Construct a function to model a linear relationship between two quantities. Understand the rate of change and initial value in terms of the situation it models. Describe a function rule using its initial value and rate of change, from a variety of representations, including tables, graphs, equations, and verbal descriptions. Interpret models in the context of the data and reflect on whether or not the models make sense based on slopes, initial values, or the fit to the data.

Coherence KY.7.RP.2 → KY.8.F.4 → KY.HS.F.3 and KY.HS.F.6

Standard: 8.F.5 Use graphs to represent functions.

a. Describe qualitatively the functional relationship between two quantities by analyzing a graph.
b. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Determine if a graph is increasing, decreasing, or linear or nonlinear. Sketch a graph from a verbal description.	Sketch a graph given a verbal description of its qualitative features. Describe whether a function is increasing or decreasing and linear or nonlinear. Students looks for patterns within the graphs to provide justification of the verbal description being represented by the graph.	Interpret the relationship between x and y values by analyzing a graph. Analyze a graph and describe the functional relationship between two quantities using the qualities of the graph. Function examples are described in contexts as well as in symbols. Take verbal descriptions and create graphs, while also being able to take a graph and create a verbal description.

Coherence KY.7.RP.2 → KY.8.F.5 → KY.HS.F.4

Geometry (8.G)

Standard: 8.G.1 Verify experimentally the properties of rotations, reflections, and translations:

- Lines are congruent to lines.
- Line segments are congruent to line segments of the same length.
- Angles are congruent to angles of the same measure.
- Parallel lines are congruent to parallel lines.

Enduring Skills:

MP.5: Use appropriate tools strategically.
MP.6: Attend to precision.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is a translation, reflection, rotation? Understand that translations, reflections, and rotations transform a figure into a congruent image, where line segments and angles are congruent.	Define & identify rotations, reflections, and translations. Identify corresponding sides & corresponding angles. Write prime notation to describe an image after a translation, reflection, or rotation. Identify center of rotation. Identify direction and degree of rotation. Identify line of reflection.	Use physical models, transparencies, or geometry software to verify the properties of rotations, reflections, and translations (ie. Lines are taken to lines and line segments to line segments of the same length, angles are taken to angles of the same measure, & parallel lines are taken to parallel lines.) Explain that congruence transformations preserve corresponding congruent lines, segments, and angles.

Coherence KY.8.G.1 → KY.HS.G.2 and KY.HS.G.3(+)

Standard: 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.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Understand that congruent two-dimensional figures are obtained from a sequence of rotations, reflections, and translations. Describe the rigid motions of two congruent figures. Understand that a figure, called a pre-image, is congruent to another figure, called the image, if the second figure can be obtained by a sequence of congruence transformations performed on the first figure.	Explain congruency. Identify symbols for congruency. Students use definitions to describe a sequence of rigid motions to prove or disprove congruence. Through experimentation, students verify the properties of rotations, reflections, and translations, including discovering the transformations change the position of a geometric figure but not its shape or size.	Apply the concept of congruency to write congruent statements. Reason that a 2-D figure is congruent to another if the second can be obtained by a sequence of rotations, reflections, translation. Describe the sequence of congruence transformations necessary to transform one figure to a congruent second figure. Students can explain that congruent shapes are precisely those that can be "mapped" one onto the other by using rotations, reflections, and translations.

Coherence KY.8.G.2 → KY.HS.G.4 and KY.HS.G.5

Standard: 8.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.
MP.5: Use appropriate tools strategically.
MP.6: Attend to precision.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Know that there are four types of effects on two dimensional figures: dilations, translations, reflections, and rotations.	Define dilations as a reduction or enlargement of a figure. Identify scale factor of the dilation.	Describe the effects of dilations, translations, rotations, & reflections on 2-D figures using coordinates. Notice patterns across examples, noting how the x and y values change for different kinds of transformations. Students construct arguments around the properties of rigid motion.

Coherence KY.8G.3 → KY.HS.G.9

Standard: 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.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.
MP.5: Use appropriate tools strategically.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Understand that similar figures have proportional side lengths and congruent angles. Understand that similar figures can be obtained from a sequence of rotations, reflections, translations, and dilations and describe the sequence.	Define similar figures as corresponding angles are congruent and corresponding sides are proportional. Recognize symbol for similar. Apply the concept of similarity to write similarity statements.	Reason that a 2-D figure is similar to another if the second can be obtained by a sequence of rotations, reflections, translation, or dilation. Describe the sequence of rotations, reflections, translations, or dilations that exhibits the similarity between 2-D figures using words and/or symbols. Students understand that is similar, non-congruent figures are given, a dilation must have taken place in the sequence of transformations to obtain the image from the pre-image.

Coherence KY.8.G.4 → KY.HS.G.2 and KY.HS.G.10

Standard: 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.

Enduring Skills:

MP.3: Construct viable arguments and critique the reasoning of others.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Understand that the interior angles of a triangle sum to 180 degrees. Understand that exterior angles of a triangle equal the sum of the two remote interior angles. Understand that when two or more parallel lines are cut by a transversal that alternate-interior angles and corresponding angles are congruent. Understand that vertical angles are congruent. Prove two triangles are similar using AA Similarity.	Define similar triangles. Define and identify transversals. Identify angles created when parallel line is cut by transversal (alternate interior, alternate exterior, corresponding, vertical, adjacent, etc.) Students use technology or physical tools to explore triangles. They arrange three copies of the same triangle so that the sum of three angles appears to form a line and give an argument in terms of transversals of why this is so. Use Angle-Angle Similarity to prove similarity among triangles. (Give an argument in terms of transversals why this is so.)	Justify that the sum of interior angles equals 180. (For example, arrange three copies of the same triangle so that the three angles appear to form a line.) Justify that the exterior angle of a triangle is equal to the sum of the two remote interior angles. Students build a logical progression of statements to show relationships between angles of parallel lines cut by a transversal, the angle sum of triangles and properties of polygons like rectangles and parallelograms. Students make assumptions about parallel and perpendicular lines and use properties of rigid motions to directly or indirectly approve their assumptions.

Coherence KY.7.G.5 → KY.8.G.5 → KY.HS.G.7 and KY.HS.G.10

Standard: 8.G.6 Explain a proof of the Pythagorean Theorem and its converse.

Enduring Skills:

MP. 3: Construct viable arguments and critique the reasoning of others.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is a strategy to determine with accuracy if a given triangle is a right triangle? Know key vocabulary: square root, Pythagorean Theorem, right triangle, legs a & b, hypotenuse, sides, right angle, converse, base, height, proof.	Identify the legs and hypotenuse of a right triangle. Verify, using a model, the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Investigate into Pythagorean Triples and the relationships among similar triangles with the same ratio of Pythagorean Triples allows students to reason about the relationships.	Explain a proof of the Pythagorean Theorem; if the sum of the squares of the two smaller legs is equal to the square of the third leg, then the triangle is a right triangle. Explain a proof of the converse of the Pythagorean Theorem. By explaining the proof of the Pythagorean Theorem and its converse, students are constructing and defending arguments as to why the relationship is true. Prove the relationship exists and apply the relationship to the quantitative task by extending knowledge of the Pythagorean Theorem to the coordinate plane.

Coherence KY.7.G.6 → KY.8.G.6 → KY.HS.G.11

Standard: 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.

Enduring Skills:

MP.1: Make sense of problems and persevere in solving them.
MP.2: Reason abstractly and quantitatively.
MP.4: Model with mathematics.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What strategy can be used to determine the length of a side in a right triangle?	Recall the Pythagorean Theorem and its converse. The structure inherent in the use of the Theorem is a set of guidelines students seek to apply when applying the Theorem to the right triangle relationships. Students make sense of the world around them by applying the Pythagorean Theorem in a variety of ways. Discuss leaving a solution in terms of a radical, or a rational approximation ($\sqrt{50}$ vs. 7.07106…).	Solve basic mathematical Pythagorean Theorem problems and its converse to find missing lengths of sides of triangles in two and three-dimensions. Apply Pythagorean theorem in solving real-world problems dealing with two and three-dimensional shapes. For example, finding the width of a television given the length and diagonal distance (two-dimensional) and the distance from the top left rear corner of a prism to the bottom to the right front corner of the prism (three-dimensional).

Coherence KY.7.G.6 → KY.HS.G.12

Standard: 8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Enduring Skills:

MP.5: Use appropriate tools strategically.
MP.6: Attend to precision.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is a strategy to find the distance between two points on a coordinate plane?	Recall the Pythagorean Theorem and its converse. Calculate the distance on a coordinate plane between two non-vertical and non-horizontal points by applying the Pythagorean Theorem.	Determine how to create a right triangle from two points on a coordinate graph. Use the Pythagorean Theorem to solve for the distance between the two points. Students calculate the distance between two non-vertical or non-horizontal points not given on a coordinate place by applying the Pythagorean Theorem to absolute horizontal and vertical distances the students calculates.

Coherence KY.8.G.8 → KY.HS.G.19 and KY.HS.G.21

Standard: 8.G.9 Apply the formulas for the volumes and surface area of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Enduring Skills:

MP.1: Make sense of problems and persevere in solving them.
MP.7: Look for and make use of structure.
MP.8: Look for and express regularity in repeated reasoning.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How do you calculate the volume of cones, cylinders, and spheres? Cones: $V = \frac{1}{3}\pi r^2 h$ $SA = \pi r + (r + \sqrt{r^2 + h^2})$ Cylinders: $V = \pi r^2 h$ $SA = 2\pi rh + 2\pi r^2$ Spheres: $V = \frac{4}{3}\pi r^3$ $SA = 4\pi r^2$	Identify and define vocabulary: cone, cylinder, sphere, radius, diameter, circumference, area, volume, pi, base, height. Recall and use the formulas for volume of cones, cylinders, and spheres. Students examining structure in real-world problems in order to apply the correct volume formula (if needed) begin to see where these are useful in real life. Compare volumes of similar shapes. For example, which of two storage tanks can hold the most fuel. This is repeated reasoning in the real-world.	Compare the volume of cones, cylinders, and spheres. Determine and apply appropriate volume formulas in order to solve mathematical and real-world problems for the given shape. Given the volume of a cone, cylinder, or sphere, find the radii, height, or approximate. Investigate into the derivations of the volume formulas to enhance understanding.

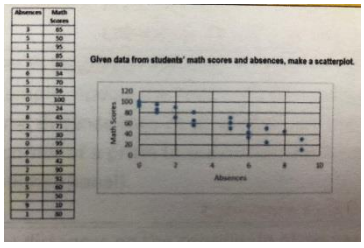
Coherence KY.7.G.4 → KY.8.G.9 → KY.HS.G.25 and KY.HS.G.29

Statistics and Probability (8.SP)

Standard: 8.SP.1 Construct and interpret scatter plots for bivariate numerical data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.7: Look for and make use of structure.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
What is a scatter plot? What is clustering, outliers, positive or negative association, linear and nonlinear association?	Describe and interpret patterns or structures in scatter plots such as clustering, outliers, positive or negative association, linear association, and nonlinear association. Construct scatter plots for bivariate measurement data. Reason quantitatively by symbolically representing the verbal description of a relationship between two bivariate variables. Attend to the meaning of data based on the context of problems and the possible linear and nonlinear functions that explain relationships of the variables.	Interpret scatter plots for bivariate (two different variables such as distance and time) measurement data to investigate patterns of association between two quantities.  Given data and a scatter plot, like the one above, students explain the relationship between student' absences and math scores shows a negative, linear association and has no obvious outliers.

Coherence KY.8.SP.1 → KY.HS.SP.6 and KY.HS.SP.8

Standard: 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.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
How can the understanding of linear functions and scatter plots be useful when analyzing data?	Model relationships between variables using linear and nonlinear functions. Informally fit a line to data displayed in a scatter plot to determine the equations of lines based on points or the slope and initial value.	Judge whether or not a given line is a good fit for the data and describe the needed adjustments. Recognize some scatter plots cannot be described by a line and explain why.

Coherence KY.8.SP.2 → KY.HS.SP.6 and KY.HS.SP.8

Standard: 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.

Enduring Skills:

MP.2: Reason abstractly and quantitatively.
MP.4: Model with mathematics.

Know: *What content does the student need to know to demonstrate this standard?*	**Do:** *What skill must the student demonstrate?*	**Mastery:** *How does the student demonstrate the learning of the standard?*
Use a linear equation to describe a bivariate measurement data problem and interpret the slope and intercept in the situation.	Find the slope and intercept of a linear equation. Solve problems using the equation of a linear model. 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 and an initial value of four cm means the plant was four cm tall when measuring began.	Interpret models in the context of the data and reflect on whether or not the models make sense based on slopes, initial values, or fit to the data. *This requires a deep understanding of the parts of the model used and their interpretations.*

Coherence KY.8.SP.3 → KY.HS.SP.6 and KY.HS.SP.7