West Virginia
College & Career
Readiness Standards

Support for College- and Career-Readiness Standards

MATHEMATICS GRADES 6-8

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Introduction

Support for College- and Career-Readiness Standards: Mathematics 6-8 is a companion document to the *West Virginia College- and Career-Readiness Standards.* This document prepares students for study of the grade-level standards through the teaching of prerequisite and enabling skills necessary for mastering each standard. **This allows students to work toward grade-level and course content standards while working at individual ability levels.** By identifying the prerequisites and enabling skills for each standard, teachers may plan instruction **to address the achievement gap.**

Support for College- and Career-Readiness Standards: Mathematics 6-8 provides short-term objectives to help students reach grade-level standards. Educators are encouraged to use the support document to:

- Write annual Individualized Education Program (IEP) goals
- Design targeted interventions
- Write learner objectives
- Develop lesson plans
- Plan for instructional grouping
- Plan for parent communication and conferences
- Prepare students for mastery of state standards

This document helps educators recognize what students are able to do in relation to the grade-level standards in order to help them move toward explicit success criteria.

Educators are reminded that content standards indicate minimum content—what all students should know and be able to do by the end of each grade level or course. Local education agencies (LEAs) may have additional instructional or achievement expectations and may provide instructional guidelines that address content sequence, review, and remediation.

Navigating the Document

The West Virginia College-and Career-Readiness Standards (WV CCRS) will be listed by domain on the left- hand side of each page. The right-hand column labeled *"Can this student...?"* lists suggested supports, or steps, that a student might need to accomplish prior to mastering the grade-level standard.

The bullet at the top of this list is generally the skill closest to the grade-level standard. If a student is unprepared to demonstrate the skill at the top of the list, the teacher should continue to move down the list of suggestions until he or she identifies what that student is able to do. The bulleted list can be thought of as a ladder; starting at the bottom, educators help the student step up each rung until they are ready to demonstrate mastery of the grade-level standard. It is important to remember the pre-requisite skills are **not meant to replace** the grade-level standard nor are they a "break-down" of the standard itself.

For example, if a student has not yet mastered WV CCRS M.6.28, *"Display numerical data in plots on a number line, including dot plots, histograms and plots,"* the teacher should look to the first bullet listed to the right under "Can this student...?" The teacher would ask *"Can this student organize, display, and interpret information in line plot with a horizontal scale in fractional units?"* If not, move to the next bullet: *"Can this student calculate median, mean, and range for a data set?"* Continue down the list until the teacher finds an appropriate starting point for instruction.

Cluster	Summarize and describe distributions.	Can this student...?
M.6.28	Display numerical data in plots on a number line, including dot plots, histograms and box plots.	• Organize, display, and interpret information in line plots with a horizontal scale in fractional units • Calculate median, mean, and range for a data set • Create number lines using appropriate intervals

*Note for educators writing IEP goals:

Goals should address student's unique needs across the content areas and should link to the West Virginia College- and Career-Readiness Standards so that a student has the foundation or precursor skills and strategies needed to access and progress in the general education curriculum. Keep in mind that the standards themselves are generally not stated in measurable terms and cannot be substituted for individually developed goals. Rather, the annual goal should focus on what is needed for the student to learn and attain the grade-level standard.

Support for Mathematics Standards
Grade 6

All West Virginia teachers are responsible for classroom instruction that integrates content standards and mathematical habits of mind. Students in the sixth grade will focus on four critical areas: (1) connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting and using expressions and equations; and (4) developing understanding of statistical thinking. Mathematical habits of mind, which should be integrated in these content areas, include: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively; constructing viable arguments and critiquing the reasoning of others; modeling with mathematics; using appropriate tools strategically; attending to precision, looking for and making use of structure; and looking for and expressing regularity in repeated reasoning. Students in sixth grade will continue developing mathematical proficiency in a developmentally-appropriate progressions of standards. Continuing the skill progressions from fifth grade, the following chart represents the mathematical understandings that will be developed in sixth grade:

Ratios and Proportional Reasoning	The Number System
• Understand ratios and rates, and solve problems involving proportional relationships (e.g., If it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours?).	• Divide fractions and solve related word problems (e.g., How wide is a rectangular strip of land with length ¾ mile and area ½ square mile?). • Use positive and negative numbers together to describe quantities; understand the ordering and absolute values of positive and negative numbers.

Expressions and Equations	Geometry
• Work with variables and expressions by generalizing the way numbers work (e.g., When adding numbers, the order doesn't matter, so x + y = y + x; likewise, properties of addition and multiplication can be used to rewrite 24x + 18y as 6(4x + 3y), or y + y + y as 3y). • Write equations to solve word problems and describe relationships between quantities (e.g., The distance D traveled by a train in time T might be expressed by an equation D = 85T, where D is in miles and T is in hours.).	• Reason about relationships between shapes to determine area, surface area, and volume.

Statistics and Probability	
• Create graphical representations of data and reason about statistical distributions.	

Numbering of Standards

The following Mathematics Standards will be numbered continuously. The following ranges relate to the clusters found within Mathematics:

Ratios and Proportional Relationships	
Understand ratio concepts and use ratio reasoning to solve problems.	Standards 1-3
The Number System	
Apply and extend previous understandings of multiplication and division to divide fractions by fractions.	Standard 4
Compute fluently with multi-digit numbers and find common factors and multiples.	Standards 5-7
Apply and extend previous understandings of numbers to the system of rational numbers.	Standards 8-11
Expressions and Equations	
Apply and extend previous understandings of arithmetic to algebraic expressions.	Standards 12-15
Reason about and solve one-variable equations and inequalities.	Standards 16-19
Represent and analyze quantitative relationships between dependent and independent variables.	Standard 20
Geometry	
Solve real-world and mathematical problems involving area, surface area, and volume.	Standards 21-24
Statistics and Probability	
Develop understanding of statistical variability.	Standards 25-27
Summarize and describe distributions.	Standards 28-29

Ratios and Proportional Relationship

Cluster	Understand ratio concepts and use ratio reasoning to solve problems	Can this student...?
M.6.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (e.g., "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.")	• Understand a part-to-whole (fraction) relationship • Recognize different units of measurement
M.6.2	Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. (e.g., "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.") Instructional Note: Expectations for unit rates in this grade are limited to non-complex fractions.	• Understand and create equivalent fractions • Write a ratio as a fraction

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M.6.3	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.
		• Understand and create equivalent fractions • Make a connection from horizontal tables to T-charts for ordered pairs, input/output tables, and multiplication charts • Determine the pattern to construct or complete the ratio table and connect the values to ordered pairs • Understand the multiple steps necessary to plot points on a coordinate plane
	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.
	b. Solve unit rate problems including those involving unit pricing and constant speed. (e.g., 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?)	• Understand and create equivalent fractions • Recognize different units of measurement • Recall basic multiplication and division facts
		c.
	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.	• Represent part-to-whole (fraction) and percent relationships accurately • Interpret fractions as division of the numerator by the denominator
		d.
	d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	• Use conversions of different-sized units of measure in solving multi-step, real-world problems • Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m) • Recognize units of measurement

The Number System

Cluster	Apply and extend previous understandings of multiplication and division to divide fractions by fractions.	Can this student...?
M.6.4	Interpret and compute quotients of fractions and solve word problems involving division of fractions by fractions by using visual fraction models and equations to represent the problem. (e.g., 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 ½ square mi?)	• Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions • Construct the visual fraction model from the given word problem using fraction model and number lines • Multiply fractions • Understand and create equivalent fractions • Recall and use division facts related to multiplication facts through 144

Cluster	Compute fluently with multi-digit numbers and find common factors and multiples.	Can this student...?
M.6.5	Fluently divide multi-digit numbers using the standard algorithm.	• Find whole-number quotients of whole numbers up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division • Divide decimals to hundredths place using concrete models or drawings and strategies based on place value, properties of operation, and/or the relationship between related operations • Recall and use division facts related to multiplication facts through 144

M.6.6	Fluently add, subtract, multiply and divide multi-digit decimals using the standard algorithm for each operation.	• Add, subtract, multiply, and divide multi-digit whole numbers using standard algorithms • Explain patterns in the placement of the decimal point when a decimal is multiplied or divided by the power of 10 • Explain patterns in the number of zeros of the product when multiplying a number by the powers of 10 • Use estimation to gauge the reasonableness of a calculation • Recall and use division facts related to multiplication facts through 144
M.6.7	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 (e.g., express 36 + 8 as 4 (9 + 2)).	• Interpret multiplication as scaling (resizing), by comparing the size of a product to the size of one factor • Use order of operations, including parentheses and other grouping symbols, to simplify numerical expressions • See patterns in skip counting and multiplication; continue sequences beyond memorized or modeled numbers • Find all factor pairs for a whole number in the range 1—100 • Recognize that a whole number is a multiple of each of its factors • Determine whether a given whole number in the range 1—100 is prime or composite • Recall and use division facts related to multiplication facts through 144

Cluster	Apply and extend previous understandings of numbers to the system of rational numbers.	Can this student…?
M.6.8	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.	• Locate points on both vertical and horizontal number lines • Read thermometers in increments of 1s, 2s, and 5s.

M.6.9	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.
		a.
		• Locate and show on a number line that numbers that are equal distance from zero and on opposite sides of zero have opposite signs
		• Understand that 0 is neither positive nor negative.
		b.
		• Plot ordered pairs on a coordinate plane
		• Identify which signs indicate the location of a point on a coordinate plane
		• Identify and locate ordered pairs, quadrants, origin, x-axis, and y-axis on a coordinate plane
		c.
		• Identify the ordered pair, given a position in Quadrant 1
		• Order integers on a horizontal and vertical number line

M.6.10	Understand ordering and absolute value of rational numbers.	a—d.
	a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. (e.g., interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.)	• Compare and order integers on a number line with and without models • Identify greater than (>) and less than (<) symbols and understand their meaning • Identify values on a number line, including rational numbers
	b. Write, interpret, and explain statements of order for rational numbers in real-world contexts (e.g., write –3° C > –7° C to express the fact that –3° C is warmer than –7° C).	
	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. (e.g., 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. (e.g., recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.)	
M.6.11	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.	• Represent real-world mathematical problems by graphing points in the first quadrant of the coordinate plane • Interpret coordinate values of points in the context of real-world situation • Interpret the meaning of each number in an ordered pair • Understand the meaning of each axis and the intersection of the axes

Expressions and Equations

Cluster	Apply and extend previous understandings of arithmetic to algebraic expressions.	Can this student…?
M.6.12	Write and evaluate numerical expressions involving whole-number exponents.	• Model multiplication in a variety of ways including grouping objects, repeated addition, rectangular arrays, skip counting, and area models • Use order of operations, including parentheses and other grouping symbols, to simplify numerical expressions
M.6.13	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. (e.g., 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. (e.g., 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 (e.g., use the formulas $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = 1/2$).	a—b. • Translate between models or verbal phrases and numerical expressions b. • Find all factor pairs for a whole number in the range 1—100 • Recognize that a whole number is a multiple of each of its factors • Fluently multiply multi-digit whole numbers using the standard algorithm c. • Use order of operations including parentheses and other grouping symbols to simplify numerical expressions • Recall and understand what the variables mean for formulas to represent real world situations

M.6.14	Apply the properties of operations to generate equivalent expressions (e.g., 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).	• Use commutative, associative, and distributive properties, inverses, and identities to solve number and word problems • Recall basic facts for multiplication and division through 144
M.6.15	Identify when two expressions are equivalent; i.e., when the two expressions name the same number regardless of which value is substituted into them. (e.g., The expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.)	• Use commutative, associative, and distributive properties, inverses, and identities to solve number and word problems • Recall basic facts for multiplication and division through 144

Cluster	Reason about and solve one-variable equations and inequalities.	Can this student...?
M.6.16	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.	• Use order of operations, including parentheses and other grouping symbols, to simplify numerical expressions • Compare and order rational numbers with and without models
M.6.17	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.	• Identify and utilize the symbols to represent the word problem • Describe the meaning of an unknown in the context of a word problem

M.6.18	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.	• Describe the meaning of an unknown in the context of a word problem. • Translate between models or verbal phrases and algebraic expressions • Find the value of a variable in a number sentence • Recall and use basic facts for addition/subtraction/multiplication and division through 144
M.6.19	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.	• Describe the meaning of an unknown in the context of a word problem. • Compare and order rational numbers with and without models

Cluster	Represent and analyze quantitative relationships between dependent and independent variables.	Can this student…?
M.6.20	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. (e.g., 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.)	• Translate between models or verbal phrases and algebraic expressions • Determine the ratio or rate of change of a relation given a table or graph

Geometry

Cluster	Solve real-world and mathematical problems involving area, surface area, and volume.	Can this student...?
M.6.21	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.	• Apply the formula for the area of rectangles • Evaluate algebraic expressions in number and word problems
M.6.22	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.	• Identify what the variable means for formulas and what measurement from the shape will be substituted • Recall vocabulary for attributes of shapes including perpendicular, sides, faces, base, height, radius, diameter, and area formulas • Evaluate algebraic expressions in number and word problems • Calculate products using rational numbers
M.6.23	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.	• Locate a point in Quadrant I of a coordinate plane, given an ordered pair; name the ordered pair for a point in Quadrant 1 of a coordinate planeRecall the side measure length is found by counting segments not points • Model or compute with integers using multiplication or division in number and word problems
M.6.24	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.	• Recall that the whole is equal to the sum of its parts • Recognize the 2-dimensional elements of 3-dimensional figures • Use manipulatives, pictorial representations, and appropriate vocabulary (e.g., face, edge, vertex, and base) to identify and compare properties of solid figures

Statistics and Probability

Cluster	Develop understanding of statistical variability.	Can this student...?
M.6.25	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. (e.g., "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.)	· Organize, display, and interpret information in tables and graphs
M.6.26	Through informal observation, understand that a set of data collected to answer a statistical question has a distribution which can be described by its center (mean/median), spread (range), and overall shape.	· Recognize that a statistical question is one that will require gathering data that has variability · Organize, display, and interpret information in tables and graphs (frequency, pictographs and line plots) · Describe a data set using mode
M.6.27	Recognize that a measure of center for a numerical data set summarizes all of its values with a single number.	· Calculate mean, median, and mode for a data set · Differentiate between mean, median, and mode

Cluster	Summarize and describe distributions.	Can this student...?
M.6.28	Display numerical data in plots on a number line, including dot plots, histograms and box plots.	· Organize, display, and interpret information in line plots with a horizontal scale in fractional units · Calculate median, mean, and range for a data set · Create number lines using appropriate intervals

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M.6.29	Summarize numerical data sets in relation to their context, such as by:	a—d.
	a. Reporting the number of observations.	• Organize, display, and interpret information in line plots with horizontal scale in fractional units
	b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.	• Select appropriate graph that best displays the given data • Estimate and compute sums and differences with decimals • Describe data set using mean, median, mode, and range
	c. Giving quantitative measures of center (median and/or mean), 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 to the shape of the data distribution and the context in which the data were gathered.	

Support for Mathematics Standard
Grade 7

All West Virginia teachers are responsible for classroom instruction that integrates content standards and mathematical habits of mind. Students in the seventh grade will focus on four critical areas: (1) developing understanding of and applying proportional relationships; (2) developing understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions and working with two- and three-dimensional shapes to solve problems involving area, surface area and volume; and (4) drawing inferences about populations based on samples. Mathematical habits of mind, which should be integrated in these content areas ,include: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively; constructing viable arguments and critiquing the reasoning of others; modeling with mathematics; using appropriate tools strategically; attending to precision, looking for and making use of structure; and looking for and expressing regularity in repeated reasoning. Students in seventh grade will continue developing mathematical proficiency in a developmentally-appropriate progressions of standards. Continuing the skill progressions from sixth grade, the following chart represents the mathematical understandings that will be developed in seventh grade:

Ratios and Proportional Reasoning	The Number System
• Analyze proportional relationships (e.g., by graphing in the coordinate plane), and distinguish proportional relationships from other kinds of mathematical relationships (e.g., Buying 10 times as many items will cost you 10 times as much, but taking 10 times as many aspirin will not lower your fever 10 times as much.).	• Solve percent problems (e.g., tax, tips, and markups and markdowns). • Solve word problems that have a combination of whole numbers, fractions, and decimals (e.g., A woman making $25 per hour receives a 10% raise; she will make an additional $1/10$ of his or her salary an hour, or $2.50, for a new salary of $27.50.)

Expressions and Equations	Geometry
• Solve equations such as $1/2 \, (x - 3) = 3/4$ quickly and accurately, and write equations of this kind to solve word problems.	• Solve problems involving scale drawings.

Statistics and Probability	
• Use statistics to draw inferences and make comparisons (e.g., deciding which candidate is likely to win an election based on a survey).	

Numbering of Standards

The following Mathematics Standards will be numbered continuously. The following ranges relate to the clusters found within Mathematics:

Ratios and Proportional Relationships	
Analyze proportional relationships and use them to solve real-world and mathematical problems.	Standards 1-3
The Number System	
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	Standards 4-6
Expressions and Equations	
Use properties of operations to generate equivalent expressions.	Standards 7-8
Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	Standards 9-10
Geometry	
Draw, construct and describe geometrical figures and describe the relationships between them.	Standards 11-13
Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	Standards 14-16
Statistics and Probability	
Use random sampling to draw inferences about a population.	Standards 17-18
Draw informal comparative inferences about two populations.	Standards 19-22
Investigate chance processes and develop, use, and evaluate probability models.	Standards 23-26

Ratios and Proportional Relationships

Cluster	Analyze proportional relationships and use them to solve real-world and mathematical problems.	Can this student...?
M.7.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. (e.g., 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.)	· Translate the model or verbal expression to mathematical symbols · Recall unit rate compares the ratio with a denominator of 1 · Interpret a fraction as division of the numerator by the denominator · Recall how to multiply and divide fractions · Identify numerator, denominator, ratio, and proportion
M.7.2	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. (e.g., 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. Focus special attention on the points (0,0) and (1, r) where r is the unit rate.	a. · Calculate equivalent ratios · Graph in a coordinate plane and identify the origin b. · Calculate unit rates · Determine patterns in tables c. · Use reasoning with equivalent ratios to solve number and word problems · Write a ratio or rate to compare two quantities · Translate between models or verbal phrases and algebraic expressions d. · Identify x- and y-axis, origin, and how to graph an ordered pair in all four quadrants

M.7.3	Use proportional relationships to solve multistep ratio and percent problems (e.g., simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, and/or percent error).	• Model the concept of percent and relate to the value in decimal or fractional form • Identify part-to-whole and part-to-part relationships • Recall solving proportions

The Number System

Cluster	Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	Can this student...?
M.7.4	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. (e.g., A hydrogen atom has 0 charge because its two constituents are oppositely charged.) b. Understand p + q as the number located a distance |q| from p, in the positive or negative direction, depending on whether q is positive or negative. (i.e., To add "p + q" on the number line, start at "0" and move to "p" then move |q| 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.	a. · Use the identity properties for addition and multiplication and the zero property for multiplication · Understand the absolute value of a rational number as its distance from zero on the number line · Interpret statements of inequalities about the relative position of two numbers on a number line · Understand a rational number as a point on a number line b. · Understand that positive and negative numbers are used together to describe quantities having opposite directions or values · Distinguish comparisons of absolute value from statements about order · Understand absolute value of a rational number as its distance from zero · Locate rational numbers on a number line · Recall basic addition facts c. · Understand absolute value of a rational number as its distance from zero · Locate rational numbers on a number line · Recall basic subtraction facts d. · Use the commutative and associative properties to add or multiply numerical expressions · Use the distributive property to represent and simplify numerical expressions · Estimate and compute sums and differences with rational numbers

M.7.5	Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.	a—d.
	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.	• Use the commutative and associative properties to add or multiply numerical expressions • Use the distributive property to represent and simplify numerical expressions • Estimate and compute sums and differences with rational numbers • Recall basic multiplication and division facts
	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.	
	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.	
M.7.6	Solve real-world and mathematical problems involving the four operations with rational numbers. Instructional Note: Computations with rational numbers extend the rules for manipulating fractions to complex fractions.	• Solve multistep word problems posed with whole numbers and having whole number answers using the four operations • Assess the reasonableness of answers using mental computation and estimation strategies • Use the standard algorithm for addition, subtraction, multiplication, and division of rational numbers

Expressions and Equations

Cluster	Use properties of operations to generate equivalent expressions.	Can this student...?
M.7.7	Apply properties of operations as strategies to add, subtract, factor and expand linear expressions with rational coefficients.	• Apply the properties of operations to generate equivalent expressions • Identify when two expressions are equivalent • Write simple expressions that record calculations with numbers
M.7.8	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. (e.g., a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05.")	• Identify when two expressions are equivalent • Apply the properties of operations to generate equivalent expressions • Find a percent of a quantity as a rate per 100 • Recognize that a variable without a written coefficient is understood to have a coefficient of 1

Cluster	Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	Can this student...?
M.7.9	Solve multi-step real-life and mathematical problems posed with positive and negative rational 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. (e.g., 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 3/4 inches long in the center of a door that is 27 1/2 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.)	• Find a percent of a quantity as a rate per 100 • Use the standard algorithm for addition, subtraction, multiplication, and division of rational numbers • Use order of operations including parentheses and other grouping symbols to simplify numerical expressions • Apply appropriate type of estimation for sums and differences • Recall basic facts for the four basic operations

| M.7.10 | 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. (e.g., The perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? An arithmetic solution similar to "54 − 6 − 6 divided by 2" may be compared with the reasoning involved in solving the equation $2w − 12 = 54$. An arithmetic solution similar to "54/2 − 6" may be compared with the reasoning involved in solving the equation $2(w − 6) = 54$.)

   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. (e.g., As a salesperson, you are paid $50 per week plus $3 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.) | a—b.

• Solve real-world and mathematical problems by writing and solving one step equations
• Use variables to represent numbers and write expressions when solving a real-world or mathematical problem
• Recognize and use properties of numbers, distributive, associative, and commutative
• Understand that a variable can represent an unknown number or depending on the purpose at hand, any number in a specified set |

Geometry

Cluster	Draw, construct and describe geometrical figures and describe the relationships between them.	Can this student...?
M.7.11	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.	• Use ratio and rate reasoning to solve real-world and mathematical problems • Find the area of various polygons • Write, read, and evaluate expressions in which letters stand for numbers
M.7.12	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.	• Recall the attributes of shapes and vocabulary associated with triangles • Measure lengths in inches/centimeters using appropriate tools and units
M.7.13	Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.	• Represent three-dimensional figures using nets made up of rectangles and triangles

Cluster	Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	Can this student...?
M.7.14	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.	• Write and evaluate numerical expressions involving whole-number exponents. • Recall formulas and how to find area of basic shapes from pictures and word problems • Partition a rectangle into rows and columns of the same-size squares and count to find the area • Generate measurement data by measuring lengths
M.7.15	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.	• Utilize strategies for solving multi-step problems • Solve for an unknown quantity using algebraic equations • Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems • Recognize angle measure as additive

M.7.16	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.	• Apply the formulas for volume of right rectangular prisms • Find the volume of a right rectangular prism by packing it with unit cubes • Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures • Find area of various polygons

Statistics and Probability

Cluster	Use random sampling to draw inferences about a population.	Can this student...?
M.7.17	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.	• Recognize that a statistical question is one that will require gathering data that has variability • Understand that a set of data collected to answer a statistical question has a distribution which can be describe by its center, spread, and overall shape
M.7.18	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. (e.g., 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.)	• Recognize that a statistical question is one that will require gathering data that has variability • Understand that a set of data collected to answer a statistical question has a distribution which can be describe by its center, spread, and overall shape • Recall how to solve for the mean, median, mode, and range

Cluster	Draw informal comparative inferences about two populations.	Can this student...?
M.7.19	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.	• Identify mean, median, mode, and range and explain how to calculate each

M.7.20	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. 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.	a—c. · Organize, display and interpret information in line plots with horizontal scale in fractional units · Select appropriate graph that best displays the given data · Estimate and compute sums and differences with decimals · Describe data sets using mean, median, mode, range, and interquartile range · Select which data display is most appropriate for the data set
M.7.21	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. (e.g., The mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.)	· Read and interpret graphs to determine measures of center and variability
M.7.22	Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. (e.g., 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.)	· Draw inferences on a sample population using measures of center and variation · Calculate and interpret mean, median, mode, range, interquartile range, and mean absolute deviation

Cluster	Investigate chance processes and develop, use, and evaluate probability models.	Can this student...?
M.7.23	Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely and a probability near 1 indicates a likely event.	• Recall writing and simplifying ratios • Convert between fractions, decimals, and percent • Use tables of equivalent ratios, tape diagrams, and double number line diagrams • Recall benchmark numbers, 0, ½, 1, to compare and order fractions
M.7.24	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. (e.g., 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.)	• Understand the concept of a ratio • Convert between three forms of rational numbers: fraction, decimal, and percent • Understand equivalent fractions

| M.7.25 | Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

   a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. (e.g., 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. (e.g., 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?) | a—b.

· Organize, analyze, and display information in data displays
· Calculate probability using spinners, data tables, tree diagrams, and other models
· Write and solve proportions
· Convert between three forms of rational numbers: fractions, decimals, and percent |

M.7.26	Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.	a—c.
	a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. b. Represent sample spaces for compound events using 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. (e.g., 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?)	• Use ratio and rate reasoning to solve real-world and mathematical problems • Convert between three forms of rational numbers: fractions, decimals, and percent • Organize, analyze, and display information in data displays • Recall operations with fractions

Support for Mathematics Standard
Grade 8

All West Virginia teachers are responsible for classroom instruction that integrates content standards and mathematical habits of mind. Students in the eighth grade will 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; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity and congruence and understanding and applying the Pythagorean Theorem. Mathematical habits of mind, which should be integrated in these content areas, include: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively; constructing viable arguments and critiquing the reasoning of others; modeling with mathematics; using appropriate tools strategically; attending to precision, looking for and making use of structure; and looking for and expressing regularity in repeated reasoning. Students in eighth grade will continue developing mathematical proficiency in a developmentally-appropriate progressions of standards. Continuing the skill progressions from seventh grade, the following chart represents the mathematical understandings that will be developed in eighth grade:

The Number System	Expressions and Equations
• Understand that every number has a decimal expansion and use these to compare the size of irrational numbers.	• Work with positive and negative exponents, square root and cube root symbols, and scientific notation (e.g., Evaluate 36 + 64; estimate world population as 7×10^9). • Solve linear equations (e.g., $-x + 5(x + 1/3) = 2x - 8$); solve pairs of linear equations (e.g., $x + 6y = -1$ and $2x - 2y = 12$); and write equations to solve related word problems.
Functions	**Geometry**
• Understand slope, and relating linear equations in two variables to lines in the coordinate plane. • Understand functions as rules that assign a unique output number to each input number; use linear functions to model relationships.	• Understand congruence and similarity using physical models, transparencies, or geometry software (e.g., Given two congruent figures, show how to obtain one from the other by a sequence of rotations, translations, and/or reflections).
Statistics and Probability	
• Analyze statistical relationships by using a best-fit line (a straight line that models an association between two quantities).	

Numbering of Standards

The following Mathematics Standards will be numbered continuously. The following ranges relate to the clusters found within Mathematics:

The Number System	
Know that there are numbers that are not rational, and approximate them by rational numbers.	Standards 1-2

Expressions and Equations	
Work with radicals and integer exponents.	Standards 3-6
Understand the connections between proportional relationships, lines, and linear equations.	Standards 7-8
Analyze and solve linear equations and pairs of simultaneous linear equations.	Standards 9-10

Functions	
Define, evaluate, and compare functions.	Standards 11-13
Use functions to model relationships between quantities.	Standards 14-15

Geometry	
Understand congruence and similarity using physical models, transparencies, or geometry software.	Standards 16-20
Understand and apply the Pythagorean Theorem.	Standards 21-23
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	Standard 24

Statistics and Probability	
Investigate patterns of association in bivariate data.	Standards 25-28

The Number System

Cluster	Know that there are numbers that are not rational and approximate them by rational numbers.	Can this student...?
M.8.1	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. Instructional Note: A decimal expansion that repeats the digit 0 is often referred to as a "terminating decimal."	• Rewrite and compare decimals to fractions (tenths and hundredths) with and without models and picturesLocate numbers on a number line • Identify examples and non-examples of rational numbers • Fluently divide multi-digit numbers using the standard algorithm
M.8.2	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 such as π^2. (e.g., By truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.)	• Compare and order rational numbers with and without models • Locate points on a number line • Use the definition of rational numbers to convert decimals and fractions to equivalent forms • Use exponential notation and repeated multiplication to describe and simplify exponential expressions

Expressions and Equations

Cluster	Work with radicals and integer exponents.	Can this student...?
M.8.3	Know and apply the properties of integer exponents to generate equivalent numerical expressions. (e.g., $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.)	• Use exponential notation and repeated multiplication to describe and simplify exponential expressions • Recall integer operations • Recall simplifying fractions • Identify exponent, powers, coefficients, integers, equivalent and numerical expression
M.8.4	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.	• Calculate the multiplication of single and multi-digit whole numbers • Restate exponential numbers as repeated multiplication • Recall inverse operations and solving equations • Recall area and volume formulas using models and word problems

Support for West Virginia College- and Career-Readiness Standards

M.8.5	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. (e.g., 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.)	• Use rules of exponents to simplify numeric and algebraic expressions • Simplify numerical expressions that may contain exponents • Read, write, or model numbers in expanded form using exponents • Demonstrate how to convert between a fraction and a decimal • Use order of operations, including parentheses and other grouping symbols, to simplify numerical expressions • Recognize and use patterns in powers of ten (with or without exponents) to multiply and divide whole numbers and decimals.
M.8.6	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.	• Recognize and use patterns in powers of ten (with or without exponents) to multiply and divide whole numbers and decimals. • Recall number properties • Recall operations with decimals

Cluster	Understand the connections between proportional relationships, lines, and linear equations.	Can this student...?
M.8.7	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. (e.g., Compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.)	• Recall multiple-representations of proportional relationships (table of values, ordered pairs, graph, unit rate, and constant of proportionality) • Plot points in a coordinate plane • Calculate and explain unit rate

Cluster		Can this student…?
M.8.8	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.	• Given a proportional relationship represented by tables, graphs, models, or algebraic or verbal description, identify the unit rate (constant of proportionality) • Recognize and represent proportional relationships between quantities • Use a coordinate plane to solve number and word problems • Describe the path between given points on the planeSolve linear equations • Identify corresponding parts of similar and congruent figures • Graph ordered pairs

Cluster	Analyze and solve linear equations and pairs of simultaneous linear equations.	Can this student…?
M.8.9	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.	a—b. • Use variables to represent quantities and construct simple equations to solve problems a. • Solve multi-step equations with rational numbers • Identify from a set of numbers which values satisfy a given equation or inequality b. • Apply properties of operation to add, subtract, factor, and expand linear expressions with rational coefficients • Simplify expressions and combining like terms

| M.8.10 | 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. (e.g., 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. (e.g., Given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.) | a—c.

• Use ordered pairs derived from tables, algebraic rules, or verbal descriptions to graph linear functions
• Use variables to represent quantities and construct simple equations
• Recall all operations with integers
• Apply properties of operation to add, subtract, factor, and expand linear expressions with rational coefficients
• Understand solving an equation as a process for making a mathematical statement true
• Use the substitution method to determine whether a given number in a specified set makes an equation or inequality true |

Functions

Cluster	**Define, evaluate, and compare functions.**	**Can this student…?**
M.8.11	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. Instructional Note: Function notation is not required in grade 8.	• Locate a point in any quadrant of a coordinate plane, given an ordered pair, and name the ordered pair for a point • Recognize and represent proportional relationships between quantities • Identify the ordered pairs from a table

M.8.12	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). (e.g., 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.)	• Recall multiple representations of proportional relationships (table of values, ordered pairs, graph, unit rate, and constant of proportionality) • Generate a set of ordered pairs using a rule which is stated in verbal, algebraic, or table form; generate a sequence given a rule in verbal or algebraic form • Given a list of ordered pairs in a table or graph, identify either verbally or algebraically the rule used to generate and record the results • Identify rate of change/slope when given a linear function • Recall y=mx + b and how to determine values for each variable using tables, graphs, or verbal descriptions
M.8.13	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. (e.g., 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.)	• Generate a set of ordered pairs using a rule which is stated in verbal, algebraic, or table form; generate a sequence given a rule in verbal or algebraic form. • Use ordered pairs derived from tables, algebraic rules, or verbal descriptions to graph linear functions • Differentiate between linear and non-linear in graphical representations

Cluster	Use functions to model relationships between quantities	Students will be able to...
M.8.14	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.	• Given a proportional relationship represented by tables, graphs, models, or algebraic or verbal descriptions, identify the unit rate (constant of proportionality) • Use a coordinate plane to solve number and word problems • Generate a set of ordered pairs using a rule which is stated in verbal, algebraic, or table form; generate a sequence given a rule in verbal or algebraic form

Cluster	Understand congruence and similarity using physical models, transparencies, or geometry software.	Can this student…?
M.8.15	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.	• Construct or complete a table of values to solve problems associated with a given relationshipOrganize, display, and interpret information in line graphs

Geometry

Cluster	Understand congruence and similarity using physical models, transparencies, or geometry software.	Can this student…?
M.8.16	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.	a—c. • Classify plane figures according to type of symmetry (line, rotational) • Recall the notation for naming geometric figures and the properties of each • Use protractors to measure angles • Use rulers to measure line segments • Provide examples for parallel, congruent, similar, equivalent, and symmetrical
M.8.17	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.	• Identify the attributes of two-dimensional figures • Use models or points in the coordinate plane to illustrate, recognize, or describe rigid transformations (translations, reflections, and rotations) of plane figures • Identify strategies to organize sequence of steps to solve multi-step problems • Recall integer operations

M.8.18	Describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates.	• Give examples of scale drawings • Use models or points in the coordinate plane to illustrate, recognize, or describe rigid transformations (translations, reflections, and rotations) of plane figures • Multiply or divide two decimals or a decimal and a whole number in number and word problems • Recall scale factor and how to find scale factor
M.8.19	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.	• Identify similar figures • Use models or points in the coordinate plane to illustrate, recognize, or describe rigid transformations (translations, reflections, and rotations) of plane figures • Identify strategies to organize a sequence of steps to solve multi-step problems
M.8.20	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. (e.g., 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.)	• Identify and name polygons by the number of sides. Distinguish quadrilaterals based on properties of their sides or angles; relate quadrilaterals based upon their hierarchical attributes. • Identify and classify triangles according to the measures of the interior angles and the lengths of the sides; relate triangles based upon their hierarchical attributes • Write a proportion to model a word problem; solve proportions • Write and solve simple equations given pictorial models and word problems • Recall angle relationships (supplementary, complementary, vertical and adjacent) and how to solve for an unknown measure

Cluster	Understand and apply the Pythagorean Theorem.	Can this student...?
M.8.21	Explain a proof of the Pythagorean Theorem and its converse.	• Use geometric models and equations to investigate the meaning of the square of a number and the relationship to its positive square root. Know perfect squares to 625. • Identify and classify triangles according to the measures of the interior angles and the lengths of the sides; relate triangles based upon their hierarchical attributes • Distinguish between various types of triangles (e.g., right triangles) • Calculate square roots and perfect squares
M.8.22	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	• Use geometric models and equations to investigate the meaning of the square of a number and the relationship to its positive square root. Identify perfect squares to 625. • Identify and classify triangles according to the measures of the interior angles and the lengths of the sides; relate triangles based upon their hierarchical attributes • Write and solve algebraic equations • Utilize strategies to solve real-world problems

M.8.23	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	• Use geometric models and equations to investigate the meaning of the square of a number and the relationship to its positive square root. Identify perfect squares to 625. • Identify and classify triangles according to the measures of the interior angles and the lengths of the sides; relate triangles based upon their hierarchical attributes • Write and solve algebraic equations • Utilize strategies to solve real-world problems • Use coordinates and absolute value to find distances between points

Cluster	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	Can this student...?
M.8.24	Know the formulas for the volumes of cones, cylinders and spheres and use them to solve real-world and mathematical problems.	• Use models to find volume for prisms and cylinders as the product of the area of the base and the height • Calculate the volume (with and without fractional edge lengths) of prisms in number and word problems • Evaluate algebraic expressions in number and word problems • Find the area of triangles, quadrilaterals, and polygons • Write and solve equations from models and word problems including units

Statistics and Probability

Cluster	Investigate patterns of association in bivariate data.	Can this student...?
M.8.25	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.	• Represent and analyze quantitative relationships between dependent and independent variablesDescribe qualitatively the functional relationship between two quantities by analyzing a graph • Identify and use appropriate scales and intervals in graphs and data displays • Identify linear and nonlinear relationships in data sets • Plot points in coordinate plane
M.8.26	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.	• Organize, display, and interpret information in line graphs • Explain how to draw inferences from data distributions • Recall how to summarize numerical data sets in relation to their context • Identify scatter plot, outlier, linear, quantitative, variable
M.8.27	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. (e.g., 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.)	• Organize, display, and interpret information in line graphs • Determine the rate of change (slope) from a graph

| M.8.28 | 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. (e.g., 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?) | • Describe a data set by its number of observations, what is being measured, and the units of measurement
• Convert between three forms of rational numbers: fractions, decimals, and percent
• Organize, display, and interpret information in a table
• Utilize strategies to solve multi-step, real world problems
• Identify frequency, relative frequency, and bivariate data |

Support for West Virginia College- and Career-Readiness Standards

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