Arkansas Mathematics Standards
Grades 6-8
2016

Introduction to the Grades 6-8 Arkansas Mathematics Standards

When charged with the task of revising the previous mathematics standards, a group of qualified individuals from across the state came together to craft standards that were specific for the schools and students of Arkansas. The result of this work, the Arkansas Mathematics Standards, is contained in this document. These standards reflect what educators across our state know to be best for our students.

These standards retain the same structure as the previous standards in terms of organization. The standards are organized by domains, clusters, and standards. Domains represent the big ideas that are to be studied at each grade level and sometimes across grade bands. These big ideas support educators in determining the proper amount of focus and instructional time to be given to each of these topics.
Clusters represent collections of standards that are grouped together to help educators understand the building blocks of rich and meaningful instructional units. These units help students make connections within clusters and avoid seeing mathematics as a discreet list of skills that they must master. Standards represent the foundational building blocks of math instruction. The standards outlined in this document work together to ensure that students are college and career ready and on track for success.

There are additional similarities shared by these new standards and the previous standards. The main similarity is the structure of the nomenclature. The only change that was made to the naming system was intended to reflect that these standards belong to Arkansas. However, educators may still search for open education resources by using the last part of the label, which will link to the resources for the previous standards. New standards can be found at the end of each cluster in which a new standard was deemed necessary.

Another similarity to the previous standards is the use of the symbols (+) and (*) to distinguish certain standards from others. The plus (+) symbol is used to designate standards that are typically beyond the scope of an Algebra II course. However, some of the plus (+) standards are now included in courses that are not considered to be beyond Algebra II. Standards denoted with the asterisk (*) symbol represent the modeling component of the standards. These standards should be presented in a modeling context where students are required to engage in the modeling process that is outlined in the Standards for Mathematical Practice.

The revision committee opted to include some new elements in the Arkansas Mathematics Standards that represent an attempt at greater clarity and more consistent implementation across the state. Many of the revisions are a rewording of the original Common Core State Standards. The purpose of the rewording is often to help educators better understand the areas of emphasis and focus within the existing standard. Likewise, many of the standards are separated into a bulleted list of content. This does not mean that teachers should treat this content as a checklist of items that they must teach one at a time. The content was bulleted out so that teachers can better understand all that is included in some of the broader standards.

Many of the examples that were included in the original standards were either changed for clarity or separated from the body of the actual standard. The committee wanted educators to understand that the examples included in the body of the standards document in no way reflect all of the possible examples. Likewise, these examples do not mandate curriculum or problem types. Local districts are free to select the curriculum and instructional methods they think best for their students.

In some instances, notes of clarification were added. These notes were intended to clarify, for teachers, what the expectations are for the student. Likewise, these notes provide instructional guidance as well as limitations so that teachers can better understand the scope of the standard. This will help the educators in determining what is developmentally appropriate for students when they are working with certain standards.

Finally, the Arkansas Mathematics Standards will become a living document. The staff of the Arkansas Department of Education hopes that this document portrays the hard work of the Arkansas educators who took part in the revision process and that it represents an improvement to the previous set of standards. As these standards are implemented across schools in the state, the Arkansas Department of Education welcomes further suggestions related to notes of clarification, examples, professional development needs, and future revisions of the standards.

Abbreviations:

Ratios and Proportional Relationships – RP
The Number System – NS
Expressions and Equations – EE
Geometry – G
Statistics and Probability – SP
Functions – F

Grade 6 – Arkansas Mathematics Standards

Ratios and Proportional	**Understand ratio concepts and use ratio reasoning to solve problems**
AR.Math.Content.6.RP.A.1	Understand the concept of a *ratio* and use *ratio* language to describe a *ratio* relationship between two quantities For example, "The *ratio* of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."
AR.Math.Content.6.RP.A.2	Understand the concept of a unit rate a/b associated with a *ratio* a:b with b ≠ 0, and use rate language in the context of a *ratio* relationship For example, "This recipe has a *ratio* of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger." Note: Expectations for unit rates in this grade are limited to non-*complex fractions*.
AR.Math.Content.6.RP.A.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): • Use and create tables to compare equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the *coordinate plane* • Solve unit rate problems including those involving unit pricing and constant speed For example: If it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed? • 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 • Use *ratio* reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities Example: How many centimeters are in 7 feet, given that 1 inch ≈ 2.54 cm? $7\ feet \times \frac{12\ inches}{1\ foot} \times \frac{2.54\ cm}{1\ inch} = 7\ \cancel{feet} \times \frac{12\ \cancel{inches}}{1\ \cancel{foot}} \times \frac{2.54\ cm}{1\ \cancel{inch}} = 213.36\ cm$ Note: Conversion factors will be given. Conversions can occur both between and across the metric and English system. Estimates are not expected.

Grade 6 – Arkansas Mathematics Standards

The Number System	Apply and extend previous understandings of multiplication and division to divide fractions by fractions
AR.Math.Content.6.NS.A.1	• Interpret and compute quotients of fractions • Solve word problems involving division of fractions by fractions (e.g., by using various strategies, including but not limited to, visual fraction models and equations to represent the problem) For example: Create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. How many 3/4-cup servings are in 2/3 of a cup of yogurt? Note: In general*, (a/b) ÷ (c/d) = ad/bc.*

The Number System	Compute fluently with multi-digit numbers and find common factors and multiples
AR.Math.Content.6.NS.B.2	Use computational fluency to divide multi-digit numbers using a standard algorithm Note: A *standard algorithm* can be viewed as, but should not be limited to, the traditional recording system. A *standard algorithm* denotes any valid base-ten strategy.
AR.Math.Content.6.NS.B.3	Use computational fluency to add, subtract, multiply, and divide multi-digit decimals and fractions using a standard algorithm for each operation Note: A *standard algorithm* can be viewed as, but should not be limited to, the traditional recording system. A *standard algorithm* denotes any valid base-ten strategy.
AR.Math.Content.6.NS.B.4	• Find the *greatest common factor* of two whole numbers less than or equal to 100 using prime factorization as well as other methods • Find the *least common multiple* of two whole numbers less than or equal to 12 using prime factorization as well as other methods • Use the distributive property to express a sum of two whole numbers 1-100 with a common factor as a multiple of a sum of two whole numbers with no common factor For example, express 36 + 8 as 4 (9 + 2).

Grade 6 – Arkansas Mathematics Standards

The Number System	**Apply and extend previous understandings of numbers to the system of rational numbers**
AR.Math.Content.6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values, explaining the meaning of 0 (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge)
AR.Math.Content.6.NS.C.6	Understand a rational number as a point on the number line Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates: • 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) • 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 • 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*
AR.Math.Content.6.NS.C.7	Understand ordering and *absolute value* of *rational numbers:* • Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram For example, interpret -3 > -7 as a statement that -3 is located to the right of -7 on a number line oriented from left to right. • Write, interpret, and explain statements of order for *rational numbers* in real-world contexts For example, write -3° C > -7° C to express the fact that -3° C is warmer than -7° C. • Understand the *absolute value* of a rational number as its distance from 0 on the number line • Interpret *absolute value* as magnitude for a positive or negative quantity in a real-world situation For example, for an account balance of -30 dollars, write $\lvert -30 \rvert = 30$ to describe the size of the debt in dollars. • Distinguish comparisons of *absolute value* from statements about order For example, recognize that an account balance less than -30 dollars represents a debt greater than 30 dollars.

AR.Math.Content.6.NS.C.8	• Solve real-world and mathematical problems by graphing points in all four quadrants of the *coordinate plane* • Use coordinates and *absolute value* to find distances between points with the same first coordinate or the same second coordinate

Expressions and Equations	**Apply and extend previous understandings of arithmetic to algebraic expressions**
AR.Math.Content.6.EE.A.1	Write and evaluate numerical *expressions* involving whole-number *exponents*
AR.Math.Content.6.EE.A.2	Write, read, and evaluate *expressions* in which letters (variables) stand for numbers: • Write *expressions* that record operations with numbers and with letters standing for numbers For example, express the calculation 'subtract *y* from 5' or '*y* less than 5' as 5 - *y*. • Identify parts of an *expression* using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an *expression* as a single entity For example, describe the *expression* 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms. • Evaluate *expressions* at specific values of their variables • Include *expressions* that arise from formulas used in real-world problems • Perform arithmetic operations, including those involving whole-number *exponents*, in the conventional order when there are no parentheses to specify a particular order (*Order of Operations*) For example, use the formulas involved in measurement such as $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = 1/2$.
AR.Math.Content.6.EE.A.3	Apply the properties of operations to generate equivalent *expressions* For example: Apply the distributive property to the *expression* 3(2 + *x*) to produce the equivalent *expression* 6 + 3*x*; apply the distributive property to the *expression* 24*x* + 18*y* to produce the equivalent *expression* 6(4*x* + 3*y*); apply properties of operations to *y* + *y* + *y* to produce the equivalent *expression* 3*y*. Note: Includes but not limited to the distributive property.
AR.Math.Content.6.EE.A.4	Identify when two *expressions* are equivalent (i.e., when the two *expressions* name the same number regardless of which value is substituted into them) For example: The *expressions* *y* + *y* + *y* and 3*y* are equivalent because they name the same number regardless of which number *y* stands for.

Expressions and Equations	Reason about and solve one-variable equations and inequalities
AR.Math.Content.6.EE.B.5	Understand solving an equation or inequality as a process of answering a question: • Using substitution, which values from a specified set, if any, make the equation or inequality true?
AR.Math.Content.6.EE.B.6	• Use variables to represent numbers and write *expressions* when solving a real-world or mathematical problem • Understand that a variable can represent an unknown number or any number in a specified set
AR.Math.Content.6.EE.B.7	Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative *rational numbers*
AR.Math.Content.6.EE.B.8	For real world or mathematical problems: • Write an inequality of the form $x > c$, $x \geq c$, $x < c$, or $x \leq c$ to represent a constraint or condition • Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions • Represent solutions of such inequalities on number line diagrams

Expressions and Equations	Represent and analyze quantitative relationships between dependent and independent variables
AR.Math.Content.6.EE.C.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another: • Write an equation to express one quantity, thought of as the *dependent variable*, in terms of the other quantity, thought of as the *independent variable* • Analyze the relationship between the dependent and *independent variables* using graphs and tables, and relate these to the equation For example: In a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time. Note: The *independent variable* is the variable that can be changed; the *dependent variable* is the variable that is affected by the change in the *independent variable*.

Grade 6 – Arkansas Mathematics Standards

<table>
<tr><th>Geometry</th><th>Solve real-world and mathematical problems involving area, surface area, and volume</th></tr>
<tr><td></td><td></td></tr>
<tr><td>AR.Math.Content.6.G.A.1</td><td>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
Note: Trapezoids will be defined to be a quadrilateral with at least one pair of opposite sides parallel, therefore all parallelograms are trapezoids.</td></tr>
<tr><td>AR.Math.Content.6.G.A.2</td><td>Find the volume of a right rectangular prism including whole number and 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 including fractional edge lengths in the context of solving real-world and mathematical problems</td></tr>
<tr><td>AR.Math.Content.6.G.A.3</td><td>Apply the following techniques in the context of solving real-world and mathematical problems:
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</td></tr>
<tr><td>AR.Math.Content.6.G.A.4</td><td>Apply the following techniques in the context of solving real-world and mathematical problems:
Represent three-dimensional figures using nets made up of rectangles and triangles
Use the nets to find the surface area of these figures</td></tr>
</table>

Grade 6 – Arkansas Mathematics Standards

Statistics and Probability	Develop understanding of statistical variability
AR.Math.Content.6.SP.A.1	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers For example, 'How old am I?' is not a statistical question, but 'How old are the students in my school?' is a statistical question because one anticipates variability in students' ages. Note: Statistics is also the name for the science of collecting, analyzing and interpreting data. Data are the numbers produced in response to a statistical question and are frequently collected from surveys or other sources (i.e. documents).
AR.Math.Content.6.SP.A.2	Determine center, spread, and overall shape from a set of data
AR.Math.Content.6.SP.A.3	Recognize that a measure of center for a numerical data set summarizes all of its values with a single number (*mean*, *median*, *mode*), while a measure of variation (*interquartile range*, *mean absolute deviation*) describes how its values vary with a single number Example: If the mean height of the students in the class is 48" are there any students in the class taller than 48"?

Statistics and Probability	Summarize and describe distributions
AR.Math.Content.6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots
AR.Math.Content.6.SP.B.5	Summarize numerical data sets in relation to their context, such as by: • Reporting the number of observations • Describing the nature of the attribute under investigation, including how it was measured and its units of measurement • Calculate quantitative measures of center (including but not limited to *median* and *mean*) and variability (including but not limited to *interquartile range* and *mean absolute deviation*) • Use the calculations to describe any overall pattern and any striking deviations (outliers) from the overall pattern with reference to the context in which the data were gathered Note: Instructional focus should be on summarizing and describing data distributions. • 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. For example, demonstrate in the case where there are outliers in the data *median* would be a better measure of center than the *mean*.

Grade 7 – Arkansas Mathematics Standards

Ratios and Proportional	**Analyze proportional relationships and use them to solve real-world and mathematical problems**
AR.Math.Content.7.RP.A.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units For example: If a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the *complex fraction* $^{1/2}/_{1/4}$ miles per hour, equivalently 2 miles per hour.
AR.Math.Content.7.RP.A.2	Recognize and represent proportional relationships between quantities: • 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) • Identify unit rate (also known as the constant of proportionality) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships • 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 $t = pn$) • Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate Note: Unit rate connects to slope concept in 8th grade.
AR.Math.Content.7.RP.A.3	Use proportional relationships to solve multi-step ratio and percent problems Note: Examples include but are not limited to simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease.

Grade 7 – Arkansas Mathematics Standards

<table>
<tr><th>The Number System</th><th>Apply and extend previous understandings of operations with fractions</th></tr>
<tr><td></td><td></td></tr>
<tr><td>AR.Math.Content.7.NS.A.1</td><td>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:
Describe situations in which opposite quantities combine to make 0 and show that a number and its opposite have a sum of 0 (additive inverses) (e.g., A hydrogen atom has 0 charge because its two constituents are oppositely charged.)
Understand $p + q$ as a number where p is the starting point and q represents a distance from p in the positive or negative direction depending on whether q is positive or negative
Interpret sums of rational numbers by describing real-world contexts (e.g., 3 + 2 means beginning at 3, move 2 units to the right and end at the sum of 5; 3 + (-2) means beginning at 3, move 2 units to the left and end at the sum of 1; 70 + (-30) = 40 could mean after earning $70, $30 was spent on a new video game, leaving a balance of $40)
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 (e.g., the distance between -5 and 6 is 11. -5 and 6 are 11 units apart on the number line)</td></tr>
<tr><td>AR.Math.Content.7.NS.A.2</td><td>Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers:
Understand that multiplication is extended from fractions to all rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, and the rules for multiplying signed numbers
Interpret products of rational numbers by describing real-world contexts
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 (e.g., if p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$)
Interpret quotients of rational numbers by describing real-world contexts
Fluently multiply and divide rational numbers by applying properties of operations as strategies
Convert a fraction to a decimal using long division
Know that the decimal form of a fraction terminates in 0s or eventually repeats</td></tr>
<tr><td>AR.Math.Content.7.NS.A.3</td><td>Solve real-world and mathematical problems involving the four operations with rational numbers, including but not limited to complex fractions</td></tr>
</table>

Grade 7 – Arkansas Mathematics Standards

Expressions and Equations	**Use properties of operations to generate equivalent expressions**
AR.Math.Content.7.EE.A.1	Apply properties of operations as strategies to add, subtract, expand, and factor linear expressions with rational coefficients
AR.Math.Content.7.EE.A.2	Understand how the quantities in a problem are related by rewriting an expression in different forms For example: $a + 0.05a = 1.05a$ means that 'increase by 5%' is the same as 'multiply by 1.05' or the perimeter of a square with side length *s* can be written as $s+s+s+s$ or $4s$.

Expressions and Equations	**Solve real-life and mathematical problems using numerical and algebraic expressions and equations**
AR.Math.Content.7.EE.B.3	Solve multi-step, real-life, and mathematical problems posed with positive and negative *rational numbers* in any form using tools strategically: • Apply properties of operations to calculate with numbers in any form (e.g., -(1/4)(n-4)) • Convert between forms as appropriate (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) • Assess the reasonableness of answers using mental computation and estimation strategies (e.g., 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)
AR.Math.Content.7.EE.B.4	• Use variables to represent quantities in a real-world or mathematical problem • Construct simple equations and inequalities to solve problems by reasoning about the quantities • Solve word problems leading to equations of these forms $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific *rational numbers*. Solve equations of these forms fluently • Write an algebraic solution identifying the sequence of the operations used to mirror the arithmetic solution (e.g., The perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? Subtract 2*6 from 54 and divide by 2; (2*6) + 2w = 54) • 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.)

Grade 7 – Arkansas Mathematics Standards

Geometry	Draw construct, and describe geometrical figures and describe the relationships between them
AR.Math.Content.7.G.A.1	Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale Note: This concept ties into ratio and proportion.
AR.Math.Content.7.G.A.2	Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions: • Given three measures of angles or sides of a triangle, notice when the conditions determine a unique triangle, more than one triangle, or no triangle • Differentiate between regular and irregular polygons
AR.Math.Content.7.G.A.3	Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids

Geometry	Solve real-life and mathematical problems involving angle measure, area, surface area and volume
AR.Math.Content.7.G.B.4	• Know the formulas for the area and circumference of a circle and use them to solve problems. • Give an informal derivation of the relationship between the circumference and area of a circle
AR.Math.Content.7.G.B.5	Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure
AR.Math.Content.7.G.B.6	Solve real-world and mathematical problems involving area of two-dimensional objects and volume and surface area of three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms

Grade 7 – Arkansas Mathematics Standards

Statistics and Probability	Use random sampling to draw inferences about a population
AR.Math.Content.7.SP.A.1	Understand that: • Statistics can be used to gain information about a population by examining a sample of the population • Generalizations about a population from a sample are valid only if the sample is representative of that population • Random sampling tends to produce representative samples and support valid inferences
AR.Math.Content.7.SP.A.2	• Use data from a random sample to draw inferences about a population with a specific characteristic • Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions For example: Estimate the mean word length in a book by randomly sampling words from the book, or predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.

Statistics and Probability	Draw informal comparative inferences about two populations
AR.Math.Content.7.SP.B.3	Draw conclusions about the degree of visual overlap of two numerical data distributions with similar variability such as *interquartile range* or *mean absolute deviation*, expressing the difference between the centers as a multiple of a measure of variability such as *mean*, *median*, or *mode* For example: The mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability on either team; on a dot plot, the separation between the two distributions of heights is noticeable.
AR.Math.Content.7.SP.B.4	Draw informal comparative inferences about two populations using measures of center and measures of variability for numerical data from random samples For example: Decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.

Grade 7 – Arkansas Mathematics Standards

<table>
<tr><th>Statistics and Probability</th><th>Investigate chance processes and develop, use, and evaluate probability models</th></tr>
<tr><td></td><td></td></tr>
<tr><td>AR.Math.Content.7.SP.C.5</td><td>Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring
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</td></tr>
<tr><td>AR.Math.Content.7.SP.C.6</td><td>Collect data to approximate the probability of a chance event
Observe its long-run relative frequency
Predict the approximate relative frequency given the probability
For example: When rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.

Note: Emphasis should be given to the relationship between experimental and theoretical probability.</td></tr>
<tr><td>AR.Math.Content.7.SP.C.7</td><td>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:
Develop a uniform probability model, 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 of 6 girls and 4 boys, the probability that Jane will be selected is .10 and the probability that a girl will be selected is .60.)
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?)</td></tr>
<tr><td>AR.Math.Content.7.SP.C.8</td><td>Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation:
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
Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams
Identify the outcomes in the sample space which compose the event
Generate frequencies for compound events using a simulation (e.g., What is the frequency of pulling a red card from a deck of cards and rolling a 5 on a die?)</td></tr>
</table>

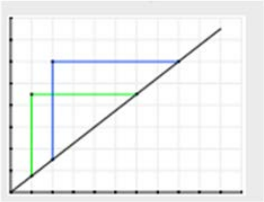
Grade 8 - Arkansas Mathematics Standards

The Number System	Know that there are numbers that are not rational, and approximate them by rational numbers
AR.Math.Content.8.NS.A.1	Know that numbers that are not rational are called irrational: • Understand that every number has a decimal expansion For example: 2=2.00… • Write a fraction a/b as a repeating decimal • Write a repeating decimal as a fraction
AR.Math.Content.8.NS.A.2	Use rational approximations of *irrational numbers* to compare the size of *irrational numbers*, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2) For example: 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.

Grade 8 - Arkansas Mathematics Standards

Expressions and Equations	Work with radicals and integer exponents
AR.Math.Content.8.EE.A.1	Know and apply the properties of *integer exponents* to generate equivalent numerical *expressions* using product, quotient, power to a power, or expanded form
AR.Math.Content.8.EE.A.2	Use square root and cube root symbols to represent solutions to equations: • Use square root symbols to represent solutions to equations of the form $x^2 = p$, where p is a positive rational number Evaluate square roots of small perfect squares. • Use cube root symbols to represent solutions to equations of the form $x^3 = p$, where p is a rational number. Evaluate square roots and cube roots of small perfect cubes
AR.Math.Content.8.EE.A.3	Use numbers expressed in the form of a single digit times an *integer* power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other For example: Estimate the population of the United States as 3 times 10^8 and the population of the world as 7 times 10^9, and determine that the world population is more than 20 times larger.
AR.Math.Content.8.EE.A.4	• Perform operations with numbers expressed in scientific notation, including problems where both standard form 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

Expressions and Equations	Understand the connections between proportional relationships, lines, and linear equations
AR.Math.Content.8.EE.B.5	• Graph proportional relationships, interpreting the unit rate as the slope of the graph. • Compare two different proportional relationships represented in different ways (graphs, tables, equations) For example: Compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

AR.Math.Content.8.EE.B.6	• Using a non-vertical or non-horizontal line, show why the slope m is the same between any two distinct points by creating similar triangles • Write the equation $y=mx + b$ for a line through the origin • Be able to write the equation $y = mx + b$ for a line intercepting the vertical axis at b 

Expressions and Equations	Analyze and solve linear equations and pairs of simultaneous linear equations
AR.Math.Content.8.EE.C.7	Solve linear equations in one variable: • Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions Note: 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) • Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms Note: Students should solve equations with variables on both sides.
AR.Math.Content.8.EE.C.8	Analyze and solve pairs of simultaneous linear equations: • Find solutions to a system of two linear equations in two variables so they correspond to points of intersection of their graphs • Solve systems of equations in two variables algebraically using simple substitution and by inspection (e.g., 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6) • Solve real-world mathematical problems by utilizing and creating two linear equations in two variables. For example: Given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Grade 8 - Arkansas Mathematics Standards

Functions	**Define, evaluate, and compare functions**
AR.Math.Content.8.F.A.1	• Understand that a *function* is a rule that assigns to each input exactly one output • The graph of a *function* is the set of ordered pairs consisting of an input and the corresponding output Note: An informal discussion of *function notation* is needed; however, student assessment is not required.
AR.Math.Content.8.F.A.2	Compare properties (e.g., y-intercept/initial value, slope/rate of change) of two *functions* each represented in a different way (e.g., algebraically, graphically, numerically in tables, or by verbal descriptions) For example: Given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
AR.Math.Content.8.F.A.3	Identify the unique characteristics of *functions* (e.g., linear, quadratic, and exponential) by comparing their graphs, equations, and input/output tables

Functions	**Use functions to model relationships between quantities**
AR.Math.Content.8.F.B.4	Construct a *function* to model a linear relationship between two quantities: • Determine the rate of change and initial value of the *function* from: o a verbal description of a relationship o two (*x, y*) values o a table o 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
AR.Math.Content.8.F.B.5	• Describe 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 features of a *function* that has been described verbally

Geometry	Understand congruence and similarity using physical models, transparencies, or geometry software
AR.Math.Content.8.G.A.1	Verify experimentally the properties of rotations, reflections, and translations: • 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
AR.Math.Content.8.G.A.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
AR.Math.Content.8.G.A.3	Given a two-dimensional figure on a *coordinate plane*, identify and describe the effect (rule or new coordinates) of a transformation (dilation, translation, rotation, and reflection): • Image to pre-image • Pre-image to image
AR.Math.Content.8.G.A.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
AR.Math.Content.8.G.A.5	Use informal arguments to establish facts about: • The angle sum and exterior angle of triangles For example: Arrange three copies of the same triangle so that the sum of the three angles appears to form a line. • The angles created when parallel lines are cut by a transversal For example: Give an argument in terms of translations about the angle relationships. • The angle-angle criterion for similarity of triangles

Grade 8 - Arkansas Mathematics Standards

Geometry	**Understand and apply the Pythagorean Theorem**
AR.Math.Content.8.G.B.6	Model or explain an informal proof of the Pythagorean Theorem and its converse
AR.Math.Content.8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions
AR.Math.Content.8.G.B.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system

Geometry	**Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres**
AR.Math.Content.8.G.C.9	Develop and know the formulas for the volumes and surface areas of cones, cylinders, and spheres and use them to solve real- world and mathematical problems

Grade 8 - Arkansas Mathematics Standards

Statistics and Probability	Investigate patterns of association in bivariate data
AR.Math.Content.8.SP.A.1	• Construct and interpret scatter plots for *bivariate* measurement data to investigate patterns of association between two quantities • Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association
AR.Math.Content.8.SP.A.2	• Know that straight lines are widely used to model relationships between two quantitative variables • For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line For example: Identify weak, strong, or no correlation.
AR.Math.Content.8.SP.A.3	Use the equation of a linear model to solve problems in the context of *bivariate* measurement data, interpreting the slope and intercepts 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.

AR.Math.Content.8.SP.A.4

- Understand that patterns of association can also be seen in *bivariate* categorical data by displaying frequencies and relative frequencies in a two-way table
- Construct and interpret a two-way table 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

Example: Two-Way Frequency Table
http://mathbitsnotebook.com/Algebra1/StatisticsReg/ST2TwoWayTable.html


	Sport Utility Vehicle (SUV)	Sports Car	Totals
male	21	39	60
female	135	45	180
Totals	156	84	240

ADD
ADD
Row Totals
MathBits.com
Column Totals

Example: Two-Way Relative Frequency Table

Whole Table Relative Frequencies - Divide all cells by 240.

MathBits.com

	Sport Utility Vehicle (SUV)	Sports Car	Totals
male	$\frac{21}{240}=0.09$	$\frac{39}{240}=0.16$	$\frac{60}{240}=0.25$
female	$\frac{135}{240}=0.56$	$\frac{45}{240}=0.19$	$\frac{180}{240}=0.75$
Totals	$\frac{156}{240}=0.65$	$\frac{84}{240}=0.35$	$\frac{240}{240}=1.00$

For example: Students might be asked to interpret from the tables above, if they saw an SUV in the parking lot, would it be more likely to belong to a male or female?

Note: Suggested connections for instruction: Standard 8.NS.1. On the Two-Way Relative Frequency Table, it is not required to include the fractional representation for each value, this is simply provided as an example.

Glossary

Absolute Value	A numbers' distance from 0 on the number line which gives its size, or magnitude, whether the number is positive or negative (in terms of functions, a piecewise defined function is the absolute value function)
Additive Inverses	Two numbers whose sum is 0 are additive inverses of one another
Bivariate Data	Data that has two variables
Complex Fraction	A fraction *a/b* where either *a* or *b* are fractions (*b* nonzero)
Coordinate Plane	A plane spanned by the *x*- and *y*-axis
Dependent Variable	A variable shows values depend on the values of another variable
Experimental Probability	The ratio of the number of times an event occurs to the total number of trials or times the activity is performed
Exponent	the power p in an expression of the form a^p used to show repeated multiplication
Expression	A mathematical phrase consisting of numbers, variables, and operations
First Quartile	For a data set with median M, the first quartile is the median of the data values less than M
Function	A rule or relationship in which there is exactly one output value for each input value
Function notation	A method of writing algebraic variables as function of other variables; for example $f(x) = 3x$ is the same as $y = 3x$
Greatest Common Factor	The greatest factor that divides two numbers
Independent Variable	A variable whose values don't depend on changes in other variables
Integer	A number expressible in the form of *a* or – *a* for some whole number *a*
Interquartile Range	A measure of variation in a set of numerical data; the interquartile range is the distance between the first and third quartiles of the data set
Irrational Number	A number that cannot be expressed as a fraction *p/q* for any integers *p* and *q*; have decimal expansions that neither terminate nor become periodic
Least Common Multiple	The smallest number that is exactly divisible by each member of a set of numbers
Mean	A measure of center in a set of numerical data, computed by adding the values in a slit then dividing by the number of values in the list
Mean Absolute Deviation	A measure of variation in a set of numerical data, computed by adding the distances between each data value and the mean, then dividing by the number of data values
Median	A measure of center in a set of numerical data; the median of a list of values is the value appearing at the center of a sorted version of the list – or the mean of the two central values, if the list contains an even number of values
Mode	A measure of center in a set of numerical data; the most common value in list of values
Order of Operations	A set of rules that define which procedures to perform first in order to evaluate a given expression
Probability	A number between 0 and 1 used to quantify likelihood for processes that have uncertain outcomes (tossing a coin, selecting a person at random from a group of people, tossing a ball at a target, or testing for a medical condition)
Ratio	The ratio of two number *r* and *s* is written *r/s,* where *r* is the numerator and *s* is the denominator
Rational Number	A number that can be written as a ratio of two integers
Relation	A set of ordered pairs of data
Scale Drawing	A drawing with dimensions at a specific ratio relative to the actual size of the object
Scatter Plot	A graph in the coordinate plane representing a set of bivariate data
Standard Algorithm	Denotes any valid base-ten strategy
Theoretical Probability	The number of ways that the event can occur, divided by the total number of outcomes
Third Quartile	For a data set with median M, the third quartile is the median of the data values greater than M
Unit Rate	A comparison of two measurements in which one of the terms has a value of 1
Variable	A symbol used to represent an unknown or undetermined value in an expression or equation

Appendix

Table 1: Properties of Operations

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 x b) x c = a x (b x c) *
Commutative property of multiplication	a x b = b x a *
Multiplicative identity property 1	a x 1 = 1a = a *
Existence of multiplication inverses	For every a ≠ 0 there exists 1/*a* so that a x 1/a = 1/a x a = 1 *
Distributive property of multiplication over addition	a x (b + c) = a x b + a x c *

*The x represents multiplication not a variable.

Table 2: Properties of Equality

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.

*The x represents multiplication not a variable.

Table 3: Properties of Inequality

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, b < a.
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.

*The x represents multiplication not a variable.