Kentucky Academic Standards for Mathematics: Grade 7 Overview

Ratio and Proportional Relationships (RP)	The Number System (NS)	Expressions and Equations (EE)	Geometry (G)	Statistics and Probability (SP)
• Analyze proportional relationships and use them to solve real-world and mathematical problems.	• Apply and extend previous understandings of operations with fractions to add, subtract, multiply and divide rational numbers.	• Use properties of operations to generate equivalent expressions. • Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	• Draw, construct and describe geometrical figures and describe the relationships between them. • Solve real-life and mathematical problems involving angle measure, area, surface area and volume.	• Use random sampling to draw inferences about a population. • Draw informal comparative inferences about two populations. • Investigate chance processes and develop, use and evaluate probability models.

In grade 7, instructional time should focus on four critical areas:

1. In the Ratios and Proportional Relationships domain, students will:

- extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems;
- use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips and percent increase or decrease;
- solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects;
- graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope;
- distinguish proportional relationships from other relationships.

2. In the Number System and the Expressions, Equations and Inequalities domains, students will:

- develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation) and percents as different representations of rational numbers;
- extend addition, subtraction, multiplication and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction and multiplication and division--by applying these properties and by viewing negative numbers in terms of everyday contexts;
- explain and interpret the rules for adding, subtracting, multiplying and dividing with negative numbers;
- use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

3. In the Geometry domain, students will:

- continue their work with area from grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects;

- reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions and they gain familiarity with the relationships between angles formed by intersecting lines;
- work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections;
- solve real-world and mathematical problems involving area, surface area and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

4. In the Statistics and Probability domain, students will:

- build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations;
- begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

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

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

Standards	Clarifications
KY.7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. **MP.2**, **MP.6**	For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction ½/¼ miles per hour, equivalently 2 miles per hour. KY.6.RP.2 Coherence KY.6.RP.3→ KY.7.RP.1
KY.7.RP.2 Recognize and represent proportional relationships between quantities. a. Decide whether two quantities represent a proportional relationship. 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. d. Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r)* where *r* is the unit rate. **MP.1**, **MP.2**, **MP.3**	a. Students test 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. Students understand finding the unit rate in a table or graph is equivalent to the constant of proportionality in an equation or verbal description. KY.8.F.2 KY.8.F.4 Coherence KY.6.RP.3a →KY.7.RP.2b →KY.8.EE.6 c. 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 $t = pn$. Coherence KY.7.RP.2c → KY.8.EE.5 d. Students describe points (*x, y*) in terms of the labels of the *x*- and *y*-axes; students understand in a proportional relationship (0, 0) is a valid point and (1, *r*) represents the unit rate and the constant of proportionality for the relationship between the quantities.

Standards	Clarifications
	Coherence KY.7.RP.2d → KY.8.F.5
KY.7.RP.3 Use percents to solve mathematical and real-world problems. a. Find a percent of a quantity as a rate per 100; solve problems involving finding the whole, a part and a percent, given two of these. b. Use proportional relationships to solve multistep ratio and percent problems. **MP.5**, **MP.6**	a. For example, 30% of a quantity means 30/100 times the quantity. b. Could include but not limited to simple interest, tax, markups and markdowns, gratuities and commissions, percent increase and decrease, percent error. Coherence KY.6.RP.3c → KY.7.RP.3

Attending to the Standards for Mathematical Practice

Translating a rate to a unit rate allows students to contextualize a complex ratio to something more likely for them to understand, for example, a rate of miles per ONE hour or gallons per ONE minute (**MP.2**). The use of unit rates allows students to be precise in their understanding, transferring "½ mile in ¼ hour" to something understandable, such as 2 miles per hour (**MP.1**). Students think about why some relationships are proportional where others are not. Students make sense of and solve multistep ratio problems, including cases with pairs of rational number entries; they use representations, such as ratio tables, the coordinate plane and equations and relate these representations to each other and to the context of the problem. Students depict the meaning of the constant of proportionality in proportional relationships and the importance of (0, 0) and (1, *r*) on graphs (**MP.1**). Students compute unit rates for paired data given in tables to determine if the data represents a proportional relationship. Students use concrete numbers to create and implement equations, including $y = kx$, where *k* is the constant of proportionality. (**MP.2**) One special proportional relationship in common usage involves percents. Students may think about "percent" as "part of 100" and solve a proportional relationship for any missing part of the relationship between a number, a part of that number and the associated percentage (**MP.5**). Students reason about when their resulting solutions make sense, as when the resulting solution is greater than 100% or, when speaking about percent increase, decrease and error, when their resulting solution may be a negative value (**MP.6**).

The Number System	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: **Apply and extend previous understandings of operations with fractions to add, subtract, multiply and divide rational numbers.**	
Standards	**Clarifications**
KY.7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. b. Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world 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. **MP.2**, **MP.4**, **MP.7**	a. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged. b. The sum of numbers is a directional movement from one number to another for a specified amount of spaces on the number line. The sum of opposites is 0 due to the fact that opposites have equivalent absolute values. c. Subtracting a positive number is the same as adding the positive number's opposite. KY.6.NS.5 KY.6.NS.6 Coherence KY.6.NS.7→ KY.7.NS.1
KY.7.NS.2 Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules	a. Emphasis is on exploring and understanding how the rules for multiplying and dividing with negative numbers are connected to properties for the operations, rather than to think of them as arbitrary rules. They explain 4 times (-3) could be four days of golfing 3 under par and therefore, having an overall score of -12. The remaining operations are based on applying properties.

Standards	Clarifications
for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided, provided that the divisor is not zero and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts. c. Apply properties of operations as strategies to multiply and divide rational numbers. **MP.2**, **MP.7**, **MP.8**	b. Emphasis is on the equivalence relationship provided by the movement of one negative sign among the numerator, denominator, or in front of the entire fraction. Coherence KY.6.NS.1→ KY.7.NS.2 → KY.8.NS.1
KY.7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers. **MP.1**, **MP.2**, **MP.5**	Emphasis is on applying mathematical operations to rational numbers that occur in real world context. Coherence KY.6.NS.3 → KY.7.NS.3

Attending to the Standards for Mathematical Practice

In grade 7, students build upon understanding by examining inverses and reason any number has an additive inverse, which is the mirror-image of the original number, albeit on the opposite side of zero, which brings the idea of absolute value to life (**MP.2**). The structure of working with the various properties of rational numbers cannot be ignored and students systematically apply these properties in a variety of scenarios (**MP.7**). Understanding these properties gives students a tool to model many real-world situations with simpler mathematical sentences. Through the use of number lines, tape diagrams, expressions and equations, students model relationships between rational numbers. Students relate operations involving integers to contextual examples (**MP.4**). Students demonstrate fluency in applying the four operations to rational numbers in real life situations when they strategically apply the properties of operations to model real-world situations and truly making sense of the world around them with mathematics. Additionally, as students fluently solve word problems, they consider their steps and determine whether or not they make sense in relationship to the arithmetic understanding that served as their foundation in earlier grades (**MP.1**, **MP.2**, **MP.4**, **MP.5**). Students move from recall of applying rules of multiplying and dividing signed numbers to the ability to apply these rules strategically in a variety of situations. Students formulate rules for operations with signed numbers by observing patterns (**MP.2**, **MP.8**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

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

Cluster: **Use properties of operations to generate equivalent expressions.**

Standards	Clarifications
KY.7.EE.1 Apply properties of operations as strategies to add, subtract, factor and expand linear expressions with rational coefficients. **MP.2**, **MP.3**	Students demonstrate understanding of applying the order of operations to an expression involving multiple operations, including using the distributive property and variables in the expression. Students apply the properties of commutative, associative and distributive fluently. Coherence KY.6.EE.3 → KY.7.EE.1 → KY.8.EE.7
KY.7.EE.2 Understand that rewriting an expression in different forms in a problem context can clarify the problem and how the quantities in it are related. **MP.7**, **MP.8**	Students apply mathematical properties in order to rewrite expressions and clarify the relationship of quantities in a problem. For Example: If Tom and Jim both get paid a wage of $11 per hour, but Tom was paid an additional $55 for overtime, the expression $11(T + J) + 55$ may be more clearly interpreted as $11T + 55 + 11J$ for purposes of understanding Tom's pay separated from Jim's pay. Coherence KY.6.EE.4 → KY.7.EE.2 → KY.8.EE.8c

Attending to the Standards for Mathematical Practice

Students who fluently use the strategies of the properties of rational numbers to reason through the standard order of operations by applying these properties in a structured way. Students recognize the repeated use of the distributive property as they write equivalent expressions (**MP.7**). When given an example problem involving multiple operations containing a mistake, students answer the question "Where did the mistake occur and how do I know?" (**MP.3**). Students bring mathematical context to real-life situations by understanding multiple representations of quantities may exist. For example, adding 5% to quantity *a* leads to an expression of *a + .05a = 1.05a*, which clarifies the problem. Students access previous knowledge of working with percents to use the same structure to see equivalent expressions exist, even when taken out of the context of the real-world situation (**MP.7**). Students extend this reasoning to understand other situations (**MP.8**).

Expressions and Equations	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: **Solve real-life and mathematical problems using numerical and algebraic expressions and equations.**	
Standards	**Clarifications**
KY.7.EE.3 Solve 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; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. **MP.1**, **MP.4**, **MP.6**	Students solve multi-step real-world and mathematical problems containing integers, fractions and decimals, using previously acquired skills around converting fractions, decimals and percentages and use properties of operations to find equivalent forms of expressions when needed. Students solidify understanding by checking their solutions for reasonableness using estimation strategies such as rounding, compatible numbers and benchmark numbers. Coherence KY.7.EE.3 → KY.8.EE.4
KY.7.EE.4 Use variables to represent quantities in a real-world or mathematical problem and construct 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. Graph the solution set of the equality and interpret it in context of the problem. b. Solve word problems leading to inequalities of the form $px + q > r, px + q < r, px + q \geq r, px + q \leq r$; where *p*, *q* and *r* are specific rational numbers. Graph the solution set of the inequality and interpret it in context of the problem. **MP.2**, **MP.4**	a. Interpret word problems in the form of the initial value as a one-time occurrence within the problem and the coefficient as the recurring event within the problem. Coherence KY.6.EE.7 → KY.7.EE.4 → KY.8.EE.7 b. Interpret word problems having one or more solutions that satisfy the conditions of the problem. Graph on a number line the solution set that satisfies the conditions of the problems. Coherence KY.6.EE.8 → KY.7.EE.4

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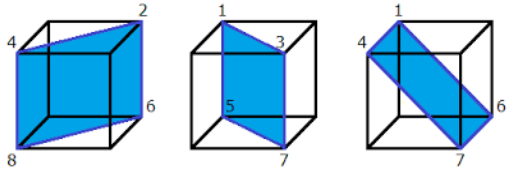
Attending to the Standards for Mathematical Practice
It is common for students to have difficulty in scaffolding from simple problems to more complex, multi-step problems; assistance in this regard is given by the use of estimation strategies to benchmark their work and lend confidence to more accurate solutions (**MP.1**, **MP.6**). Students apply the properties of rational numbers in order to solve equations and inequalities. Students must be precise when defining a variable (**MP.6**). Students reason a solution to a real-life situation but may struggle with modeling the problems with an equation or inequality involving a variable. For example, "I buy 6 pencils and a $3 pen for a total of $12. How much did each pencil cost?" Students with an understanding of numbers, but not the idea of a variable, may create an equation of $p = \frac{12-3}{6}$ = 1.50. Students who successfully model with mathematics understand the variable represents the cost of one pencil and use it appropriately, $6p + 3 = 12$, which more accurately represents the problem presented (**MP.4**).

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

Cluster: **Draw, construct and describe geometrical figures and describe the relationships between them.**

Standards	Clarifications
KY.7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. **MP.1**, **MP.2**, **MP.5**	Emphasis is on being able to convert values from one given measurement to another based on a given scale factor. For example, 1 inch on the scale drawing equals how many feet in real life based on the scale factor given. Students reproduce a given drawing based on a scale factor. Coherence KY.6.G.1→KY.7.G.1→KY.8.EE.6
KY.7.G.2 Draw (freehand, with ruler and protractor and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. **MP.6**, **MP.7**	Emphasis is on taking given conditions and converting them to geometric shapes, constructing triangles with given angle measures and side lengths and determining when the given conditions do not meet the conditions of a triangle. Coherence KY.7.G.2→KY.8.G.1
KY.7.G.3 Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. **MP.5**, **MP.6**	Cross sections may be taken from horizontal, vertical and oblique angles, such as: 

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Attending to the Standards for Mathematical Practice
Students extend their knowledge of proportional reasoning to solve problems involving dimensions and area. Proper use of tools help them understand the conditions by which three side lengths will determine one triangle or no triangle. Students have opportunities to reflect on the appropriateness of a tool for a particular task (**MP.5**). Initially, students may struggle with moving from a concrete understanding of a real-world situation to a miniature version, or vice versa; hands-on measurements and the use of technology can assist students with this abstract idea. In many cases, students make sense of new and different contexts and engage in significant struggle to solve problems (**MP.1**, **MP.2**). Students begin to understand it may not be possible to draw a certain shape with given measurements, or, if possible, may not yield a unique shape and reason why this may be the case (**MP.7**). By finding the constraints that exist in the Triangle Inequality Theorem, for example, a student determines precisely when a triangle may or may not exist (**MP.6**). By emphasizing the differences in various slicing planes, students accurately represent the resulting sections (**MP.6**).

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

Cluster: **Solve real-life and mathematical problems involving angle measure, area, surface area and volume.**

Standards	Clarifications
KY.7.G.4 Use formulas for area and circumference of circles and their relationships. a. Apply the formulas for the area and circumference of a circle to solve real-world and mathematical problems. b. Explore and understand the relationship between the radius, diameter, circumference and area of a circle. **MP.1**, **MP.2**, **MP.8**	Circle Formulas: C=dπ $C = 2r\pi$ A=πr^2 Note: Calculating the radius or diameter of a circle given its area is not expected, as finding the square root of a number is reserved for 8th grade. a. Both area and circumference are represented; students recognize when circumference is needed and when area is needed. b. Emphasis is on calculating area given diameter; finding circumference given radius or diameter; and finding radius or diameter given circumference. Special attention given to the relationship between diameter and circumference as a ratio that leads to pi. Coherence KY.7.G.4 → KY.8.G.9
KY.7.G.5 Apply properties of supplementary, complementary, vertical and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. **MP.3**, **MP.6**, **MP.7**	Emphasis is on the relationships between the various angles listed to find missing angles based on the relationships and to write and solve equations to find unknown angles. KY.8.G.1 Coherence KY.4.MD.7 →KY.7.G.5 →KY.8.G.5
KY.7.G.6 Solve problems involving area of two-dimensional objects and surface area and volume of three-dimensional objects. a. Solve real-world and mathematical problems involving area of two-dimensional objects composed of triangles, quadrilaterals and other polygons.	a. Emphasis is on finding the area of composite figures composed of convex polygons. b. Students understand volume and surface area are two different quantities used to describe the same three-dimensional figure. Building upon their understanding of area, students use nets of three dimensional objects to conceptualize surface area.

Standards	Clarifications
b. Solve real-world and mathematical problems involving volume and surface area, using nets as needed, of three-dimensional objects including cubes, pyramids and right prisms. **MP.3**, **MP.4**, **MP.5**	Students calculate with appropriate units, using nets as a possible strategy for calculation as well as formulas for volume and surface area, where appropriate. KY.6.G.1 KY.6.G.2 Coherence KY.6.G.4→ KY.7.G.6 → KY.8.G.6

Attending to the Standards for Mathematical Practice

A student who merely memorizes the area and circumference formulas for a circle or the area, volume and surface area formulas of other shapes does not have a deep, conceptual understanding of the basis for these equations. Exploring the relationships between radius, diameter, area and circumference limits the confusion inherent in rote memorization, because students are given a context to the concepts (**MP.2**, **MP.8**). Solving real-world situations involving these quantities gives the student context for their understanding of the mathematics (**MP.1**). In addition, precise drawing or manipulation of technology lends itself to generate definitions (**MP.6**). Students continue their work from grade 6 from solving area problems involving triangles and rectangles to those involving more complex shapes, such as rhombi or trapezoids (**MP.4**). Students may mischaracterize volume and surface area of three dimensional shapes, leading them to develop ways to decide upon whether a situation calls for the volume of a figure, or the surface area of a figure (**MP.3**). The use of nets and other appropriate tools gives students a structure to foster greater understanding of the concept of surface area (**MP.5**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Statistics and Probability	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: Use random sampling to draw inferences about a population.	
Standards	**Clarifications**
KY.7.SP.0 Create displays, including circle graphs (pie charts), scaled pictographs and bar graphs, to compare and analyze distributions of categorical data from both matching and different-sized samples. **MP.2**, **MP.3**, **MP.6**	Students have been introduced to pictographs and bar graphs in grades 2 and 3; Circle graphs are new and connect to the grade 7 focus on percents. Also, students' knowledge of rates mean they can approach scaled pictographs in a more sophisticated manner. An important aspect of doing statistics is *selecting* an appropriate data display for the question under investigation. Students need to be asked, "Which data display fits this data set and why?" The circle graph focuses more on the relative values of the clustering of data, whereas the bar and pictographs add a dimension of quantity. The choice of which data display (and how categories are set up within each display) will result in different pictures of the shape of data. Finally students are comparing two distributions. When comparing two different distributions, circle graphs lend to comparing different sized samples, because circle graphs are based on percentages. KY.7.SP.0 KY.7.SP.2 Coherence KY.6.SP.O→KY.7.SP.4
KY.7.SP.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random	Recognize what makes a valid and non-valid sample of a population. Recognize the size of the sample holds importance to the accuracy of the sample. KY.6.SP.0

Standards	Clarifications
sampling tends to produce representative samples and support valid inferences. **MP.3**, **MP.6**	KY.6.SP.1 Coherence KY.6.SP.2→KY.7.SP.1→KY.HS.SP.9
KY.7.SP.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. a. Generate multiple samples of categorical data of the same size to gauge the variation in estimates or predictions. b. Generate multiple samples (or simulated samples) of numerical data to gauge the variation in estimates or predictions. c. Gauge how far off an estimate or prediction might be related to a population character of interest. **MP.2**, **MP.3**, **MP.7**	Emphasis is on the sample size and how this affects the validity of the estimate or prediction. Examples: a. Randomly sample 6th, 7th and 8th graders about who their favorite superhero is to generate samples of data that are roughly the same size, looking specifically at patterns, if any. b. 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. Coherence KY.6.SP.0→ 7.SP.2→ KY.HS.SP.12

Attending to the Standards for Mathematical Practice
Students understand the method of sampling a population affects the reliability and validity of the data gleaned, so they justify their conclusions and inferences in a valid way (**MP.3**). In doing so, they create an accurate picture of the question posed (**MP.6**). In drawing inferences and reasoning about the variation of their estimates, students construct arguments based on data (**MP.2**, **MP.3**). When students, for example, examine a sample of 10 data points, versus a sample of 100 data points, they generalize why the samples may have two different sample errors (**MP.7**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

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

Cluster: **Draw informal comparative inferences about two populations.**

Standards	Clarifications
KY.7.SP.3 Describe the degree of visual overlap (and separation) from the graphical representations of two numerical data distributions (box plots, dot plots) with similar variabilities with similar contexts (same variable), measuring the difference between the centers (medians or means) by expressing this difference as a multiple of a measure of variability (interquartile range when comparing medians or the mean absolute deviation when comparing means). **MP.1**, **MP.5**, **MP.7**	For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable. KY.6.SP.2 Coherence KY.6.NS.1→KY.7.SP.3→KY.HS.SP.13 KY.HS.SP.10
KY.7.SP.4 Calculate and use measures of center (mean and median) and measures of variability (interquartile range when comparing medians and mean absolute deviation when comparing means) for numerical data from random samples to draw informal comparative inferences about two populations. **MP.2**, **MP.5**, **MP.7**	For example, decide whether the words in a chapter of a grade seven science book are generally longer than the words in a chapter of a grade four science book. KY.HS.SP.10 Coherence KY.6.SP.2→KY.7.SP.4→KY.HS.SP.13

Attending to the Standards for Mathematical Practice

When comparing two data distributions, students visually note differences, for example, of two dot plots. What is more difficult at times is to conceptualize this in mathematical terms, such that one distribution may have twice the variability of the other (**MP.2**). In moving from visual representation to measures of center and variability, students using these measures mathematically describe a situation that may be difficult to otherwise describe (**MP.5**, **MP.7**). Categorically summarizing data in circle graphs, gives students a basis for bringing their number sense from percents to statistics, allowing them to be precise when describing data (57% of students have brown shoes) (**MP.6**), while reasoning and drawing conclusions from data presented (**MP.2**, **MP.3**). Now, students drawing inferences from their calculations they have learned in grade 6 and earlier in grade 7 allows them to use these tools (**MP.5**) and allows them to mathematically compare (**MP.7**) in such a way that their inferences and conclusions make sense in context (**MP.2**).

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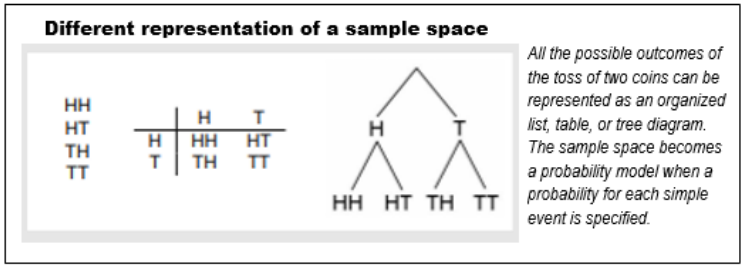
Statistics and Probability	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically.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

Cluster: **Investigate chance processes and develop, use and evaluate probability models.**

Standards	Clarifications
KY.7.SP.5 Describe the probability of a chance event is a number between 0 and 1, which tells how likely the event is, from impossible (0) to certain (1). 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. **MP.5**, **MP.6**, **MP.7**	Emphasis is on descriptive language used to describe numerical probabilities; impossible event, unlikely event, equally likely event, likely event, certain event. Students understand all probabilities must fall between 0 and 1.
KY.7.SP.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency and predict the approximate relative frequency given the probability. **MP.1**, **MP.2**	Estimate the likelihood of an event, test the estimate by trial and collect data. Students observe accuracy of the estimate will increase with the frequency of repeated trials. Coherence KY.7.SP.6→ KY.HS.SP.10
KY.7.SP.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. **MP.4**, **MP.7**, **MP.8**	For example: a. If a student is selected at random from a class, find the probability Jane will be selected and the probability a girl will be selected. b. Find the approximate probability a spinning penny will land heads up or 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? KY.7.RP.3 Coherence KY.7.SP.7→ KY.HS.SP.14
KY.7.SP.8 Find probabilities of compound events using organized lists, tables, tree diagrams and simulation.	Example: a. If the probability of heads occurring on a coin is ½, then the probability of three heads in a row is ½ ·½ ·½ = ⅛.

Standards	Clarifications
a. Explain 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 described in everyday language using methods such as organized lists, tables and tree diagrams. c. Design and use a simulation to generate frequencies for compound events. **MP.2**, **MP.4**, **MP.7**	b. For a simulation of tossing two fair coins:  c. 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 it will take at least 4 donors to find one with type A blood? Coherence KY.7.SP.8→ KY.HS.SP.14

Attending to the Standards for Mathematical Practice

Thinking of probability as being on a continuum ranging from a probability of 0 to a probability of 1 allows students to visualize the structure of ranking the chances of an event occurring (**MP.7**). When they relate these broader terms to actual calculated probability, this lends precision to otherwise vague concepts (**MP.6**). In addition, students note the opposite is also true; a calculated probability close to ½ means the event is neither unlikely nor likely, or equally likely (**MP.5**). Looking at the process that generates a set of probabilities (experimental probability) in a specific scenario gives students the opportunity to examine a situation in depth (**MP.1**) and reason about why the conclusion they draw may or may not be accurate (**MP.2**). Student thinking about theoretical probability is extended to developing a model (**MP.4**) that lends structure (**MP.7**) to an otherwise abstract idea. Students may use this model to explain why a penny comes up heads half the time and tails the other half, but in an experiment where this event is repeated multiple times, the experimental probability may not be exactly ½ and ½. (**MP.8**). Compound probability may be more difficult for students to understand; tree diagrams, lists, etc. may help students understand the concept (**MP.7**). Difficult to understand compound events may necessitate a simulation tool, for example a random digit generator (**MP.4**).