

Unit 3 Title	Estimated Time Frame
Rational Exponents, Radical Functions, and Probability	40 days or 20 block days (to also include a review of circles (9.2), matrices (10.1/10.2), and coordinate geometry.
Big Idea (s)	
<p>Students will extend their previous understanding of radical functions.</p> <p>Students will use properties of rational exponents and radicals.</p> <p>Students will learn methods to graph radical functions, solve radical equations, and combine functions.</p> <p>Students will identify inverses of functions and learn to write the equations of inverse functions.</p> <p>Students will extend their previous understanding of ratios and basic probability to the probability of multiple events, combinatorics, probability distributions, and expected value.</p> <p>Students will understand and graph probability distributions.</p> <p>Students will use probability models and expected values to make decisions.</p>	
Essential Question(s)	
<p>How are rational exponents and radical equations used to solve real-world problems?</p> <p>For what input values is the output value positive, negative, or 0?</p> <p>What happens to the output when the input value gets very large in magnitude?"</p> <p>How can you find the probability of events and combinations of events?</p>	
Standards for Mathematical Practice (MP.) - The practice standards in bold describe expertise to be intentionally developed in this unit.	Kentucky Interdisciplinary Literacy Practices (KILP.) - The practice standards in bold describe expertise to be intentionally developed in Mathematics.
<p>MP.1. Make sense of problems and persevere in solving them.</p> <p>MP.2. Reason abstractly and quantitatively.</p> <p>MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>MP.4. Model with mathematics.</p> <p>MP.5. Use appropriate tools strategically.</p> <p>MP.6. Attend to precision.</p> <p>MP.7. Look for and make use of structure.</p> <p>MP.8. Look for and express regularity in</p>	<p>KILP.1 Recognize that text is anything that communicates a message.</p> <p>KILP.2 Employ, develop, and refine schema to understand and create text.</p> <p>KILP.3 View literacy experiences as transactional, interdisciplinary and transformational.</p> <p>KILP.4 Utilize receptive & expressive language arts to better understand self, others, and the world.</p> <p>KILP.5 Apply strategic practices, with scaffolding & then independently, to approach new literacy tasks.</p> <p>KILP.6 Collaborate with others to create new meaning.</p> <p>KILP.7 Utilize digital resources to learn and share with others.</p> <p>KILP.8 Engage in specialized, discipline specific literacy practices.</p> <p>KILP.9 Apply high level cognitive processes to think deeply and critically about text.</p>

repeated reasoning.	KILP.10.Develop a literacy identity that promotes lifelong learning.	
Common Preconceptions/Misconceptions		
<p>Students often solve rational and radical equations without checking that their solutions may be erroneous. One method that helps students understand extraneous roots is to look at the graph of the original function associated with the equation. Students need to check their own work and determine if a possible solution does or does not work.</p> <p>Students will need examples to show that association does not necessarily provide evidence for cause and effect. Students often have difficulty separating the ideas of association and casualty.</p> <p>Students work with set notation to represent multiple contexts. Allowing time for students to grapple with the connection of these ideas can help them develop fluency with notation and connecting notation to multiple problem situations.</p>		
KAS Standards	Considerations	Samples of Learning Intentions and Success Criteria
<p>KY.HS.A.17 Solve and justify equations in one variable. Justify the solutions and give examples showing how extraneous solutions may arise.</p> <p>b. Solve radical equations in one variable. MP.3, MP.5, MP.7</p>	<p>Students analyze solution sets of equations to determine processes (for example, squaring both sides of an equation) that might lead to a solution set that differs from the original equation.</p>	<p>We are learning to solve radical equations with one variable. (Lesson 5-4)</p> <ul style="list-style-type: none">I can square both sides of the equation to eliminate the radical and solve for the variable,
<p>KY.HS.F.1 Understand properties and key features of functions and the different ways functions can be represented.</p> <p>c. (radical functions) For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.</p> <p>Key features include but are not limited to intercepts, intervals where the function is increasing, decreasing, or remaining constant;</p>	<p>A function is often described and understood in terms of the output behavior or over what input values it is increasing, decreasing, or constant. Important questions include, “For what input values is the output value positive, negative, or 0? What happens to the output when the input value gets very large in magnitude?”</p> <p>Graphs become useful representations for understanding and comparing functions because these behaviors are often easy to see in the graphs of functions.</p>	<p>We are learning to graph and interpret key features of graphs of radical functions. (Lesson 5-3)</p> <ul style="list-style-type: none">I can identify the domain and range of a radical function.I can sketch the graphs of a radical function.

relative maxima and minima; symmetries; end behavior, and periodicity.		
KY.HS.F.8 Understand the effects of transformations on the graph of a function. a. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$ and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. b. Experiment with cases and explain the effects on the graph using technology. MP.3, MP.5	Mastery of Part a of this standard includes recognizing even and odd functions from their graphs and algebraic expressions.	We are learning to understand the effects of transformations of a graph. (Lesson 5-3) <ul style="list-style-type: none"> I can identify transformations of a function on a graph.
KY.HS.SP.2 Use statistics appropriate to describe the shape of the numerical data distribution to compare center (median, mean) and spread (interquartile range when comparing medians and standard deviation when comparing means) of different data distributions. MP.2, MP.6	Students use raw data and data from appropriate graphical representations to compare differences in the shape, center, spread and presence of outliers and other unusual features of comparable data sets.	We are learning to understand the effects of transformations of a graph. <ul style="list-style-type: none"> I can determine the appropriate measures of center and spread for a distribution and use them to compare distributions.
KY.HS.SP.14 Describe events as subsets of a sample space. Use characteristics (or categories) of the outcomes, such as unions, “A or B,” that are mutually exclusive events, unions, “A or B,” that are non-mutually exclusive events, and as intersections, “A and B,” and as complements of other events, “not A,” to calculate basic probabilities. MP.1, MP.2	A union of two events, “A or B,” includes all elements in both events notated by: $A \cup B$. Addition Rule for mutually exclusive events: If A and B are mutually exclusive, $P(A \text{ or } B) = P(A) + P(B)$. Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model. An intersection, “A and B,” of two events include all overlapping elements notated by: $A \cap B$. A complement for any event A, $P(\text{not } A) = 1 - P(A)$.	We are learning to calculate probabilities of multiple events. (Lesson 12-1, 12-2, 12-3) <ul style="list-style-type: none"> I can define unions, intersections, and complements of events and calculate probabilities of these events. I can describe events as subsets of a sample space using characteristics of the outcomes (“or,” “and,” “not”)
KY.HS.SP.15 Understand the concept of independence. a. Understand that two events, A and B, are independent if the probability of A and B occurring together is the product of their individual probabilities, $P(A) \times P(B)$	a. Events A and B are independent if and only if $P(A \text{ and } B) = P(A)P(B)$.	We are learning to understand the concept of independence. (Lesson 12-1, 12-2, 12-3) <ul style="list-style-type: none"> I can categorize events as independent or not using the characterization that two events, A and B, are independent when the probability of A and B occurring together is the product of their probabilities. I can determine the outcome of independent

c. Recognize and explain the concept of independence in everyday language and everyday situations. MP.1, MP.6		events as the product of their probabilities.
KY.HS.SP.16 Understand the concept of conditional probability. a. Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$. c. Recognize and explain the concept of conditional probability in everyday language and everyday situations. d. Find the conditional probability of A given B as the fraction of B's outcomes belonging to A and interpret the answer in terms of the model. MP.1, MP.3	For any two events A and B, $P(A \text{ given } B) = \frac{P(A \text{ and } B)}{P(B)}$.	We are learning to understand, recognize, and explain the concept of conditional probability. (Lesson 12-1, 12-2) <ul style="list-style-type: none"> I can understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$. I can interpret the independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
KY.HS.SP.19 Use permutations and combinations to compute probabilities. a. Distinguish between situations that can be modeled using counting techniques, including the Fundamental Counting Principle, permutations, and combinations. b. Perform calculations using the appropriate counting technique, including simple probabilities. MP.1, MP.8	Permutations are calculated when order matters. Combinations are calculated when order does not matter. Number of permutations of n items taken r at a time: ${}_nP_r = \frac{n!}{(n-r)!}$ Number of combinations of n items taken r at a time: ${}_nC_r = \frac{n!}{(n-r)!r!}$	We are learning to use permutations and combinations to compute probabilities of compound events and solve problems. (Lesson 12-3) <ul style="list-style-type: none"> I can identify situations that are permutations and those that are combinations. I can use permutations to compute probabilities of compound events and solve problems. I can use combinations to compute probabilities of compound events and solve problems.
Supporting Standards		
KY.HS.N.1 Extend the properties of integer exponents to rational exponents, allowing for the expression of radicals in terms of rational exponents. MP.2, MP.7 (Lesson 5.1) KY.HS.N.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. MP.7 (Lesson 5.1)		

KY.HS.A.1 interpret expressions representing a quantity in terms of its context. ★

- a. Interpret parts of an expression, such as terms, factors, and coefficients.
- b. Interpret complicated expressions, given a context, by viewing one or more of their parts as a single entity.

MP.2, MP.6, (Lesson 5-2)

KY.HS.A.2 Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms. **MP.7, MP.8**, (Lesson 5.2)

KY.HS.F.3.b. Estimate the rate of change from a graph. ★ **MP.2, MP.4**, (Lesson 5.3)

KY.HS.A.15 Rearrange formulas to solve a literal equation, highlighting a quantity of interest, using the same reasoning as in solving equations. **MP.2, MP.7**, (Lesson 5.4)

KY.HS.A.16 Understand each step in solving a simple equation as following from the equality of numbers asserted in the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. **MP.1, MP.3** (Lesson 5-1, 5-4)

KY.HS.SP.4 (+) When appropriate, fit a normal distribution to a numerical data set for a given mean and standard deviation and then estimate population percentages using the Empirical Rule and recognize that there are data sets for which such a procedure is not appropriate. **MP.1, MP.3**

KY.HS.SP.9 Understand statistics as a process for making inferences and justifying conclusions about population parameters based on a random sample from that population. **MP.1, MP.3**

KY.HS.SP.10 Decide if a specified model is consistent with the results from a simulation. **MP.3, MP.6**

KY.HS.SP.11 Recognize the purposes of and differences among sample surveys, experiments and observational studies; explain how randomization relates to each. **MP.3, MP.8**

KY.HS.SP.12 Use data from a sample survey to estimate a population mean or proportion and explain how bias may be involved in the process. **MP.4, MP.7**

KY.HS.SP.15. b (+) Determine whether two events are independent and provide a justification to support the decision. (Lessons 12 -1, 2, 3)

KY.HS.SP.17 (+) Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide whether events are independent and to approximate conditional probabilities. **MP.2, MP.4** (Topic 12)

KY.HS.SP.18 (+) Apply the General Multiplication Rule, $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$, in a uniform probability model, and interpret the answer in terms of the model. **MP.1, MP.2**, (Lessons 12-1, 12-2)

KY.HS.SP. 19. c. (+) Use permutations and combinations to compute probabilities of compound events and solve problems. (Lesson 12-3)

KY.HS.SP.20 (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same appropriate graphical displays as for data distributions. **MP.3, MP.6**, (Lesson 12-4)

KY.HS.SP.21 (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution and use the value in analyzing decisions. **MP.1, MP.8**
(Lesson 12–5, 12-6)

KY.HS.SP.22 (+) Develop a probability distribution for a random variable. a. Find an expected value based on a sample space in which theoretical probabilities can be calculated. b. Find an expected value based on a sample space in which empirical probabilities can be calculated. **MP.2, MP.8**
(Lesson 12-4)

KY.HS.SP.23 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.

a. Find the expected payoff for a game of chance.

b. Evaluate and compare strategies based on expected values.

c. Use calculated expected values to make fair decisions and formulate strategies. **MP.6, MP.8** (Lesson 12–5, 12-6)

Essential Vocabulary

Rational Exponents/Radical Functions:	Probability Vocabulary:
complex conjugate exponent Index nth root radical symbol radicand radical expression rational exponent domain composite function composition of functions dependent variable independent variable relation inverse function inverse relation	Event/Independent events Outcome Sample space Mutually exclusive Conditional probability Dependent events Combination Factorial Fundamental counting principle Permutation Binomial probability

Common Assessment

Common Assessment Unit 3 Algebra 2

Anchor Resources

enVision Topic 5 – Rational Exponents and Radical Functions	enVision Topic 12 Probability
MILC - MILC Topic 5 Rational Exponents and Radical Functions resources FAL (one per semester): Evaluating Statements About Radicals (use with 5-4 OR anytime after 5-4) **Recommended FAL for 2nd semester 3 Act Math Task - <i>The Snack Shack</i> - (3 kids on the beach go to the snack shack (paths) - Use after Lesson 5-4	MILC - MILC Topic 12 resources 3 Act Math Task - Free Throws for the Win! (use the Calipari video clip)

*Disclaimer: Success Criteria is the evidence students must produce to demonstrate learning. This example is not comprehensive.

** Mathematical Practices (A.MP.1- 8) should be evidenced throughout each unit, depending on the tasks.

*** Modeling Standards: Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (★). The star symbol sometimes appears on the heading for a group of standards; in that case, it should be understood to apply to *all* standards in that group.