



## **ALGEBRA III- BOE Approved September 9, 2024**

### **Course Description:**

Algebra III is an option offered to students who have successfully completed Algebra II but do not want/need to proceed to Precalculus or Discrete Math. The course will involve students gaining further mastery for solving problems typically found in and extending beyond traditional Algebra II courses. In addition, time will be spent helping students learn how to solve problems typically found on college placement tests. This course is not recommended for students who have already earned a C or higher in Precalculus or B or higher in Algebra II.

**Grade Level:** 10th-12th

### **Unit Scope and Sequence**

**Unit 1:** Graphing Exponentials

**Unit 2:** Exponential Equations

**Unit 3:** Graphing Logarithms

**Unit 4:** Logarithmic Equations

**Unit 5:** Graphing Rational Functions

**Unit 6:** Rational Equations

### **Course Enduring Understandings:**

- Expressions and values can be determined using mathematical operations, procedures, and rules.
- Mathematical reasoning requires justification of both process and solution.
- Correct notation, language, and mathematical conventions are used to classify concepts and communicate solutions.
- Mathematical information can be translated from a single representation or across multiple representations in order to develop processes to problem solve.

### **Course Essential Questions:**

- How are exponents and logarithms related?
- How do the characteristics of exponential functions affect the graph?
- How do you evaluate exponential and logarithmic functions?
- How do you graph exponential and logarithmic functions?
- How do you solve application problems involving exponential and logarithmic functions?
- How do you graph rational functions using key characteristics?
- How do you solve rational equations?

# ALGEBRA 3

## UNIT 1: GRAPHING EXPONENTIALS

### UNIT 1 DESCRIPTION/OVERVIEW

Students will learn characteristics of exponential curves, how to graph exponential curves using reflections and translations, and be introduced to limits of exponential functions.

| Unit Essential Learning Targets                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                    |
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| <i>Enduring Understandings</i>                                                                                                                                                                                                               | <i>Essential Questions</i>                                                                                                                                                                                                                                         |
| <ul style="list-style-type: none"> <li>Exponents are used to represent complex expressions.</li> <li>Exponential functions have a constant ratio.</li> <li>Real world situations can be represented symbolically and graphically.</li> </ul> | <ul style="list-style-type: none"> <li>How do characteristics of exponential functions affect the graph?</li> <li>How do you evaluate exponential functions?</li> </ul>                                                                                            |
| <i>Students must know:</i>                                                                                                                                                                                                                   | <i>Students must be able to:</i>                                                                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>Exponential function</li> <li>Exponential growth</li> <li>Exponential decay</li> <li>X-intercept</li> <li>Y-intercept</li> <li>Asymptote</li> </ul>                                                   | <ul style="list-style-type: none"> <li>Identify the characteristics of exponential functions</li> <li>Transform exponential functions</li> <li>Evaluate simple limits involving exponential functions</li> <li>Identify and graph exponential functions</li> </ul> |

| Missouri Learning Standards                                                                                                                                                                                                              |
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| A1.CED.A.2: Create equations that describe linear, quadratic and exponential relationships. Create and graph linear, quadratic and exponential equations in two variables.                                                               |
| A1.REI.C.6: Represent and solve linear and exponential equations and inequalities graphically. Explain that the graph of an equation in two variables is the set of all its solutions plotted in the Cartesian coordinate plane.         |
| A1.REI.C.8: Represent and solve linear and exponential equations and inequalities graphically. Solve problems involving a system of linear inequalities.                                                                                 |
| A1.IF.B.3: Interpret linear, quadratic and exponential functions in terms of the context. Using tables, graphs and verbal descriptions, interpret key characteristics of a function that models the relationship between two quantities. |
| A1.IF.B.4: Interpret linear, quadratic and exponential functions in terms of the context. Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.                   |

## ALGEBRA 3

### UNIT 1: GRAPHING EXPONENTIALS

A1.IF.C.7: Analyze linear, quadratic and exponential functions using different representations. Graph functions expressed symbolically and identify and interpret key features of the graph.

A2.NQ.A.1: Extend and use the relationship between rational exponents and radicals. Extend the system of powers and roots to include rational exponents.

A2.NQ.A.2: Extend and use the relationship between rational exponents and radicals. Create and recognize equivalent expressions involving radical and exponential forms of expressions.

A2.NQ.A.3: Extend and use the relationship between rational exponents and radicals. Add, subtract, multiply and divide radical expressions.

A2.NQ.A.4: Extend and use the relationship between rational exponents and radicals. Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.

A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.

# ALGEBRA 3

## UNIT 2 - EXPONENTIAL EQUATIONS

### UNIT 2 DESCRIPTION/OVERVIEW

Students will learn properties of exponents, how to solve exponential equations with common bases and/or logarithms and be exposed to applications of exponential equations

| Unit Essential Learning Targets                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <i>Enduring Understandings</i>                                                                                                                                                                                                                                                                                                                                     | <i>Essential Questions</i>                                                                                                                                                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>The base of the exponent determines whether or not the function will be a growth function or a decay function.</li> <li>All exponential functions retain the same basic shape and are subject to the same transformations as all other functions.</li> <li>You can use rational exponents to represent radicals.</li> </ul> | <ul style="list-style-type: none"> <li>How can you simplify expressions involving exponents?</li> <li>What are the characteristics of exponential functions?</li> <li>How can you simplify expressions involving exponents?</li> <li>How can you solve exponential equations?</li> <li>How do you solve compound interest problems?</li> <li>How do you solve application problems involving exponential decay/growth?</li> </ul> |
| <i>Students must know:</i>                                                                                                                                                                                                                                                                                                                                         | <i>Students must be able to:</i>                                                                                                                                                                                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Properties of exponents</li> <li>Scientific Notation</li> <li>Exponential Functions</li> <li>Exponential Growth</li> <li>Exponential Decay</li> <li>Base</li> <li>Exponent</li> <li>Power</li> <li>Radical</li> <li>Square root</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>Simplify algebraic expressions involving exponents</li> <li>Solve exponential equations</li> <li>Apply methods for solving exponential equations in real world applications</li> </ul>                                                                                                                                                                                                     |

| Missouri Learning Standards                                                                                                                                                                                                              |
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| A2.NQ.A.4: Extend and use the relationship between rational exponents and radicals. Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.                          |
| A1.IF.B.3: Interpret linear, quadratic and exponential functions in terms of the context. Using tables, graphs and verbal descriptions, interpret key characteristics of a function that models the relationship between two quantities. |

## ALGEBRA 3

### UNIT 2 - EXPONENTIAL EQUATIONS

A2.SSE.A.2: Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations. Define and use logarithms: Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.

A2.FM.A.1: Use functions to model real-world problems: Create functions and use them to solve applications of quadratic and exponential function model problems. Create functions and use them to solve applications of quadratic and exponential function model problems.

A2.NQ.A.2: Extend and use the relationship between rational exponents and radicals. Create and recognize equivalent expressions involving radical and exponential forms of expressions.

A2.NQ.A.4: Extend and use the relationship between rational exponents and radicals. Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.

A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.

# ALGEBRA 3

## UNIT 3 GRAPHING LOGARITHMS

### UNIT 3 DESCRIPTION/OVERVIEW

Students will learn characteristics of logarithmic curves, how to graph logarithmic curves using reflections and translations, and be introduced to limits of logarithmic functions

| Unit Essential Learning Targets                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <i>Enduring Understandings</i>                                                                                                                                                                                | <i>Essential Questions</i>                                                                                                                                                                                                                                                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>Graphing with transformations can generate images on a host of parent functions.</li> <li>Logarithmic functions can be applied to many real world scenarios</li> </ul> | <ul style="list-style-type: none"> <li>How does one read a graph?</li> <li>When is it appropriate to use transformations?</li> <li>What is the correlation between the graphical and algebraic representations of a logarithmic function?</li> <li>How do you graph logarithmic functions?</li> <li>How do you find the limit of a logarithmic function?</li> </ul>                                                                     |
| <i>Students must know:</i>                                                                                                                                                                                    | <i>Students must be able to:</i>                                                                                                                                                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Domain</li> <li>Range</li> <li>Intercepts</li> <li>increasing/decreasing intervals</li> <li>Asymptotes</li> <li>Transformations for logarithmic functions</li> </ul>   | <ul style="list-style-type: none"> <li>Identify the characteristics of Logarithmic functions</li> <li>Transform Logarithmic functions</li> <li>Evaluate simple limits involving Logarithmic functions</li> <li>Graph logarithmic functions, with and without transformation</li> <li>Identify the domain and range of each function</li> <li>Identify where the asymptotes are and provide them in the graph of the function</li> </ul> |

| Missouri Learning Standards                                                                                                                                                                                                                                                                                                                                           |
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| A2.SSE.A.1: Define and use logarithms. Develop the definition of logarithms based on properties of exponents.                                                                                                                                                                                                                                                         |
| A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. |
| A2.SSE.A.1: Define and use logarithms. Develop the definition of logarithms based on properties of exponents.                                                                                                                                                                                                                                                         |

# ALGEBRA 3

## UNIT 4 LOGARITHMIC EQUATIONS

### UNIT 4 DESCRIPTION/OVERVIEW

Students will learn the characteristics of logarithmic equations, how to condense and expand logarithms, how to solve various types of logarithmic equations as well as learn how to solve application problems involving logarithms.

| Unit Essential Learning Targets                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Enduring Understandings</i>                                                                                                                                                                                                                                                                                                                                                              | <i>Essential Questions</i>                                                                                                                                                                                                                                                                                                                                                                                                |
| <ul style="list-style-type: none"> <li>Logarithms and exponents have corresponding properties.</li> <li>You can use logarithms to solve exponential equations; and conversely, you can use exponents to solve logarithmic properties.</li> <li>The characteristics of exponential and logarithmic functions and their representations are useful in solving real-world problems.</li> </ul> | <ul style="list-style-type: none"> <li>How are exponents and logarithms related?</li> <li>How do logarithmic functions model real-world problems and their solutions?</li> <li>How do you solve logarithmic equations?</li> <li>How do you simplify logarithmic functions?</li> <li>How do you solve application problems involving logarithmic equations?</li> </ul>                                                     |
| <i>Students must know:</i>                                                                                                                                                                                                                                                                                                                                                                  | <i>Students must be able to:</i>                                                                                                                                                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Asymptote</li> <li>Product rule of logarithms</li> <li>Quotient rule of logarithms</li> <li>Power rule of logarithms</li> <li>Change of base rule</li> <li>Common logarithm</li> <li>Natural logarithm</li> <li>Base e</li> </ul>                                                                                                                    | <ul style="list-style-type: none"> <li>Simplify algebraic expressions involving logarithms</li> <li>Solve algebra equations involving logarithms</li> <li>Use methods for solving logarithmic equations in real world applications</li> <li>Define logarithms in terms of exponential functions.</li> <li>Convert from log form to exponential form (and reverse) to solve equations and simplify expressions.</li> </ul> |

| Missouri Learning Standards                                                                                                                          |
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| A2.SSE.A.1: Define and use logarithms. Develop the definition of logarithms based on properties of exponents.                                        |
| A2.SSE.A.2: Define and use logarithms. Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations. |
| A2.SSE.A.3: Define and use logarithms. Use properties of logarithms to solve equations or find equivalent expressions.                               |

# ALGEBRA 3

## UNIT 5 GRAPHING RATIONAL FUNCTIONS

### UNIT 5 DESCRIPTION/OVERVIEW

Students will learn characteristics of rational functions, how to graph rational functions using characteristics such as asymptotes, intercepts, and point discontinuities, and be introduced to limits of rational functions.

| Unit Essential Learning Targets                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Enduring Understandings</i>                                                                                                                                                                                                                                        | <i>Essential Questions</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>• Functions can be written in many ways - some forms can be helpful under different circumstances.</li> <li>• Function families have common characteristics.</li> <li>• We can use algebra to help graph functions.</li> </ul> | <ul style="list-style-type: none"> <li>• How do you write and graph rational functions?</li> <li>• How do the characteristics of graphs relate to their corresponding equations?</li> <li>• How can algebra help us get information about a graph from an equation?</li> <li>• How can the graph of a function be used to determine the essential characteristics of the function?</li> <li>• How do you simplify rational functions?</li> </ul>                                                                                                                                                                                                            |
| <i>Students must know:</i>                                                                                                                                                                                                                                            | <i>Students must be able to:</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>• Parent graph</li> <li>• Hyperbola</li> <li>• Restricted domain</li> <li>• Vertical asymptote</li> <li>• Horizontal asymptote</li> <li>• Hole</li> <li>• Factors</li> </ul>                                                   | <ul style="list-style-type: none"> <li>• Identify the characteristics of Rational functions</li> <li>• Transform rational functions</li> <li>• Evaluate simple limits involving Rational functions</li> <li>• Distinguish between vertical asymptotes, and holes to sketch rational functions</li> <li>• Find the domain of a rational function</li> <li>• Apply direct, inverse, and joint variation models to real life situations by writing and solving variation equations.</li> <li>• Graph general rational functions by determining x- and y-intercepts, vertical and horizontal asymptotes, end behaviors, and making a table of values</li> </ul> |

| Missouri Learning Standards                                                                                                                                                                            |
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| A2.IF.A.1: Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.                   |
| A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal |

## **ALGEBRA 3**

### **UNIT 5 GRAPHING RATIONAL FUNCTIONS**

reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.

# ALGEBRA 3

## UNIT 6 RATIONAL EQUATIONS

### UNIT 6 DESCRIPTION/OVERVIEW

Students will learn characteristics of rational functions, how to multiply, divide, add and subtract rational functions, how to simplify rational functions, and how to solve rational equations.

| Unit Essential Learning Targets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Enduring Understandings</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>Essential Questions</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>A rational function is a ratio of polynomial functions. If a rational function is in simplified form and the polynomial in the denominator is not a constant, the graph of the rational function features asymptotic behavior.</li> <li>You can use much of what you know about multiplying and dividing fractions to multiply and divide rational expressions.</li> <li>To operate with rational expressions, you can use much of what you know about operating with fractions.</li> <li>When solving an equation involving rational expressions multiplying by the common denominator can result in extraneous solutions.</li> </ul> | <ul style="list-style-type: none"> <li>What kinds of asymptotes are possible for a rational function?</li> <li>Are a rational expression and its simplified form equivalent?</li> <li>How do you add, subtract, multiply and divide rational functions?</li> <li>How do you solve rational equations?</li> </ul>                                                                                                                                                                                                                                           |
| <i>Students must know:</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <i>Students must be able to:</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <ul style="list-style-type: none"> <li>Two equations are equivalent if they have the same solution set.</li> <li>Rational expressions</li> <li>Complex numbers</li> <li>Equations with rational coefficients</li> <li>Extraneous solutions</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Simplify rational expressions</li> <li>Solve algebraic equations involving rational expressions</li> <li>Use methods for solving rational equations in real world applications</li> <li>Use strategic multiplication to solve equations that have rational expressions on both sides</li> <li>Determine whether there are extraneous solutions to a rational equation</li> <li>Multiply and divide rational expressions</li> <li>Add and subtract rational expressions with like and unlike denominators</li> </ul> |

### Missouri Learning Standards

A2.REI.A.2: Solve equations and inequalities. Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.

## **ALGEBRA 3**

### **UNIT 6 RATIONAL EQUATIONS**

A2.APR.A.1: Perform operations on polynomials and rational expressions: Extend the knowledge of factoring to include factors with complex coefficients.

A2.APR.A.3: Perform operations on polynomials and rational expressions: Find the least common multiple of two or more polynomials.

A2.APR.A.3: Perform operations on polynomials and rational expressions: Find the least common multiple of two or more polynomials.