

Algebra II Essential Curriculum

UNIT I: Graphical Analysis of Functions

Goal. The student will demonstrate the ability to use the language of functions to describe, interpret, and analyze graphs to model real-world data.

Objectives – The student will be able to:

- a. Identify characteristics of graphs of functions including domain and range, increasing and decreasing, continuity, maximum and minimum, end behavior, symmetry, and asymptotes.
- b. Use technology to investigate the relationship between the graphs of functions and their symbolic representation.
- c. Develop a mathematical model, given a real-world problem or experiment, and explore the model chosen for function properties, assumptions, appropriateness to the situation, and estimated solutions.

UNIT II: Algebraic Analysis of Functions

Goal. The student will demonstrate the ability to use algebraic properties of functions to describe, interpret, and analyze graphs to model real-world data.

Objectives – The student will be able to:

- a. Evaluate and graph a function expressed in function notation.
- b. Add, subtract, multiply, and divide two functions.
- c. Find the composition of two functions.
- d. Find the inverse of a function and determine if the inverse is also a function.
- e. Recognize and sketch piece-wise, absolute value, and step functions.
- f. Determine the appropriateness of a possible functional model for a set of data using residuals.
- g. Develop a mathematical model, given a real-world problem or experiment, use residuals to evaluate the appropriateness of the model, and make predictions based on the model when appropriate.

UNIT III: Systems of Equations and Inequalities

Goal. The student will demonstrate the ability to develop and solve systems of linear equations and inequalities to model real-world problems.

Objectives – The student will be able to:

- a. Solve systems of equations using a graphing calculator, linear combination, and elimination.
- b. Solve systems of equations using matrices on the graphing calculator.
- c. Use multiplication of matrices to solve real-world problems.
- d. Solve and graph systems of linear inequalities in two variables.

- e. Use linear programming to solve real-world problems involving minimum and maximum cost.

UNIT IV: Graphical Analysis of Quadratic Functions

Goal. The student will demonstrate the ability to describe, interpret, and analyze quadratic functions to model real-world data.

Objectives – The student will be able to:

- a. Relate quadratic functions to model appropriate real-world problems.
- b. Predict the graph of a function that is a dilation, translation, or reflection of $f(x) = x^2$.
- c. Determine the symbolic representation of a function that is a transformation of $f(x) = x^2$, given the graph.
- d. Complete the square of a quadratic function in the form $f(x) = ax^2 + bx + c$ to put it in the form $f(x) = a(x - h)^2 + k$ in order to find the axis of symmetry, the vertex, and the graph of a quadratic function.
- e. Find the maximum or the minimum value of a quadratic function.
- f. Use finite differences to determine if a function is quadratic.
- g. Determine the symbolic representation of a quadratic function given three points of the function and using systems of equations and matrices.
- h. Develop a quadratic model, given a real-world problem or experiment, use residuals to evaluate the appropriateness of the model, and make predictions based on the model when appropriate.

UNIT V: Algebraic Analysis of Quadratic Functions

Goal. The student will demonstrate the ability to determine the complex solutions of quadratic equations.

Objectives – The student will be able to:

- a. Determine the nature and number of zeros of quadratic functions by examining their discriminants and their graphs.
- b. Define a complex number and represent complex numbers in standard form. (Optional for Algebra II)
- c. Determine i^n for any non-negative integer n . (Optional for Algebra II)
- d. Perform the four basic operations on complex numbers. (Optional for Algebra II)
- e. Determine the complex zeros of a real quadratic function using graphing, factoring, and quadratic formula. (Optional for Algebra II)
- f. Develop a mathematical model, given a real-world problem or experiment, use residuals to evaluate the appropriateness of the model, and make predictions based on the model when appropriate.

UNIT VI: Exponential and Logarithmic Functions

Goal. The student will demonstrate the ability to describe, interpret, and analyze exponential and logarithmic functions to model real-world data.

Objectives – The student will be able to:

- a. Define and recognize growth and decay functions.
- b. Graph exponential functions and discuss properties of these functions including domain and range, asymptotes, increasing and decreasing.
- c. Evaluate and simplify expressions involving exponents including negative and rational exponents.
- d. Define and recognize logarithmic functions.
- e. Graph logarithmic functions of different bases and discuss properties of these functions, including domain, range, asymptotes, and inverse.
- f. State and apply laws of logarithms.
- g. Solve exponential and logarithmic equations.
- h. Evaluate and apply natural exponential and natural logarithmic functions.
- i. Relate exponential and logarithmic functions to real-world models.
- j. Develop an exponential or logarithmic model, given a real-world problem or experiment, use residuals to evaluate the appropriateness of the model, and make predictions based on the model when appropriate.

UNIT VII: Radical Functions

Goal. The student will demonstrate the ability to describe, interpret, and analyze radical functions to model real-world data.

Objectives – The student will be able to:

- a. Define and recognize radical functions.
- b. Graph radical functions and discuss their properties including domain, range, translations, and inverses.
- c. Evaluate and simplify expressions.
- d. Write equivalent expressions in exponential and radical form.
- e. Add, subtract, multiply, and divide radical expressions.
- f. Solve radical equations, checking for extraneous roots.
- g. Relate radical expressions to real-world models.

UNIT VIII: Rational Functions

Goal. The student will demonstrate the ability to describe, interpret, and analyze rational functions to model real-world data.

Objectives – The student will be able to:

- a. Define and recognize rational functions.
- b. Graph rational functions and discuss properties including domain, range, asymptotes, and holes.

- c. Simplify rational expressions.
- d. Add, subtract, multiply, and divide rational expressions.
- e. Solve rational equations, checking for extraneous roots.
- f. Solve real-world problems involving inverse, joint, and combined variation.

UNIT IX: Polynomial Functions

Goal. The student will demonstrate the ability to describe, interpret, and analyze polynomial functions using technology to model real-world data.

Objectives – The student will be able to:

- a. Define and recognize a polynomial function.
- b. Graph polynomial functions and discuss their properties including domain, range, zeros, relative extrema, and end behavior.
- c. Describe the relationship between the roots and the graph of a polynomial function.
- d. Relate polynomial functions to real-world functions.
- e. Develop a mathematical model, given a real-world problem or experiment, use residuals to evaluate the appropriateness of the model, and make predictions based on the model when appropriate.

UNIT X: Modeling Data Using Families of Functions

Goal. The student will demonstrate the ability to model data using linear, quadratic, power, exponential, logarithmic, and polynomial functions.

Objectives – The student will be able to:

- a. Given sets of data, decide which type of function models the data.
- b. Justify the choice of mathematical model using residuals.
- c. Interpret their model and discuss trends and implications.