Algebra 2: Unit 2 Instructional Focus — Polynomial and Rational Functions

Topic	Instructional Foci
Topic 1: Quadratic Expressions and Equations	This topic extends students' prior knowledge of quadratic functions form Algebra 1 to include complex zeros. Students activate their knowledge of solving quadratic equations by inspection, factoring, completing the square, the quadratic formula, numerical methods, and graphical approaches; they strategically choose a technique based on the structure of the equation. They connect the solutions of the equation to key feature of the related quadratic function. Students apply techniques of solving quadratic equations to radical equations and understand why extraneous solutions may arise. Students also identify a need to extend beyond real numbers to complex numbers in order to determine all solutions of quadratic equations. They make connections between the nature of the solutions of a quadratic equation and the graph of the related quadratic function. Students extend the properties of addition, subtraction, and multiplication of real numbers to complex numbers. Honors students also enrich their understanding of complex numbers by looking at a graphical representation of multiplication by *i*. *Note: Students are not required to divide complex numbers in Algebra 2.* ***Concepts:*** • Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. • Identify zeros of quadratic functions when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the quadratic expression. • Solve radical equations in one variable and identify extraneous solutions. • Explore complex numbers and their importance in mathematics. • Define a complex number and determine its relationship to the real number system. • Add, subtract, and multiply complex numbers using properties of operations. • Solidify understanding of addition and multiplication within the complex number system. • Solve quadratic equations that have complex solutions. • Identify and describe characteristics of quadratic functions given graphs or equations.

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Topic 2: Polynomial Expressions and Equations	In previous topics, students analyzed linear and quadratic polynomials. In this topic, students expand their knowledge of functions to include polynomials whose degree is greater than two. Students apply prior knowledge of key features of functions to polynomials; they extend their understanding to describe end behavior and classify functions as even and odd. Students make connections between zeros of polynomial functions and solutions of polynomial equations. To reveal zeros, students develop additional factoring strategies, including polynomial division. *Note: Instruction does **not** include synthetic division.* Students connect multiplication of polynomial expressions with multi-digit multiplication, and division of polynomial expressions with division of natural numbers. Students move flexibly among multiple representations of polynomial functions. This topic culminates with students modeling real-world situations with polynomial functions. Honors students also apply polynomial identities to describe numerical relationships. They investigate average rates of change. ***Concepts:*** • Explore functions at large positive and negative values of *x*. • Interpret end behavior of a variety of functions in multiple representations. • Interpret key features of polynomial functions given different representations. • Add, subtract, and multiply polynomials graphically to see structure. • Add, subtract, and multiply polynomials graphically and symbolically. • Graph polynomials in factored form. • Identify zeros of polynomial functions when suitable factorizations are available in order to graph the function and identify its key features. • Divide polynomial expressions using area models, partial quotients, and long division. • Apply the Remainder Theorem and polynomial division to find the zeros of a polynomial function. • Make connections among the equation, graph, and features of a polynomial function. • Model a real-world situation using a polynomial function.

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Topic 3: Rational Expressions and Equations	In this topic, students use rational functions to model inverse variation. They analyze the key features of the functions $f(x)=\frac{k}{x}$ and $f(x)=\frac{k}{x^2}$ and perform transformations on the associated graphs. Students extend their prior knowledge of polynomial division to rewrite other simple rational functions of the form $\frac{p(x)}{d(x)}$ as $q(x)+\frac{r(x)}{d(x)}$, drawing on their understanding of whole-number division, in order to analyze key features, including horizontal and vertical asymptotes. They solve simple rational equations by multiplying each term by a suitable expression, and they give examples showing how extraneous solutions may arise. ***Concepts:*** • Develop and graph a rational function that models inverse variation of the form $y=\frac{k}{x}$ and identify its key features. • Develop and graph a rational function that models inverse variation of the form $y=\frac{k}{x^2}$ and identify its key features. • Identify the effect on the graph of a rational function of replacing $f(x)$ by $f(x)+k$, $k\cdot f(x)$, and $f(x+k)$ for specific values of k. • Rewrite rational expressions of the form $a(x)/b(x)$ as $q(x)+r(x)/b(x)$ to reveal characteristics of the associated function. • Solve simple rational equations in one variable.