Algebra II/Honors Algebra II

Scope and Sequence

Summary of Year

Building on their work with linear, quadratic, and exponential functions, students extend their repertoire of functions to include polynomial, rational, and radical functions. Students work closely with the expressions that define the functions and continue to expand and hone their abilities to model situations and to solve equations, including solving quadratic equations over the set of complex numbers and solving exponential equations using the properties of logarithms. The Mathematical Practice Standards apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

Recommended Fluencies for Algebra II

- Divide polynomials with remainder by inspection in simple cases.
- See structure in expressions and use this structure to rewrite expressions (e.g., factoring, grouping).
- Translate between recursive definitions and closed forms for problems involving sequences and series.

Major Emphasis Clusters

The Real Number System

- Extend the properties of exponents to rational exponents

Seeing Structure in Expressions

- Interpret the structure of expressions
- Write expressions in equivalent forms to solve problems

Arithmetic with Polynomials and Rational Expressions

- Understand the relationship between zeros and factors of polynomials

Reasoning with Equations and Inequalities

- Understand solving equations as a process of reasoning and explain the reasoning
- Represent and solve equations and inequalities graphically

Interpreting Functions

- Interpret functions that arise in applications in terms of the context

Building Functions

- Build a function that models a relationship between two quantities

Making Inferences and Justifying Conclusions

Mathematical Practices

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

- Make inferences and justify conclusions from sample surveys, experiments and observational studies

Rationale for Module Sequence in Algebra II

Module 1: Polynomial, Rational, and Radical Relationships:
In this module, students draw on analogies between polynomial arithmetic and base-ten computation, focusing on properties of operations, particularly the distributive property. Students connect the structure inherent in multi-digit whole number multiplication with multiplication of polynomials and similarly connect division of polynomials with long division of integers. Students identify zeros of polynomials, including complex zeros of quadratic polynomials. Through regularity in repeated reasoning, they make connections between zeros of polynomials and solutions of polynomial equations. Students analyze the key features of a graph or table of a polynomial function and relate those features back to the two quantities in the problem that the function is modeling. A theme of this module is that the arithmetic of rational expressions is governed by the same rules as the arithmetic of rational numbers.

Module 2: Trigonometric Functions
Building on their previous work with functions, and on their work with trigonometric ratios and circles in Geometry, students extend trigonometric functions to all (or most) real numbers. To reinforce their understanding of these functions, students begin building fluency with the values of sine, cosine, and tangent at $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$, etc. Students make sense of periodic phenomena as they model with trigonometric functions.

Module 3: Functions
In this module, students synthesize and generalize what they have learned about a variety of function families. They extend their work with exponential functions to include solving exponential equations with logarithms. They explore (with appropriate tools) the effects of transformations on graphs of diverse functions, including functions arising in an application. They notice, by looking for general methods in repeated calculations, that the transformations on a graph always have the same effect regardless of the type of the underlying function. These

observations lead to students to conjecture and construct general principles about how the graph of a function changes after applying a function transformation to that function. Students identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which a model is a good fit. The description of modeling as, "*the process of choosing and using mathematics and statistics to analyze empirical situations, to understand them better, and to make decisions,*" is at the heart of this module. In particular, through repeated opportunities in working through the modeling cycle (see page 61 of the CCLS), students acquire the insight that the same mathematical or statistical structure can sometimes model seemingly different situations.

Module 4: Inferences and Conclusions from Data
In this module, students see how the visual displays and summary statistics they learned in earlier grades relate to different types of data and to probability distributions. They identify different ways of collecting data, including sample surveys, experiments, and simulations, and the role that randomness and careful design play in the conclusions that can be drawn. Students create theoretical and experimental probability models following the modeling cycle (see page 61 of CCLS). They compute and interpret probabilities from those models for compound events, attending to mutually exclusive events, independent events, and conditional probability.

Additional Sub-modules:
In order to advance directly into AP Calculus, additional topics were added to the foundational Algebra II coursework, at points in the course that maintain the greatest curricular coherence. These modules are:

- Rational Functions and Compositions of Functions
- Trigonometric Functions
- Trigonometry and Triangles
- Inverse Functions
- Inverse Trigonometric Functions