North Carolina K-12 Mathematics Overview

The organization of the NC Mathematics standards provides an opportunity for algebra skills to be used every year by continuing the integrated courses from K-8 through the first 3 math courses in high school. This integrated organization of standards provides for advanced work in mathematics without isolating students' ability to think more deeply about mathematics and how it relates to the world around them. The *Standards for Mathematical Practice* (SMP) continue to be included as the foundation for reasoning mathematically in all grades. Their inclusion in each grade and course emphasizes the importance of providing opportunities throughout ALL content standards for students to analyze, argue, model, and problem solve in meaningful ways.

Modeling with mathematics also remains an integral part of all grades, including the high school courses, in all content domains. While modeling with mathematics is the fourth SMP, we use the definition from The Consortium for Mathematics and its Applications (COMAP) and the Society for Industrial and Applied Mathematics (SIAM) to detail more specifically the process of mathematical modeling that the Standards for Mathematical Practice bring to the content standards:

> Mathematical modeling is a process that uses mathematics to represent, analyze, make predictions or otherwise provide insight into real-world phenomena.

> (Guidelines for Assessment and Instruction in Mathematical Modeling Education (GAIMME), 2015)

Mathematical modeling is the way students connect the mathematical content they are learning to the real world in which they live. The vision for mathematics education in North Carolina is to ensure North Carolina students have mathematical understanding at or above the level of their national and international peers, ensuring that they are life, college and career ready.

Elementary School Mathematics

Students in **Kindergarten** develop an understanding between numbers and quantities, and count to answer "How many?" They begin to develop an understanding of single-digit addition and subtraction based on subitizing. Students develop meanings for addition and subtraction as they encounter problem situations in Kindergarten, and they extend these meanings as they encounter increasingly difficult problem situations subsequent grades. In **grades 3-5**, students focus on understanding the meaning and properties of multiplication and division, and they extend these meanings as they encounter increasingly difficult problem situations. Developing an understanding of the properties of place value and the base ten number system is fundamental in elementary school. Students begin to develop an understanding of addition and subtraction using place value properties. As students progress they begin to use place value understanding to develop fluency with procedures and to solve problems by selecting and applying appropriate methods. Students also begin building a foundational understanding of fractions by partitioning circles and rectangles into equal shares which builds to an understanding of fractions as numbers. They develop an understanding of equivalence and begin to apply this understanding to compare quantities. Using models, student develop an understanding of the algorithms for adding, subtracting and multiplying fractions. Students learn to describe and compare measureable attributes, as well as, estimating and measuring in length units and comparing lengths. Students start to solve real-world problems using customary and metric units of measurement finding the areas, perimeter and volume of geometric shapes. In elementary school, students work with categorical and numerical data, answering simple questions regarding the data in graphs. Students pose questions, collect and analyze data, generate appropriate mathematical

representations, and interpret the data to answer questions. In geometry, students begin to identify and compose shapes. They develop an understanding of measureable attributes to describes shapes. Students understand that geometric figures can be described, analyzed, compared, and classified based on their properties, such as the presence or absence of parallel or perpendicular sides, angle measures, and symmetry. Students also begin to graph points in the first quadrant of a coordinate plane, and identify and interpret the x- and y-coordinates to solve problems. The concepts that students engage in during elementary school are fundamental to the work they will do in subsequent grades.

Middle School Mathematics

In middle school mathematics, students continue to build upon numerical concepts and skills learned in elementary grades. The development of fluency skills with numerical expressions and eventually simple algebraic expressions is a vital part of the middle grades standards. The development of formalized algebraic skills begins **in 6th grade** with the application of numerical concepts to algebraic expressions and reasoning with one-variable equations. Statistical Thinking through the study of statistics and probability will also begin in 6th grade and continue into all the High School Courses. Lastly, one vital area of emphasis in 6th grade is the introduction of ratios and the relationship between equivalent ratios. Work with ratios will continue into **7th grade** and be explored in depth to build understanding for the concepts associated with proportional reasoning, a major connection to the study of functions. **8th grade** serves as the final year of pre-algebraic exploration. Students study the characteristics of linear and non-linear functions as they begin to see how patterns of data, in some cases, can be modeled with a linear relationship. The integration of concepts from statistics & probability and geometry continue into the high school courses.

High School Mathematics

The goal of NC High School Mathematics is for students to develop a thorough understanding of the characteristics and behaviors of specific families of functions. There is a great deal of emphasis on the application and understanding of functions in the high school mathematics standards.

NC Math 1 includes the study of linear, exponential and quadratic functions; extending from the work in middle school where proportional reasoning skills were emphasized along with an introduction of the concept of a function. NC Math 1 students apply and extend their understandings of functions from grade 8 to the formal definition of a function and the use of function notation when expressing functions symbolically. The Algebra, Geometry and Statistics & Probability standards also support the study of functions in NC Math 1.

In **NC Math 2**, quadratic, square root and inverse variation function families are added to the study of functions along with the more complex algebra skills to support working with more advanced algebraic expressions. NC Math 2 is also where students begin to apply transformational geometry learned in the middle grades to the study of functions. Geometric reasoning and proof are also emphasized in NC Math 2 as students focus on the study of triangles and their relationship to other planar figures.

Lastly, **NC Math 3** capstones the required standard mathematics progression with the study of more complex function families and geometric modeling as an application of concepts learned in previous years from number sense, algebra, functions and geometry.