Module 1 Overview
Searching for Patterns

"Critical to algebraic thinking is the capacity to recognize patterns and organize data to represent situations in which input is related to output by well-defined functional rules." (*Fostering Algebraic Thinking: A Guide for Teacher Grades 6-10,* pg. 2)

Why is the Module named Searching for Patterns?

Students have been searching for patterns in math class since kindergarten. They have recognized patterns in lists, learned to extend a pattern beyond a given list, and applied a rule to determine an arbitrary value well beyond the given list. This module extends students' understanding of functions to explore specific function families, including linear, exponential, quadratic, and absolute value.

Throughout the module, students are searching for, recognizing, and defining patterns in relationships between quantities. In the first topic, students explore a variety of functions, presented as graphs and equations, and investigate their differentiating characteristics. Once they recognize patterns in the graphs and equations, they sort the functions into their corresponding function families. In the second topic, students search for patterns in sequences of numbers. They recognize that while all sequences are functions, arithmetic sequences are linear functions and some geometric sequences are exponential functions. Finally, students search for patterns in data. They recognize that linear functions can be used to model certain data sets, and they explore how well a linear function fits the pattern of a data set.

What is the mathematics of Searching for Patterns?

Searching for Patterns contains three topics: *Quantities and Relationships, Sequences,* and *Linear Regressions*.

In *Quantities* and *Relationships*, students begin to recognize and identify the key characteristics of different function families. Students search for patterns in equations and graphs, analyzing their structure and shape. They use these patterns to classify functions into one of four function types: linear, linear absolute value, exponential, and quadratic.

Sequences builds on students' vast experience with recognizing and extending patterns. They learn to write recursive and explicit formulas for arithmetic and geometric sequences. Students consider patterns in real-world scenarios, write the patterns as sequences and as tables of values, and then connect the scenarios to equations and graphs. They learn that all sequences are functions and how to classify graphs of sequences by their shape.

In *Sequences*, students are introduced to the modeling process: Notice and Wonder, Organize and Mathematize, Predict and Analyze, and Test and Interpret. Through these four steps, students learn a framework for approaching and solving problems that they encounter in the real world. Students practice this process in this topic and will use it throughout the remainder of the course.

Linear Regressions requires students to analyze patterns of data and consider whether a linear model is a good fit for the data. They formalize their understanding of lines of best fit and use technology to determine a regression line. They use the patterns they recognize in graphs, along with the correlation coefficient, to decide whether a given linear model is a reasonable fit for a data set.

How is Searching for Patterns connected to prior learning?

Students have been reasoning with quantities in middle school and are familiar with independent and dependent quantities. In this module, students consider how these quantities can be used to describe more complicated situations. In their study of linear relationships, students identified the slope and *y*-intercept in an equation or graphical representation.

Students now learn a more extensive list of key characteristics, including the domain and range, intervals of increasing or decreasing, maximums and minimums, and intercepts. These characteristics are important for analyzing and classifying more complicated functions throughout this course.

Students are also familiar with recognizing and extending numeric patterns. In this module, students categorize patterns based on specific characteristics and write algebraic rules to define them. Also in this module, students use technology to write a linear regression and they learn to assess the fit of a line using the correlation coefficient.

When will students use the knowledge from Searching for Patterns in future learning?

The concept of a function is the underpinning for the study of algebra in high school mathematics. Students will explore three of the function families introduced in **Searching for Patterns**—linear, exponential, and quadratic—in more detail throughout the remainder of the course. It is not expected that students have complete understanding of the functions presented in this module at its completion. The remaining modules in this course are focused

on building a deep conceptual understanding of each function type and making connections between all of the function families. Students will extend their library of functions when examining polynomial, trigonometric, and logarithmic functions in later courses.

Recognizing that function families have equations of the same form and graphs with the same key characteristics helps students to identify and use appropriate functions to model scenarios. In later modules, students will formalize their understanding of a graph's key characteristics and learn to interpret them in terms of the function it models. These characteristics are also critical as students develop strategies to solve equations for given values.

In the next module, **Exploring Constant Change**, students will use their understanding of arithmetic sequences to launch their study of linear functions. Likewise, in **Investigating Growth and Decay**, they will build from their knowledge of geometric sequences to explore exponential functions.

Finally, patterns are important in the study of statistics and the development of geometric relationships. As they build a larger library of functions, students will be able to recognize patterns in more complicated data and use regressions to model nonlinear data.