

# Module 1: Searching for Patterns

## TOPIC 1: QUANTITIES AND RELATIONSHIPS

In this topic, students explore a variety of different functions. The intent is merely to introduce these new functions, providing an overview but not a deep understanding at this point. The topic is designed to help students recognize that different function families have different key characteristics.

In later study in this course, they will formalize their understanding of the defining characteristics of each type of function.

### Where have we been?

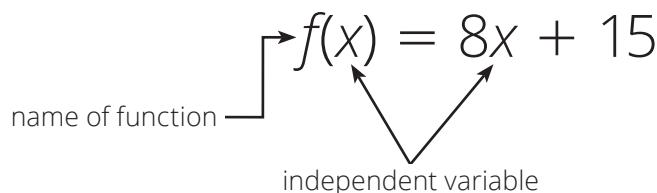
In previous grades, students defined a function and used linear functions to model the relationship between two quantities. They have written linear functions in slope-intercept form and should be able to identify the slope and  $y$ -intercept in the equation. Students have also characterized graphs as functions using the terms *increasing*, *decreasing*, *constant*, *discrete*, *continuous*, *linear*, and *nonlinear*.

### Where are we going?

The study of functions is a main focus of high school mathematics. This topic builds the foundation for future, more in-depth study by familiarizing students with the concept of a function. Students will continue to use formal function notation throughout this course and in higher-level math courses.

## Function Notation

The linear equation  $y = 8x + 15$  can be written to represent a relationship between the variables  $x$  and  $y$ . You can write this linear equation as a function with the name  $f$  to represent it as a mathematical object that has a specific set of inputs (the domain of the function) and a specific set of outputs (the range of the function).



The input of the function,  $x$ , is represented by a single variable, but this variable often represents a whole collection of values.

# Functions Are Everywhere. Google It.

Every time you open a web page, you are calling hundreds, if not thousands, of functions. At the time of this writing, there were 88 functions mentioned in the background on the homepage of a popular search engine, which contains just a name and a search box.



Functions that programmers write are very similar to the functions students study in mathematics. They take inputs and produce outputs. And they are often written in the same way too—with a function name and an input variable in parentheses, like  $f(x)$ . Search functions take in search terms as inputs and output hundreds of thousands or millions of results. Mathematical functions can only output one result for each input.

## Talking Points

Functions is an important topic to know about for college admissions tests.

Here is a sample question:

**For the function  $f(x) = 2x^2 - 3x$ , what is the value of  $f(-5)$ ?**

To solve this, students need to know that the input  $-5$  is substituted for  $x$  in the equation:

$$\begin{aligned}f(-5) &= 2(-5)^2 - 3(-5) \\&= 2(25) + 15 \\&= 50 + 15 \\&= 65\end{aligned}$$

The point  $(-5, 65)$  is on the graph of the function.

## Key Terms

### increasing function

If a function increases across the entire domain, then the function is called an increasing function.

### decreasing function

If a function decreases across the entire domain, then the function is called a decreasing function.

### function family

A function family is a group of functions that all share some characteristics.

### **x-intercept**

The  $x$ -intercept is the point where a graph crosses the  $x$ -axis.

### **y-intercept**

The  $y$ -intercept is the point where a graph crosses the  $y$ -axis.