UNIT DESCRIPTION

The overarching objective of the *Variables and Patterns* unit is to develop students' ability to recognize, describe, and analyze two kinds of relationships between variables: (1) change in the value of a single variable over time and (2) change in the value of a dependent variable as it responds to change in the value of a related independent variable. Students should learn how to reason about those relationships using numeric, graphic, symbolic, and verbal representations.

Student progress toward these learning goals is supported by work on the problems that are arranged in three investigations.

This unit introduces finding solutions for equations and inequalities. Students will continue to solve equations and inequalities both informally and symbolically throughout several grade 6 units. It would be possible to introduce the mathematical vocabulary of *terms*, *factors*, *sum*, and *products* in this unit. However, to allow students to focus on how to represent variables and patterns, those words are introduced in the next unit, *Number Connections: Expressing Factors and Multiples Algebraically*.

As with all of the *Connected Mathematics®* 4 units, one Mathematical Reflection guides the development of the understanding of the mathematical ideas in the unit.

Mathematical Reflection

In this unit, we are studying variables and the relationship between two variables. We will use words, tables, graphs, and equations to represent these relationships and to find information about the situation. At the end of this investigation, ask yourself:

What are the advantages and disadvantages of using different representations to show the relationship between two variables?

SUMMARY OF INVESTIGATIONS

Investigation 1 develops ideas of variables and relationships and the ways that students can express and study them in data tables and coordinate graphs. The primary focus is on patterns of change over time, with special attention to distance, rate, and time relationships.

Investigation 2 develops the concepts of independent and dependent variables, again studying such relationships using tables, graphs, and "stories."

Investigation 3 develops student understanding and skill in use of letter names for variables and equations using symbolic forms to represent relationships of variables. Students use tables, graphs, and numeric reasoning to find a value of one variable given the value of the other variable.

Investigation 1: Organizing a Bike Tour: Variables, Tables, and Graphs

The goal of this investigation is to develop students' ability to look for quantities that change over time, especially distance and speed of moving objects, and their ability to construct and interpret notes, data tables, and coordinate graphs representing patterns in that change. These mathematical goals are pursued through work on four problems in the context of planning and pilot-testing a three-day cross-country bicycle trip from Atlantic City, NJ, to Norfolk, VA. In Problems 1.1 and 1.2, students will collect data by doing jumping jacks to simulate endurance patterns of bicycling. Problem 1.3 has students encounter the first two days of the bike trip and focus on patterns of change. In Problem 1.4, students will look at the patterns of change on the final day of the bike trip through written notes, tables, and graphs.

Investigation 2: Determining Tour Needs: Analyzing Relationships Among Variables

The goal of this investigation is to extend students' understanding and skill in working with relationships between quantitative variables as they are expressed in written stories, tables, and graphs. In particular, the problems of this investigation focus on cause-and-effect relationships where changes in one variable can reasonably be thought to cause changes in another. In these cases, it is natural to call the first quantity the independent variable and the responding quantity the dependent variable (though this designation is sometimes arbitrary). In Problem 2.1, students will look at renting bikes for the bike tour. Data will be presented in a table for one store and a graph for another store, and students will analyze the relationship between the variables to find the better price. In Problem 2.2, students will decide how much to charge for the bike tour by analyzing survey data. Problem 2.3 has students matching stories to graphs to focus on the relationships of the variables.

Investigation 3: Returning Home: Relating Variables, Expressions, and Equations

This investigation continues development of student understanding and skill in analyzing relationships between quantitative variables by use of algebraic expressions and equations to represent those relationships. Problem 3.1 uses the context of number of customers and income or traveling home after the bike tour to focus on algebraic equations involving only one arithmetic operation in the form $y = mx$. Problem 3.2 focuses on special properties of quantitative relationships with rules in the form of $y = x + a$ through the context of planning

for a second bike tour around the Great Lakes. In Problem 3.3, students analyze many aspects of planning components of the bike tour around the Great Lakes to connect equations with tables and graphs. The relationships represented by the equations are also represented with tables and graphs. Students use numeric reasoning, tables, graphs, and equations to find the value of a variable in a given relationship.