Key Concepts

Lesson 4

Using Formulas

Objective Teach students to interpret formulas and to write formulas that describe relationships between quantities.

Formulas

Use an example to introduce the idea of a formula.

Note to the Teacher *This example is a particularly important one, that comes up again and again in future years, so it is worthwhile to spend some time on it. It also gives a good idea about the mechanics of creating formulas and using them to solve problems.*

Suppose we are driving a car. We want to describe the relationship between the distance traveled, the speed at which we have been traveling, and the time we have been traveling. In order to think about this, we assign letters to each of the quantities.

d = distance traveled, in miles

t = time spent traveling, in hours

r = speed (or rate) we have been traveling, in miles per hour

Recall that each of the letters is called a variable. It represents a number whose value we don't know or have not specified. We wish to write an expression that describes the relationship between these quantities.

Key Idea	We don't yet wish to use specific numbers for the variables, because we want the relationship to be reusable so that we can take many different values of the quantities and work out answers for each, without going through the "setting up" process for the formula over and over again.

Now, how do we determine a relationship between d, r, and t? The speed is measured in number of miles traveled in one hour. If we have been traveling for 4 hours and have traveled 200 miles, then in

each hour we have traveled 200 divided by 4 or 50 miles. So, we obtain the speed by dividing the distance traveled by the time it takes to travel that distance. Now let's write this in terms of the variables we have chosen.

$$\frac{d}{t} = r$$

This relationship represents $\frac{\text{distance}}{\text{time}} = \text{rate}$.

In words, we read this formula as "distance divided by time equals rate." We can also find other relationships among these variables. For instance, suppose we know the speed and the time traveled and we want to know the total distance traveled. The total distance is given by

(number of hours traveled) $\times$ (number of miles traveled in one hour).

In terms of the variables we wrote down, this is the same as

$$d = t \times r.$$

We read this as "distance traveled equals time traveled times the speed."

Now, suppose we have specific numbers. For instance, we have traveled 440 miles in 11 hours. How do we use the formulas to determine the speed? First write down the formula. In this case, let's use the first one.

$$\frac{d}{t} = r$$

Next, substitute the actual numbers into the formula and simplify.

$$\frac{440}{11} = r \quad \textit{Replace d with 440 and t with 11.}$$

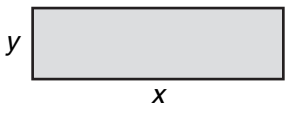
$$40 = r \quad \textit{Divide 440 by 11.}$$

So, we've been traveling at 40 miles per hour.

Present the following examples to students.

Note to the Teacher *It is important that students get used to the idea of assigning their own variables in problems. Do not always give them the variables, but leave the problem in verbal form and allow them to choose their own.*

Example 1 **Find a formula that describes the relationship between x, y, and the area of the rectangle shown.**



Solution Let A represent the area of the rectangle. Then we have $A = xy$ since the area of a rectangle is equal to its length times its width.

Example 2 **Suppose you are selling boxes of greeting cards. Find a formula that describes the relationship between the number of boxes sold, the total amount of money received, and the cost of each box.**

Solution Let n represent the number of boxes sold, m the amount of money received, and c the cost per box. Valid answers include

$$m = n \times c \quad \text{and} \quad \frac{m}{n} = c.$$