

## Lesson 7: Unit Rate as the Constant of Proportionality

### Classwork

#### Example 1: National Forest Deer Population in Danger?

Wildlife conservationists are concerned that the deer population might not be constant across the National Forest. The scientists found that there were 144 deer in a 16-square-mile area of the forest. In another part of the forest, conservationists counted 117 deer in a 13-square-mile area. Yet a third conservationist counted 216 deer in a 24-square-mile plot of the forest. Do conservationists need to be worried?

- Why does it matter if the deer population is not constant in a certain area of the National Forest?
- What is the population density of deer per square mile?

The unit rate of deer per 1 square mile is \_\_\_\_\_.

Constant of Proportionality:

Explain the meaning of the constant of proportionality in this problem:

- Use the unit rate of deer per square mile (or  $\frac{y}{x}$ ) to determine how many deer there are for every 207 square miles.
- Use the unit rate to determine the number of square miles in which you would find 486 deer.

**Vocabulary**

A *variable* is a symbol (such as a letter) that is a placeholder for a number.

If a proportional relationship is described by the set of ordered pairs  $(x, y)$  that satisfies the equation  $y = kx$  for some number  $k$ , then  $k$  is called the *constant of proportionality*. It is the number that describes the multiplicative relationship between measures,  $x$  and  $y$ , of two types of quantities. The  $(x, y)$  pairs represent all the pairs of numbers that make the equation true.

Note: In a given situation, it would be reasonable to assign any variable as a placeholder for the given measures. For example, a set of ordered pairs  $(t, d)$  would be all the points that satisfy the equation  $d = rt$ , where  $r$  is the constant of proportionality. This value for  $r$  specifies a number for the given situation.

**Example 2: You Need WHAT?**

Brandon came home from school and informed his mother that he had volunteered to make cookies for his entire grade level. He needs 3 cookies for each of the 96 students in seventh grade. Unfortunately, he needs the cookies the very next day! Brandon and his mother determined that they can fit 36 cookies on two cookie sheets.

- a. Is the number of cookies proportional to the number of cookie sheets used in baking? Create a table that shows data for the number of sheets needed for the total number of cookies baked.

Table:

The unit rate of  $\frac{y}{x}$  is \_\_\_\_\_.

Constant of Proportionality:

Explain the meaning of the constant of proportionality in this problem:

- b. It takes 2 hours to bake 8 sheets of cookies. If Brandon and his mother begin baking at 4:00 p.m., when will they finish baking the cookies?

### Example 3: French Class Cooking

Suzette and Margo want to prepare crêpes for all of the students in their French class. A recipe makes 20 crêpes with a certain amount of flour, milk, and 2 eggs. The girls already know that they have plenty of flour and milk to make 50 crêpes, but they need to determine the number of eggs they will need for the recipe because they are not sure they have enough.

- Considering the amount of eggs necessary to make the crêpes, what is the constant of proportionality?
- What does the constant or proportionality mean in the context of this problem?
- How many eggs are needed to make 50 crêpes?

**Lesson Summary**

If a proportional relationship is described by the set of ordered pairs  $(x, y)$  that satisfies the equation  $y = kx$  for some number  $k$ , then  $k$  is called the *constant of proportionality*.

**Problem Set**

For each of the following problems, define the constant of proportionality to answer the follow-up question.

1. Bananas are \$0.59/pound.
  - a. What is the constant of proportionality, or  $k$ ?
  - b. How much will 25 pounds of bananas cost?
2. The dry cleaning fee for 3 pairs of pants is \$18.
  - a. What is the constant of proportionality?
  - b. How much will the dry cleaner charge for 11 pairs of pants?
3. For every \$5 that Micah saves, his parents give him \$10.
  - a. What is the constant of proportionality?
  - b. If Micah saves \$150, how much money will his parents give him?
4. Each school year, the seventh graders who study Life Science participate in a special field trip to the city zoo. In 2010, the school paid \$1,260 for 84 students to enter the zoo. In 2011, the school paid \$1,050 for 70 students to enter the zoo. In 2012, the school paid \$1,395 for 93 students to enter the zoo.
  - a. Is the price the school pays each year in entrance fees proportional to the number of students entering the zoo?
  - b. Explain why or why not.
  - c. Identify the constant of proportionality, and explain what it means in the context of this situation.
  - d. What would the school pay if 120 students entered the zoo?
  - e. How many students would enter the zoo if the school paid \$1,425?