Types of Subtraction Situations

In this unit, students encounter three categories of subtraction situations. All of these are situations that are commonly encountered in the world and that subtraction can be used to solve. Students should be able to visualize each type of problem situation and apply subtraction (or, in some cases, addition) to solve them.

The way students visualize each type of situation may lead to particular strategies for solving the problem that seem to the student to best match the action or characteristics of the situation. In Grades 3 and 4, students will also be developing recognition that they can apply any subtraction strategy to any of these situations.

Here are the three types of situations students encounter in the story problems in this unit:

1. Removal

This type of subtraction situation is the one students first become familiar with in the early grades. They often refer to this kind of situation as "take away" because some quantity is removed or "taken away" from a larger amount. For example, some of the sticker problems in the first Grade 3 addition and subtraction unit, *Trading Stickers, Combining Coins,* involve removal:

Gil had 85 stickers. He gave 47 stickers to his cousin. How many stickers does he have now?

This type of subtraction situation is characterized by an action in which part of a quantity is removed in any number of ways—spent, eaten, lost, given away, used up, and so forth. Matching this action, students often think about solving a removal problem by subtracting in parts:

$$85 - 40 = 45$$

$$45 - 5 = 40$$

$$40 - 2 = 38$$

Problems in this category differ in terms of which quantities are given and which quantity must be determined. For example, the problem above might be altered to solve for either the starting amount or the amount removed:

Gil had some stickers. He gave 47 stickers to his cousin. Then he had 38 stickers left. How many stickers did Gil have to start?

Gil had 85 stickers. He gave some to his cousin. Then he had 38 left. How many stickers did he give to his cousin?

Students typically find these problems more difficult to visualize and solve than the simple removal problem. In the first case, they have to work backwards from the amounts used and remaining to determine the initial quantity (this is actually solved by addition). In the second case, students have to figure out that they have to remove the remaining amount from the initial quantity in order to determine the amount used.

2. Comparison

Problems in this category involve questions such as "how much more?" and "how much less?" The Comparing Collections: How Many More? problems in Investigation 4 involve comparison. Here is an example (*Student Activity Book* page 67, Problem 3).

Ms. Santos' class collected 86 bottle caps in the first two days of their Class Collection. Mr. Singh's class collected 123 bottle caps. How many more bottle caps did Mr. Singh's class collect than Ms. Santos' class?

In this type of problem, two different quantities are compared, unlike the previous category in which one quantity is initially part of the other. Students often visualize comparison as one quantity lined up next to the other—as you might visualize comparing the heights of two people.

Matching the image of the problem, they may think about adding up to find out how much more one quantity is than the other, or subtracting back to find out how much less one quantity is than the other.

There are two types of problems in this category, problems like the one above in which two quantities are given, or problems in which one quantity and the difference from the other quantity are given, for example:

Ms. Singh's class collected 123 bottle caps in the first two days of their class collection. Ms. Santos' class collected 37 fewer bottle caps than Mr. Singh's class. How many bottle caps did Ms. Santos' class collect?

3. Missing part

In this situation, a quantity is divided into two parts. The Travel Story problems in Investigation 3 are missing part problems. Here is an example (*Student Activity Book* page 59, Problem 1).

Philip and Keith are on a 3-day biking trip. Their final destination is 138 miles away. On the first day, they rode 51 miles. How much farther do they have to bike?

In this case, the whole quantity is the number of miles from the start to the final destination. This situation is not one of removal: there is no *action* of giving away or using up. Rather, we are considering *two* parts of the total mileage, the part already traveled and the part remaining to be traveled.

As in comparison problems, students often think of starting with one of the parts and adding up to the whole quantity. They might notate such problems as missing addend problems and solve them by adding up:

$$51 + \_\_\_\_ = 138$$

There is only one type of problem in this category: the whole and one part are given, and the other part must be determined. (If both parts are given, and the problem is to determine the whole, the problem is categorized as addition, not subtraction.)

Solving problems in any category

We have named these categories in order to be able to describe them, but it is not necessary for students to name these categories or say to which category a problem belongs. What is important is that they can visualize the relationship between the quantities in all three types of situation, regardless of which quantities are given and which must be determined, and can then apply the operation of subtraction (or addition) appropriately. Some of these problem types may be easier for students than others. They have been familiar with removal situations for many years; they may have a harder time visualizing comparison and missing part problems.

There are many similarities, as well as differences, between these three types of situation. While the actions in the situations differ, they all involve the difference between two quantities. When unfamiliar with a problem type, students are more likely to select a method that closely matches the action of the problem. As students become more familiar and flexible with all of these situations, they can apply any solution strategy to a problem of any type. For example, students might solve the removal problem above by adding up or the missing part problem by subtracting in parts. (See the **Teacher Note:** Subtraction Strategies, page 210.)