

we are repeatedly picking objects from the same category, we need to be more careful.

Let's consider an example. At the beginning of math class every day, Mr. Smith selects students to write up homework problems on the board. These problems are then discussed as a class. There are 26 students in Mr. Smith's math class, and he randomly selects a student to write up each of the first five problems. How many different ways can students be assigned to the problems?

This problem is more complicated than the sandwich or candy problems because we are selecting objects from the same group each time. Mr. Smith is not selecting students from five different classes or from different groups within his class. In this way, the problem is more like the license plate problem. In that problem, we were selecting repeatedly from two different groups. Here we are repeatedly selecting objects from only one group, the class of 26 students.

The first thing we have to determine is if any student can be selected more than once. In our imaginary list of all possible arrangements, is *Fred, Fred, Fred, Fred, Fred* an allowable selection? Or if Fred is selected to write up the first problem, is he "safe" from writing up problems #2 – 5?

This is an important distinction and can drastically impact the answer to the question. Fortunately, this does not significantly alter the way we think about the problem, just the answer we get. Hopefully whether or not objects can be repeated is clear from the context and description of the problem. Sometimes, the phrases "with replacement" or "without replacement" are used to clarify whether or not an object from a category can be selected more than once. This example will be presented for you to solve in the review problems at the end of this section. Let's now work through a few examples here.

EXAMPLE 1.2a: How many different ways can three cards be drawn with replacement from a standard 52-card deck?

SOLUTION: Since the cards are drawn with replacement, each card is put back into the deck before the next card is drawn. So, the same card could be drawn all three times, and there are 52 choices for the first card, 52 choices for the second card, and 52 choices for the third card. Therefore, there are $52 \times 52 \times 52 = 140,608$ different ways three cards can be drawn with replacement.

EXAMPLE 1.2b: How many different ways can three cards be drawn without replacement from a standard 52-card deck, assuming the order of drawing cards matters?

SOLUTION: Since the cards are drawn without replacement, each card is kept when the next card is drawn. This means there are 52 choices for the first card, but only 51 choices for the second card, and 50 choices for the third card. Therefore, there are $52 \times 51 \times 50 = 132,600$ different ways three different cards can be drawn without replacement.

There are two important things to consider from this pair of problems. The first is the difference in the answers. Although there are more ways to draw three cards with replacement than without, this difference is perhaps not as large as expected. Because there are so many cards to choose from, and we are selecting so few of them, most