## 12.4 <br> Solve Problems Using Organized Lists

## GOAL

Use an organized list to solve a problem.

## Learn about the Math

Carina wants to buy a drink and a snack on the way to her next class. She knows that she has five coins in her locker, but she cannot remember whether they are quarters, dimes, or loonies. Depending on what the coins are, she may not be able to buy both the drink and the snack.


## 1 Understand the Problem

- Carina has five coins.
- She has loonies, dimes, and/or quarters.
- There may be more than one of some types of coins.
- There may be none of some types of coins.
- If the total value of the coins is at least $\$ 2.00$, but less than $\$ 4.00$, Carina will be able to buy only one item.


## 2 Make a Plan

Carina decides to write all the possible combinations of coins in an organized list. This will help her see what combinations have a value of at least $\$ 2.00$ but less than $\$ 4.00$.

## 3 Carry Out the Plan

| Loonies | Quarters | Dimes | Total value | Summary of possible outcomes |
| :---: | :---: | :---: | :---: | :---: |
| 5 | 0 | 0 | \$5.00 | with five loonies, one combination |
| 4 | 1 | 0 | \$4.25 | with four loonies, two combinations |
| 4 | 0 | 1 | \$4.10 |  |
| 3 | 2 | 0 | \$3.50 $\checkmark$ | with three loonies, three combinations |
| 3 | 1 | 1 | \$3.35 V |  |
| 3 | 0 | 2 | \$3.20 J |  |
| 2 | 3 | 0 | \$2.75 V | with two loonies, four combinations |
| 2 | 2 | 1 | \$2.60 $V$ |  |
| 2 | 1 | 2 | \$2.45 V |  |
| 2 | 0 | 3 | \$2.30 $\checkmark$ |  |
| 1 | 4 | 0 | \$2.00 ل | with one loonie, five combinations |
| 1 | 3 | 1 | \$1.85 |  |
| 1 | 2 | 2 | \$1.70 |  |
| 1 | 1 | 3 | \$1.55 |  |
| 1 | 0 | 4 | \$1.40 |  |
| 0 | 5 | 0 | \$1.25 | with no loonies, six combinations |
| 0 | 4 | 1 | \$1.10 |  |
| 0 | 3 | 2 | \$0.95 |  |
| 0 | 2 | 3 | \$0.80 |  |
| 0 | 1 | 4 | \$0.65 |  |
| 0 | 0 | 5 | \$0.50 |  |

Carina checks off the combinations with a total value of at least $\$ 2.00$ but less than $\$ 4.00$. The probability of being able to buy only one item is $\frac{8}{21}$.

## 4 Look Back

Carina sees a pattern in her table, so she feels confident that she did not miss or repeat any combinations.

## Reflecting <br> ,

1. How did using an organized list help Carina solve her problem?
2. What other methods could Carina have used to solve her problem?


## Work with the Math

## Example: Making an organized list to solve a problem

Kayley threw three darts at the target and hit three different colours. In how many ways can her score be greater than 30 ?


## Rishi's Solution

1 Understand the Problem
This is the information I know:

- Kayley threw three darts.
- All three darts hit the target.
- Each dart earned a different score.
- Four different scores are possible: 20, 10, 5, and 1.
(2) Make a Plan

I'll make an organized list of all the possible outcomes. I'll start with a score of 20 and then list 10 , then 5 , and finally 1 . I'll look for scores greater than 30.
(3) Carry Out the Plan

| Dart 1 | 20 | 20 | 20 | 20 | 20 | 20 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Dart 2 | 10 | 10 | 5 | 5 | 1 | 1 | 20 | 20 | 5 | 5 | 1 | 1 | 20 | 20 | 10 | 10 | 1 | 1 | 20 | 20 | 10 | 10 | 5 | 5 |
| Dart 3 | 5 | 1 | 10 | 1 | 10 | 5 | 5 | 1 | 20 | 1 | 20 | 5 | 10 | 1 | 20 | 1 | 20 | 10 | 10 | 5 | 20 | 5 | 20 | 10 |
| Score | $(35)$ | 31 | 35 | 26 | 31 | 26 | $(35$ | 31 | 35 | 16 | 31 | 16 | 35 | 26 | 35 | 16 | 26 | 16 | 31 | 26 | 31 | 16 | 26 | 16 |

There are 12 ways for Kayley's score to be greater than 30 .

## (4) Look Back

I'm sure that I considered all the possible combinations because of the patterns I see in my list. For the first dart, each score appears six times. For the second dart, the other three scores appear in pairs. For the third dart, the two remaining scores are the possible scores.

## A Checking

3. John has four jobs to do every day. For variety, he chooses slips of paper from a jar each morning to decide in which order he will do the jobs. What is the probability that John will unload the dishwasher after taking out the garbage?


## B Practising

4. Alex bought a guitar pick for $25 \phi$. He paid the exact amount, so he received no change.
a) List the combinations of coins that Alex could have used to pay for the guitar pick.
b) What is the least number of coins that Alex could have used?
c) What is the greatest number of coins that Alex could have used?
d) Could he have paid for the guitar pick using seven coins?
5. Robert and Frank were shooting baskets. They scored 3 points for a long shot, 2 points for a regular basket, and 1 point for a free throw.
a) List the ways that Robert could have scored 12 points.
b) Are there more ways to score 12 points with a free throw or without a free throw? How many more or less?

6. Rachel is trying to remember the combination for her lock. This is what she remembers:

- There are three numbers in the combination.
- The numbers may be $1,2,3$, or 4 .
- No number is used twice.
- The sum of the numbers may be even.
a) Use an organized list to determine all the possible combinations with an even or odd sum.
b) How many of the combinations have an even sum?
c) What is the theoretical probability of the combination having an even sum?

7. To play "POETS in a Bag," players take turns selecting four of the five cards in a bag without looking, shuffling the cards, and laying them out. Players score a point if the letters on the cards spell a word.


What is the probability that Kumar will score a point?
b) Calculate the probability of scoring a point for a different set of four letters.
c) In one round of the game, each player chose a different set of four cards to shuffle and play. What is the greatest number of people who could have been playing?
d) Describe a strategy to determine the four cards that give the greatest probability of scoring a point.
8. Create a problem that can be solved using an organized list. Provide a complete solution to your problem.

