

**YOU WILL NEED**

- slips of paper
- 2 containers

**fair game**

A game in which all the players are equally likely to win; for example, tossing a coin to get heads or tails is a fair game.

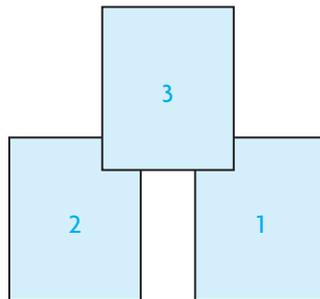
**GOAL**

Use probability to make predictions.

**EXPLORE the Math**

Sasha and Mika have to invent a **fair game** for a class project. Sasha suggests this game:

- Two people play. Each player has a container.
- Both players put three identical slips of paper, numbered 1, 2, and 3, into their own container.



- For each turn, both players draw one slip of paper from their container.
  - Player 1 scores a point if the product of the two numbers drawn is less than their sum.
  - Player 2 scores a point if the product of the two numbers drawn is greater than their sum.
  - Neither player gets a point if the product and sum are equal.
- After each turn, the players return their slip of paper to their container.
- A game consists of 10 turns.

**?** Is Sasha's game a fair game?

**Reflecting**

- Is playing Sasha's game once a good way to decide if it is fair? Explain.
- Mika says that you can use theoretical probability to determine if the game is fair. Do you agree? Explain.
- When you play Sasha's game, would you rather be player 1 or player 2? Explain.

## In Summary

### Key Ideas

- Knowing the probability of an event is useful when making decisions.
- The **experimental probability** of event  $A$  is represented as

$$P(A) = \frac{n(A)}{n(T)}$$

where  $n(A)$  is the number of times event  $A$  occurred and  $n(T)$  is the total number of trials,  $T$ , in the experiment.

- The **theoretical probability** of event  $A$  is represented as

$$P(A) = \frac{n(A)}{n(S)}$$

where  $n(A)$  is the number of favourable outcomes for event  $A$  and  $n(S)$  is the total number of outcomes in the sample space,  $S$ , where all outcomes are equally likely.

- A game is fair when all the players are equally likely to win.

### Need to Know

- An event is a collection of outcomes that satisfy a specific condition. For example, when throwing a standard die, the event “throw an odd number” is a collection of the outcomes 1, 3, and 5.
- The probability of an event can range from 0 (impossible) to 1 (certain). You can express probability as a fraction, a decimal, or a percent.
- You can use theoretical probability to determine the likelihood that an event will happen.

## FURTHER Your Understanding

1. How can you change Sasha’s game so that it is fair? Explain.
2. Consider each game below. Is it fair? If it is not fair, which player has the advantage? Explain.
  - a) Matt and Pat each toss a coin. If the coins land as both heads or both tails, Matt wins. If the coins land as a head and a tail, Pat wins.
  - b) Treena, Lena, and Gina each toss a coin. If all three coins land as heads, Treena wins. If all three coins land as tails, Lena wins. Otherwise, Gina wins.
  - c) Ann and Dan each roll a standard die. If the sum of the two dice is greater than 7, Ann wins. If the sum is less than 7, Dan wins. If the sum is 7, they tie.
3. Everard says he has a 120% chance of making the school football team. Is this possible? Explain.
4. Mika suggests playing Sasha’s game with four slips of paper, numbered 1 to 4. Is Sasha’s game now fair? If not, who has the advantage? Explain.