Jenny and Morningstar put coloured cubes into a bag.
They used 4 blue, 2 red, 2 green, and 2 yellow cubes.
A cube is picked from the bag at random.
The theoretical probability that a blue cube
is picked is $\frac{4}{10}$, or $\frac{2}{5}$.

➤ Jenny and Morningstar planned an experiment
   for the class.
   Each student would pick a cube from the bag
   without looking, then replace it.
   She would do this 10 times.
   Here are the results of one experiment.

Colour	Blue	Red	Green	Yellow
Number of Times	6	1	1	2

The blue cube was picked 6 times.
The **experimental probability** is the likelihood that something occurs
based on the results of an experiment.

$$\text{Experimental probability} = \frac{\text{Number of times an outcome occurs}}{\text{Number of times the experiment is conducted}}$$

So, the experimental probability of picking a blue cube is $\frac{6}{10}$, or $\frac{3}{5}$.
This is different from the theoretical probability.

➤ Jenny and Morningstar combined the results from 10 experiments.
   Here are the results for 100 trials.

Colour	Blue	Red	Green	Yellow
Number of Times	43	22	18	17

The blue cube was picked 43 times.
So, the experimental probability of picking a blue cube is $\frac{43}{100}$.

The experimental probability is close to the theoretical probability of $\frac{4}{10}$.

The more trials we conduct, the closer
the experimental probability may come
to the theoretical probability.

$$\xrightarrow{\times 10}$$
$$\frac{4}{10} = \frac{40}{100}$$
$$\xrightarrow{\times 10}$$

$\frac{40}{100}$ is close to $\frac{43}{100}$.
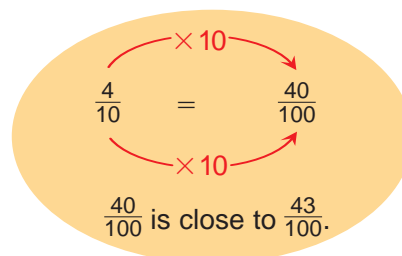
Practice

1. For each experiment, state the possible outcomes.
   a) The spinner has 3 equal sectors labelled
      Win, Lose, Spin Again.
      The pointer on a spinner is spun.
   b) A bag contains 6 marbles: 3 red, 2 black, and 1 blue.
      One marble is picked at random.
   c) A regular tetrahedron has 4 faces labelled 1, 2, 2, 3.
      The tetrahedron is rolled.

2. Dave tossed a coin 20 times. Heads showed 12 times.
   a) How many times did tails show?
   b) What fraction of the tosses showed heads? Tails?
   c) Are these results what you would expect? Explain.
   d) Dave tosses the coin 100 times.
      What would you expect the results to be? Explain.

3. Avril spins the pointer on this spinner several times.
   Here are her results.

Blue	Orange
### ### ### ||	### ||
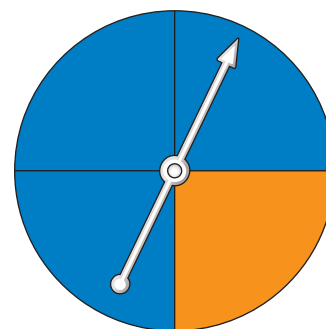
   a) How many times did Avril spin the pointer?
      How do you know?
   b) What fraction of the spins were blue? Orange?
   c) Were Avril's results what you would have expected? Explain.

4. Nina and Allegra placed 35 red tiles and 15 yellow tiles in a bag.
   At random, they picked a tile from the bag, recorded its colour, and
   replaced it. They did this 100 times.
   a) What is the theoretical probability of picking a red tile?
   b) Predict how many times Nina and Allegra should get a red tile in 100 trials.
   c) Nina and Allegra picked a red tile from the bag 58 times.
      What is the experimental probability of picking a red tile?
   d) Nina said, "I think we did something wrong." Do you agree? Why?
   e) Work with a partner. Try the experiment. Record your results.
      What is your experimental probability of picking a red tile?

5. A die labelled 1 to 6 is rolled.
  a) What are the possible outcomes?
  b) What is the theoretical probability of
    each outcome?
      i) rolling a 6
      ii) rolling an even number
      iii) rolling a 2 or a 4
      iv) rolling a number greater than 4
  c) Work with a partner. Roll a die 20 times.
    Record your results.
    What is the experimental probability of
    each outcome in part b?
    How do these probabilities compare with
    the theoretical probabilities? Explain.
  d) Combine your results with those of 4 other groups.
    What is the experimental probability of
    each outcome in part b?
    How do these probabilities compare with
    the theoretical probabilities? Explain.
    What do you think might happen if you rolled the die 500 times?
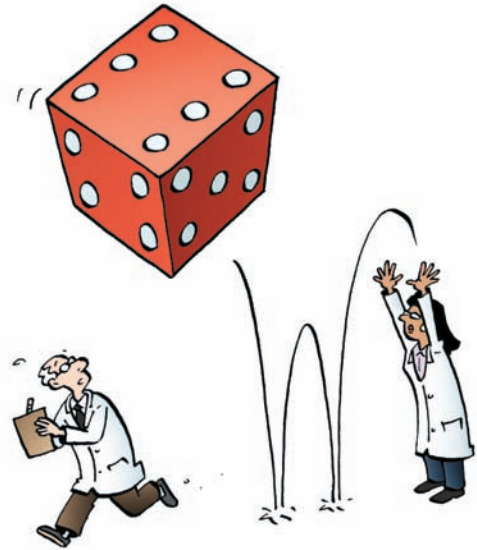
6. Zeroun and Ammon are playing a game.
  They spin the pointer on this spinner.
  If the pointer lands on an even number, Zeroun wins.
  If the pointer lands on an odd number, Ammon wins.
  a) Is this a fair game? How do you know?
  b) What is the theoretical probability of the pointer
    landing on an even number?
  c) Use a spinner like this one.
    Play the game at least 30 times.
    Record your results.
    Were the results what you expected? Explain.
  d) What results would you expect if you played the game
    100 times? Explain how you made your prediction.

Reflect

What is the difference between experimental and theoretical probability?
Are they ever equal? Sometimes equal? Never equal?
Use examples to explain.