Experimental Probability

WALT calculate the experimental probability
Success Criteria I know

- **I can use a fair coin that I can toss to get a result**
- **I can use a fair die to collect information / result**
- **I can use spinners to collect data**

If the probability of an event is unknown, an experiment can help. For example, when flipping a coin, the theoretical probability of it landing on heads is $\frac{1}{2}$. If you suspect that the coin is not fair, you could run an experiment and use the results to estimate the experimental probability of heads.

The more trials (flips) you use in your experiment, the more likely you are to get a good estimate of the probability of heads.

Tossing a coin 100 times does not mean it will come up heads 50 times.

Let's start: Tossing coins

For this experiment, each class member needs a fair coin that they can toss.

- Each student should toss the coin 20 times and count how many times heads occurs.
- Tally the total number of heads obtained by the class.
- How close is this total number to the number you would expect that is based on the theoretical probability of $\frac{1}{2}$? Discuss what this means.

Use a coin to toss it 20 times and record your results

Coin	Heads	Tails
My result as a tally		
Total		

Pr(head) =
Pr(tail) =

1 Which of the following experiments would be best to see if a coin was fair?

A Flipping it once **B** Flipping it twice **C** Flipping it 20 times

2 A coin is flipped and the results are:

a How many times did the coin show heads? **b** How many times did the coin show tails?

c How many times was the coin flipped?

When using a spinner numbered 1 to 4, the following numbers come up.
1, 4, 1, 3, 3, 1, 4, 3, 2, 3.

a What is the experimental probability of getting a 3?

b What is the experimental probability of getting an even number?

Solution	Explanation
a $\frac{2}{5}$ or 0.4 or 40%	$\frac{\text{number of 3s}}{\text{number of trials}} = \frac{4}{10} = \frac{2}{5}$
b $\frac{3}{10}$	$\frac{\text{number of even results}}{\text{number of trials}} = \frac{3}{10}$

Play a dice game

- Roll the dice 30 times and record your results as tally chart

No on a die	1	2	3	4	5	6
My score						
Total						

Answer the following questions

3 A 6-sided die is rolled 10 times and the following numbers come up: 2, 4, 6, 4, 5, 1, 6, 4, 4, 3. Find the experimental probability of getting:

a a 3

b a 4

c an odd number

For part **c**, count how many times a 1, 3 or 5 was rolled.

4 When a coin is tossed 100 times, the results are 53 heads and 47 tails.

a What is the experimental probability of getting a head?

b What is the experimental probability of getting a tail?

c The actual probability of getting a tail on a fair coin is $\frac{1}{2}$. Does this experiment prove that the coin is not fair?

Spinner Game

Use a spinner: Spin it for 30 times
And record your results

Colour	Red	Yellow	Purple	Orange	Green	Blue
Tally						
Frequency						

5 The table shows the results of spinning a spinner.

Colour	red	green	blue
Number of times	13	5	2

State the experimental probability of getting:

a red **b** green **c** blue

6 A survey is conducted on people's television viewing habits.

Number of hours per week	0–5	5–10	10–20	20–30	30+
Number of people	20	10	15	5	0

a How many people participated in the survey?

b Find the probability that a randomly selected participant watches television for:

i less than 5 hours

ii 20–30 hours

iii between 5 and 20 hours

Example 13 Finding expected numbers

A spinner is found to land on red $\frac{1}{4}$ of the time. If it is spun 200 times, how many times would you expect it to land on red?

Solution	Explanation
50 times	Expected number = probability × number of trials = $\frac{1}{4} \times 200 = 50$

Computerised simulation with 100 trials

Use this link see the result

7 A fair coin is tossed.

a How many times would you expect it to show tails in 1000 trials?

b How many times would you expect it to show heads in 3500 trials?

c You start by tossing the coin 10 times to find the probability of the coin showing tails.

i Explain how you could get an experimental probability of 0.7.

ii If you toss the coin 100 times, are you more or less likely to get an experimental probability close to 0.5?

The theoretical probability of tails is $\frac{1}{2}$.

8 A fair 6-sided die is rolled.

a How many times would you expect to get a 3 in 600 trials?

b How many times would you expect to get an even number in 600 trials?

c If you roll the die 600 times, is it possible that you will get an even number 400 times?

d Are you more likely to obtain an experimental probability of 100% from two rolls or to obtain an experimental probability of 100% from 10 rolls?

Car park activity - Practical

Record the colours of the cars (select any 5 colours leave the odd ones out)

Based on your records what is the probability of a colour that you have recorded.

Car colour					
Tally					
No of cars					

9 The colour of the cars in a school car park is recorded.

Colour	red	silver	white	blue	purple	black
Number of cars	21	24	25	20	3	7

a Based on this sample, find the probability that a randomly chosen car is:
i white **ii** purple **iii** silver or black

b How many purple cars would you expect to see in a shopping centre car park with 2000 cars?

Problem-solving and Reasoning

10 The number of children in some families is recorded in the table shown.

Number of children	0	1	2	3	4
Number of families	5	20	32	10	3

For part **f**, think:
3 families each with 4 children makes 12 children.

a How many families have no children?

b How many families have an even number of children?

c How many families participated in the survey?

d Based on this experiment, what is the probability that a randomly selected family has 1 or 2 children?

e Based on this experiment, what is the probability that a randomly selected family has an even number of children?

f What is the total number of *children* in this survey?

11 A handful of 10 marbles of different colours is placed into a bag. A marble is selected at random, its colour recorded and then returned to the bag.

Red marble chosen	Green marble chosen	Blue marble chosen
21	32	47

a Based on the results in the table, how many marbles of each colour do you think there are? Justify your answer in a sentence.

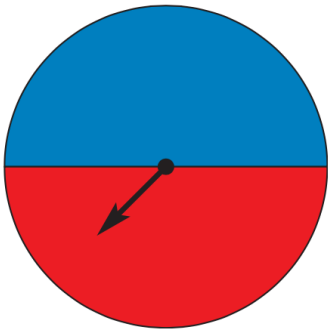
b For each of the following, state whether or not they are possible colours for the 10 marbles in the bag.

i 3 red, 3 green, 4 blue
ii 2 red, 4 green, 4 blue
iii 1 red, 3 green, 6 blue
iv 2 red, 3 green, 4 blue, 1 purple
v 2 red, 0 green, 8 blue

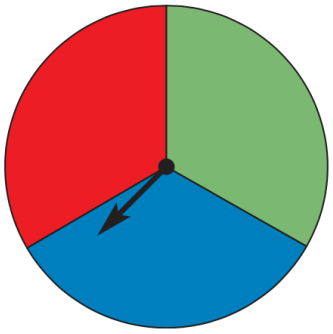
12 Match each of the experiment results (**a** to **d**) with the most likely spinner that was used (**A** to **D**).

	red	green	blue
a	18	52	30
b	27	23	0
c	20	23	27
d	47	0	53

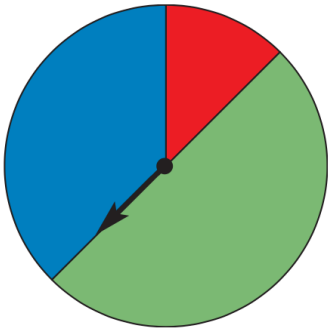
A



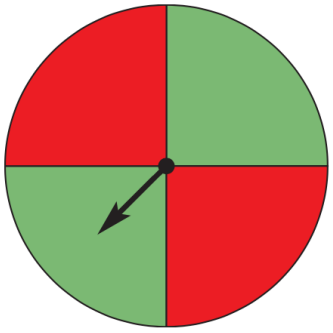
B



C



D



Extension and Fun

Dice-based basketball

13 Each time a certain basketball player takes a free throw there is a 4 in 6 chance that the shot will go in. This can be simulated by rolling a 6-sided die and using numbers 1 to 4 to mean 'shot goes in' and numbers 5 and 6 to mean 'shot misses'.

- **a** Use a 6-sided die over 10 trials to find the experimental probability that the shot goes in.
- **b** Use the die over 50 trials to find the experimental probability that the shot goes in.
- **c** Working with a group, use the die over 100 trials to find the experimental probability that the shot goes in.
- **d** Use the die over just one trial to find the experimental probability that the shot goes in. (Your answer should be either 0 or 1.)
- **e** Which of the answers to parts **a** to **d** is closest to the theoretical probability of 66.67%? Why?
- **f** How could you simulate a basketballer who has a 1 in 2 chance of getting a free throw in?

Check your answers

1 C

2 **a** 4 **b** 6 **c** 10

3 **a** $\frac{1}{10}$ **b** $\frac{2}{5}$ **c** $\frac{3}{10}$

4 **a** $\frac{53}{100}$ **b** $\frac{47}{100}$ **c** No

5 **a** $\frac{13}{20}$ **b** $\frac{1}{4}$ **c** $\frac{1}{10}$

6 **a** 50

b **i** $\frac{2}{5}$ **ii** $\frac{1}{10}$ **iii** $\frac{1}{2}$

7 **a** 500 **b** 1750 **c** **i** 7 tails **ii** more

8 **a** 100 **b** 300

c yes (but this is very unlikely) **d** from 2 rolls

9 **a** **i** $\frac{1}{4}$ **ii** $\frac{3}{100}$ **iii** $\frac{31}{100}$

b 60

10 **a** 5 **b** 35 **c** 70

d $\frac{26}{35}$ **e** $\frac{1}{2}$ **f** 126

11 **a** 2 red, 3 green and 5 blue

b **i** yes **ii** yes **iii** yes **iv** yes **v** no

12 **a** C **b** D **c** B **d** A

13 Answers will vary.