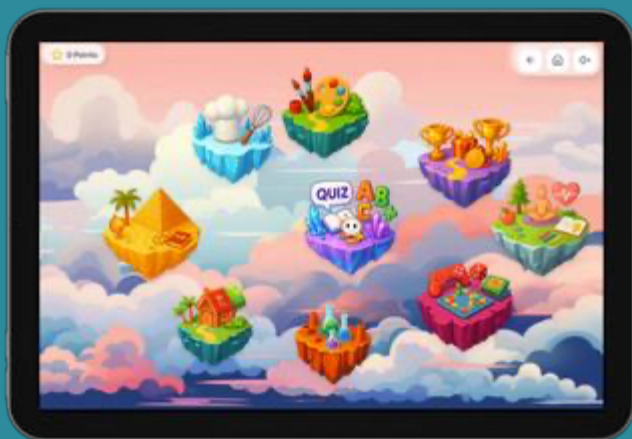




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Conducting Repeated Chance Experiments - Year 5

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Chance Experiments at a Glance

1



EVENT:
what we are
investigating

2



POSSIBLE OUTCOMES:
everything that
could happen

3



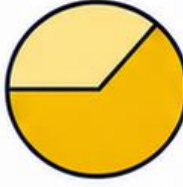
THEORETICAL PROBABILITY:
expected chance
before trials

4



EXPERIMENTAL FREQUENCY:
how often an
outcome occurs

5



RELATIVE FREQUENCY:
 $\text{frequency} \div$
total trials

EXAMPLE 1: FAIR COIN



EVENT: getting Heads

POSSIBLE OUTCOMES	THEORETICAL PROBABILITY	EXPERIMENTAL FREQUENCY (OUT OF 10)	RELATIVE FREQUENCY
Heads	$\frac{1}{2}$	5	$\frac{5}{10} = \frac{1}{2}$
Tails	$\frac{1}{2}$	5	$\frac{5}{10} = \frac{1}{2}$

EXAMPLE 2: FAIR SIX-SIDED DICE



EVENT: rolling a 4

POSSIBLE OUTCOMES	THEORETICAL PROBABILITY	EXPERIMENTAL FREQUENCY (OUT OF 60)	RELATIVE FREQUENCY
4	$\frac{1}{6}$	10	$\frac{10}{60} = \frac{1}{6}$
Not 4	$\frac{5}{6}$	50	$\frac{50}{60} = \frac{5}{6}$

EXAMPLE 3: UNEQUAL SPINNER



EVENT: landing on
Blue, Green or Orange

POSSIBLE OUTCOMES	THEORETICAL PROBABILITY	EXPERIMENTAL FREQUENCY (OUT OF 40)	RELATIVE FREQUENCY
Blue	$\frac{1}{2}$	20	$\frac{20}{40} = \frac{1}{2}$
Green	$\frac{1}{4}$	10	$\frac{10}{40} = \frac{1}{4}$
Orange	$\frac{1}{4}$	10	$\frac{10}{40} = \frac{1}{4}$



Repeat, record, compare and explain.

Equal and Unequal Chance

EQUALLY LIKELY OUTCOMES

Outcomes have the same chance of occurring.



Heads

$$\frac{1}{2}$$

Tails

$$\frac{1}{2}$$

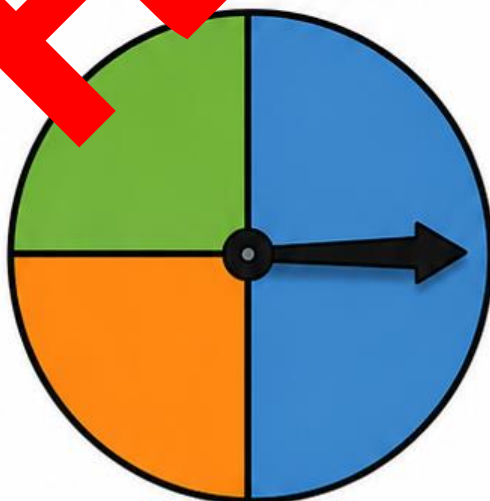


Each number:

$$\frac{1}{6}$$

UNEQUALLY LIKELY OUTCOMES

Some outcomes have a greater chance than others.



$$\frac{1}{2}$$



$$\frac{1}{4}$$

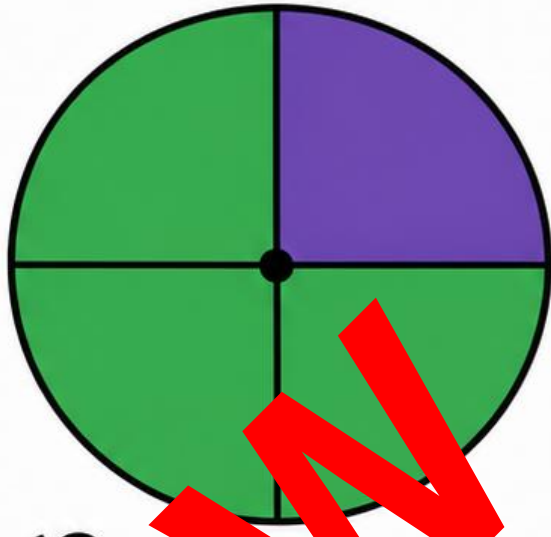
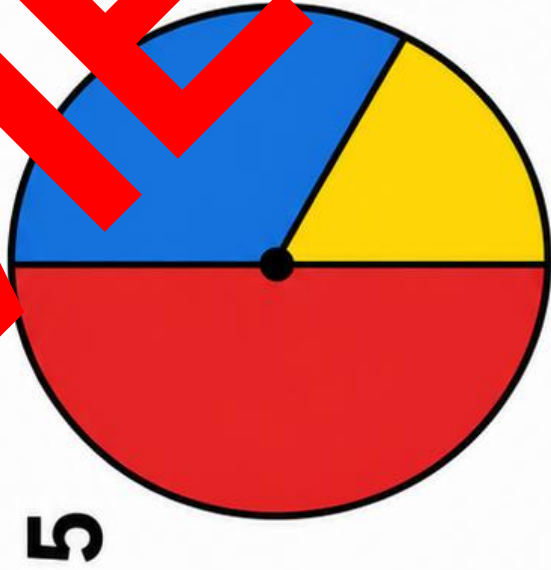
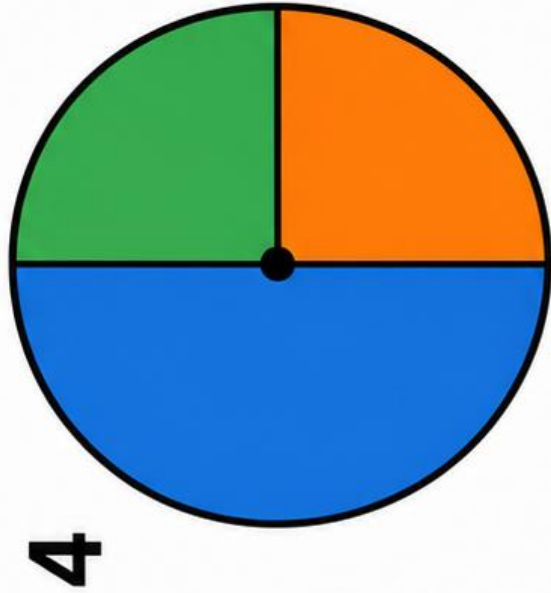
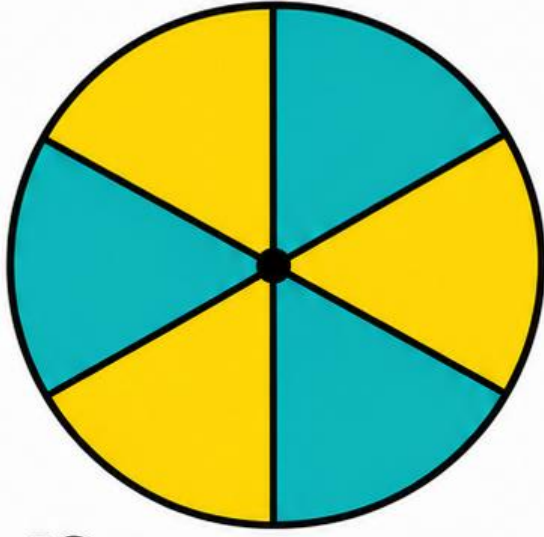
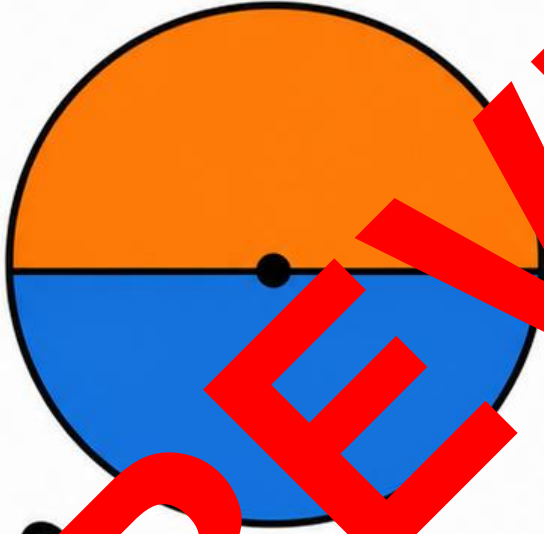
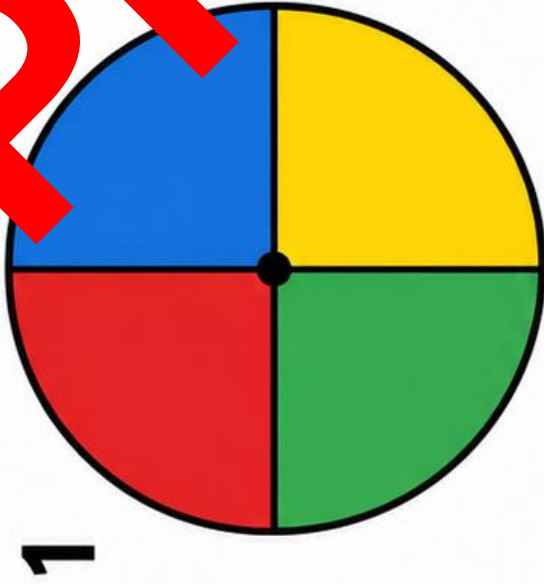


$$\frac{1}{4}$$

List the outcomes. Predict. Repeat the trial. Record and compare.

Spinner Lab: Ready-to-Use Spinners

Pre-cut first. Spin 30 times. Record and compare.

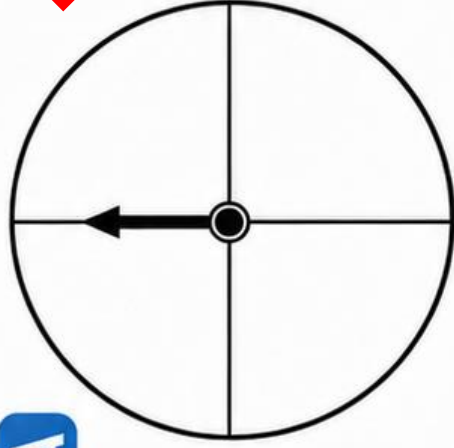


Spinner Lab: Create and Predict



Colour and spin. Predict the most and least likely outcomes. Spin 30 times and compare your results.

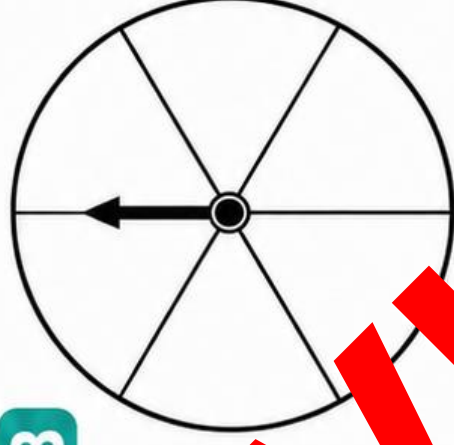
A



My prediction:

Why:

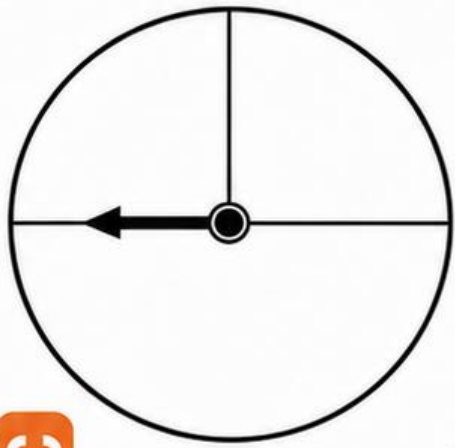
B



My prediction:

Why:

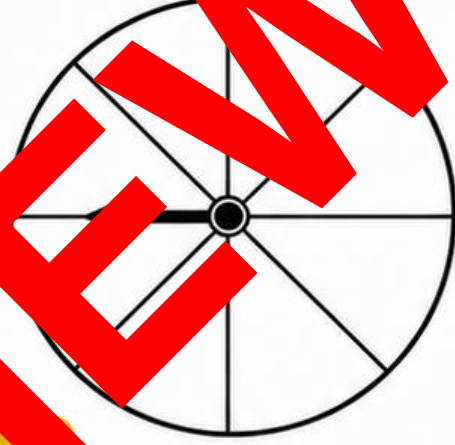
C



My prediction:

Why:

D



My prediction:

Why:

Probability Match

1/2	2/4	0.5	3/6	50%
1/4	1/8	0.25	3/12	25%
3/4	6/8	0.75	9/12	75%
1/5	2/10	0.2	3/15	20%
2/5	4/10	0.4	6/15	40%
3/5	6/10	0.6	9/15	60%
IMPOSSIBLE	LESS LIKELY	EQUALLY LIKELY	MORE LIKELY	CERTAIN

1 **START**

25 **FINISH**

24 0.5

22 1/5

21 3/5

20 2/5

19 1/4

18 3/4

17 1/2

16 LESS LIKELY

15 MORE LIKELY

14 CERTAIN

13 IMPOSSIBLE

12 0.75

11 0.5

10 0.25

9 1

8 0

6 2/5

5 1/5

4 3/4

3 1/4

2 1/2

1 1/2

0 3/5

Roll. Move. Cover a matching equivalent in the centre. First to cover five in a row wins.



Probability Match: Rules and Challenge Cards



1. Each player chooses a marker.
2. Roll a die and move around the board.
3. Cover one matching equivalent in the centre.
4. The first player to cover five spaces in a row wins.

one-half

one-quarter

three-quarters

one-fifth

two-fifths

three-fifths

zero

one whole

impossible

certain

more likely

less likely

Dice Challenge

RULES

On your turn, roll one die.

Add the number to your round total

You may **BANK** and keep the total or **RISK** another roll.

If you roll a 1, the round total becomes zero and your turn ends.

Play four rounds.

Highest grand total wins.



Before each roll: What is the probability of rolling a 1? Does the previous roll change it?

[illegible]



Dice Risk Challenge: Player Score Sheet



Name: _____

ROUND 1



Roll 1

Roll 2

Roll 3

Roll 4

Roll 5

Roll 6

Roll 7

Roll 8

BANK or RISK?

Round total

Did a 1 end the round?

Yes ☐

No ☐

ROUND 2



Roll 1

Roll 2

Roll 3

Roll 4

Roll 5

Roll 6

Roll 7

Roll 8

BANK or RISK?

Round total

Did a 1 end the round?

Yes ☐

No ☐

ROUND 3



Roll 1

Roll 2

Roll 3

Roll 4

Roll 5

Roll 6

Roll 7

Roll 8

BANK or RISK?

Round total

Did a 1 end the round?

Yes ☐

No ☐

ROUND 4



Roll 1

Roll 2

Roll 3

Roll 4

Roll 5

Roll 6

Roll 7

Roll 8

BANK or RISK?

Round total

Did a 1 end the round?

Yes ☐

No ☐



GRAND TOTAL



When did you choose to bank? Why?



Did one roll affect the probability of the next roll? Explain.

Chance Stations: Setup and Group Score Sheet



Work in groups. Visit each station. Predict before testing.
Record the result. Find out whether the observed result matched the expected chance.

Station	Prediction	Result	Score	Explanation
1 Playing Cards 				
2 Dice 				
3 Coin Toss 				
4 Marble Bag 				
5 Spinners 				

Which result surprised us most?

How did more trials change confidence?

Chance Stations: Cards 1

1 PLAYING CARDS A

What is the probability of drawing a red card from a standard 52-card deck?



2 PLAYING CARDS B

What is the probability of drawing a face card (jack, queen or king) from a standard 52-card deck?



3 DICE A

Predict how many times each number will appear in 60 rolls of a fair six-sided die.



4 DICE B

A die was rolled 60 times:
 $1=8$, $2=12$, $3=9$, $4=11$, $5=10$, $6=10$.
Which result occurred most often?
Which result occurred farthest from the expected frequency?



Chance Stations: Cards 2

1

COIN TOSSES A



Predict the number of heads and tails in 40 tosses of a fair coin.

2

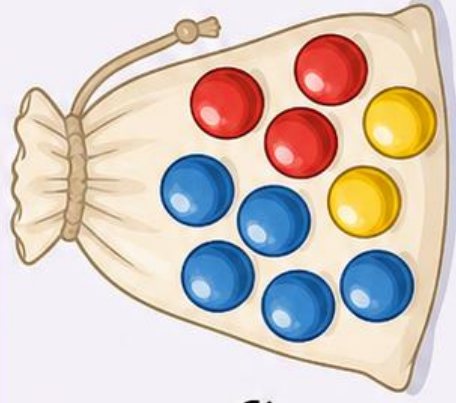
COIN TOSSES B



If three heads occur in a row, is the next toss more likely to be tails? Explain.

3

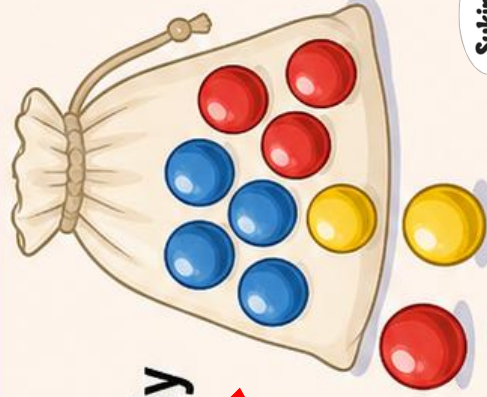
MARBLE BAG A



A bag has 5 blue, 3 red and 2 yellow marbles. What is the probability of each colour?

4

MARBLE BAG B

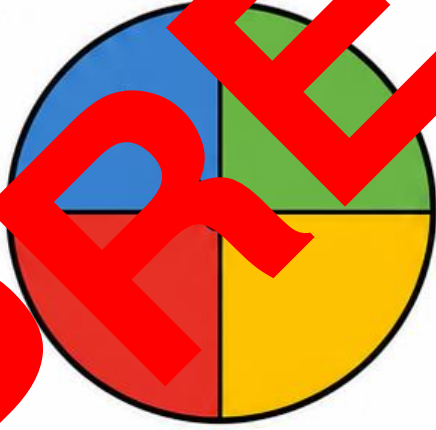


With replacement, would 50 draws usually match the expected fractions exactly? Explain.

Chance Stations: Cards 3

1

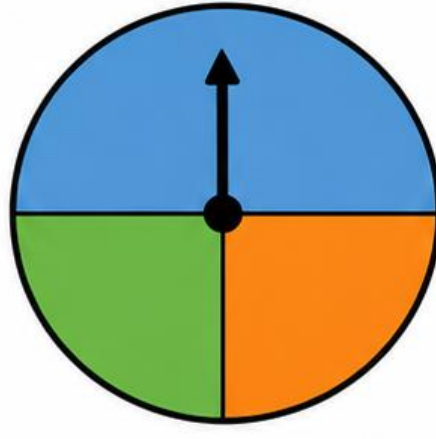
SPINNER A



A spinner has four equal sectors. What is the probability of each colour?

2

SPINNER B



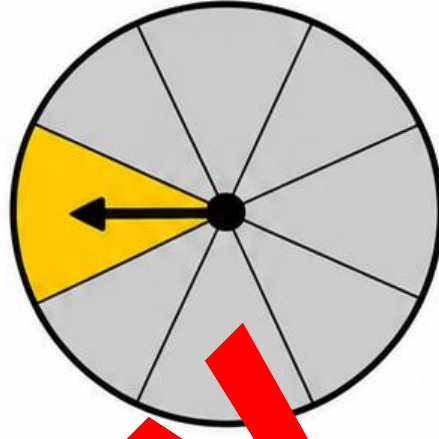
Blue covers $\frac{1}{2}$, green covers $\frac{1}{4}$ and orange covers $\frac{1}{4}$. Which outcome is most likely?

3

SAMPLE SIZE

Which result is usually more stable: 20 trials or 200 trials? Why?

BIASED GAME



A spinner has one winning sector and seven losing sectors. Is the game fair? Justify your answer.

Chance Stations: Cards 4

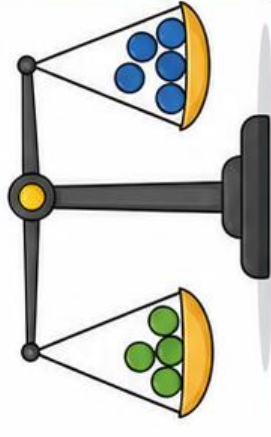
COMPARE RESULTS

Group A rolled 8 sixes in 100 trials.
Group B rolled 12 sixes in 100 trials.
How can both results be reasonable?



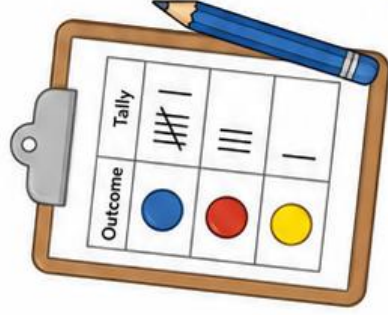
EXPLAIN VARIATION

Why do repeated samples from the same chance experiment produce different frequencies?



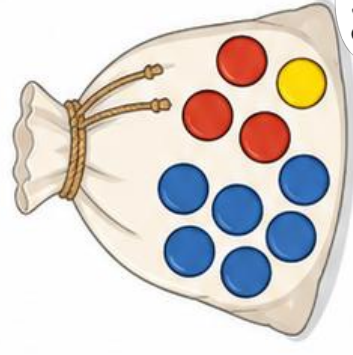
DESIGN A FAIR TEST

Design a repeatable chance experiment.
List the outcomes, number of trials and recording method.



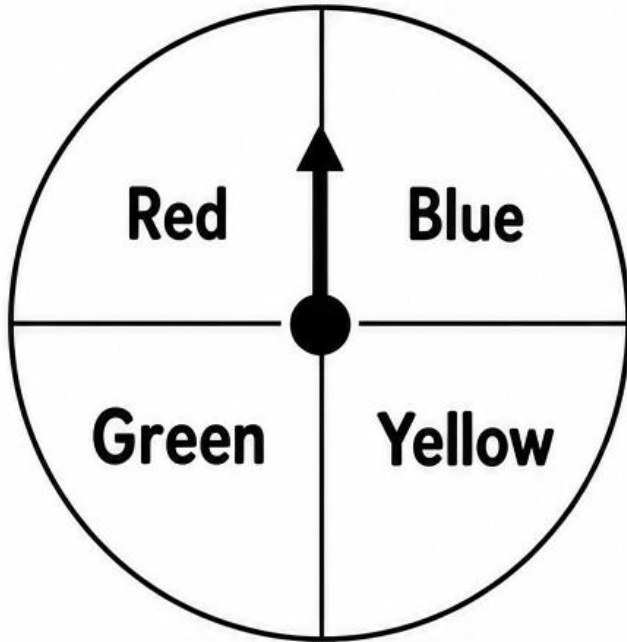
JUSTIFY A PREDICTION

Has a bag of counters, 3 red and 1 yellow counter.
Predict the most likely colour and justify.



WORKSHEET 1: SPINNER RESULTS

≧ EXPERIMENT ≦



PREDICTIONS (BEFORE YOU SPIN)

COLOUR	SECTOR FRACTION	PREDICTED FREQUENCY OUT OF 30
☐ Red		
☐ Blue		
☐ Green		
☐ Yellow		

★ **DIRECTIONS:** Spin 30 times. Record each result with a tally, then write the total.

COLOUR	TALLY	TOTAL
☐ Red		
☐ Blue		
☐ Green		
☐ Yellow		

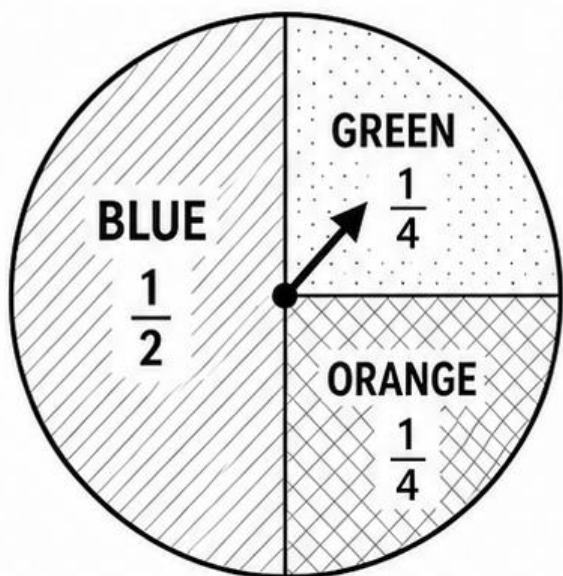
★ Which colour occurred most often? _____

★ Which occurred least often? _____

★ Were your results exactly what you predicted? Explain. _____

Worksheet 1: Spinner Results - Analyse and Explain

Name: _____



In 40 spins, the results were
Blue 18, Green 12, Orange 10.

1. Write the theoretical probability of each colour.

2. Write each observed result as a relative frequency.

3. Which colour differed most from its expected frequency?

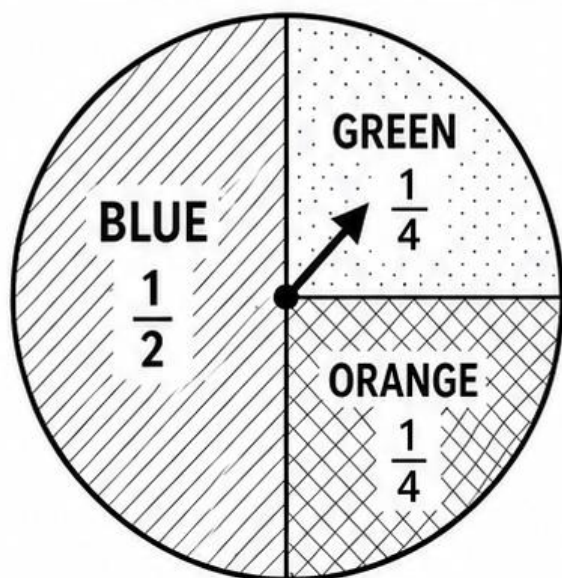
4. Did the experiment prove the spinner was unfair? Explain.

5. Predict the approximate frequencies for 400 spins.

6. Why would 400 spins usually give a more stable comparison than 40 spins?

Worksheet 1: Spinner Results - Analyse and Explain

Name: **ANSWERS**



In 40 spins, the results were
Blue 18, Green 12, Orange 10.

1. Write the theoretical probability of each colour.

Blue $\frac{1}{2}$; Green $\frac{1}{4}$; Orange $\frac{1}{4}$.

2. Write each observed result as a relative frequency.

Blue $\frac{18}{40} = \frac{9}{20} = 0.45$; Green $\frac{12}{40} = \frac{3}{10} = 0.30$; Orange $\frac{10}{40} = \frac{1}{4} = 0.25$.

3. Which colour differed most from its expected frequency?

Blue and Green each differs from the expected frequency by 2 spins.

4. Did the experiment prove the spinner was unfair? Explain.

No. Random variation in 40 spins does not prove the spinner is unfair.

5. Predict the approximate frequencies for 400 spins.

About 200 blue, 100 green and 100 orange.

6. Why would 400 spins usually give a more stable comparison than 40 spins?

A larger sample reduces the effect of chance variation, so relative frequencies usually sit closer to the theoretical probabilities.

WORKSHEET 2: PLAYING CARD CHANCE



EXPERIMENT INSTRUCTIONS



Use a standard shuffled deck. Draw one card, record it, replace it, and shuffle again. Repeat for 20 trials.

PREDICTION

Most likely colour: _____

Most likely suit: _____

Chance of drawing an ace: _____

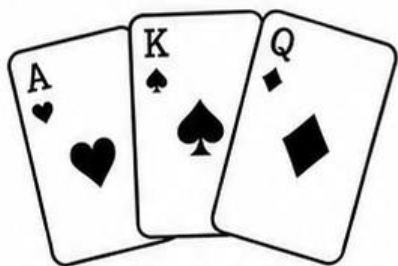
TRIAL	CARD DRAWN	COLOUR	SUIT	REPLACED?
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

OUTCOME	TALLY	TOTAL
Red		
Black		
Hearts		
Diamonds		
Clubs		
Spades		
Aces		
Face cards		

What pattern did you notice?

Worksheet 2: Playing Card Chance - Analyse

Name: _____



52 cards: 26 red, 26 black,
13 hearts, 12 face cards, 4 aces.

A group made 20 draws with replacement: 11 red, 9 black, 5 hearts and 4 face cards.

1. What is the theoretical probability of drawing a red card?

2. What is the theoretical probability of drawing a black card?

3. What is the theoretical probability of drawing a heart?

4. What is the theoretical probability of drawing a face card?

5. What is the theoretical probability of drawing an ace?

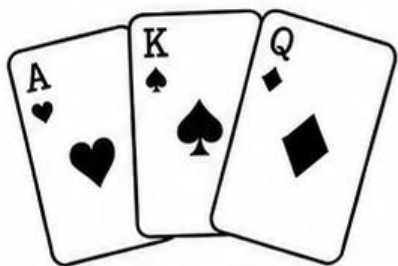
6. Compare observed frequencies with the expected probabilities.

7. How could the results change if cards were not replaced after each draw?



Worksheet 2: Playing Card Chance - Analyse

Name: **ANSWERS**



52 cards: 26 red, 26 black,
13 hearts, 12 face cards, 4 aces.

A group made 20 draws with replacement: 11 red, 9 black, 5 hearts and 4 face cards.

1. What is the theoretical probability of drawing a red card?

$$26/52 = 1/2$$

2. What is the theoretical probability of drawing a black card?

$$26/52 = 1/2$$

3. What is the theoretical probability of drawing a heart?

$$13/52 = 1/4$$

4. What is the theoretical probability of drawing a face card?

$$12/52 = 3/13$$

5. What is the theoretical probability of drawing an ace?

$$4/52 = 1/13$$

6. Compare the observed frequencies with the expected probabilities.

Red: $11/20 = 0.55$ (slightly above 0.5); black: $9/20 = 0.45$ (slightly below 0.5);
hearts: $5/20 = 0.25$ (matches); face cards: $4/20 = 0.20$ (close to $3/13$).

7. How could the results change if cards were not replaced after each draw?

Without replacement, the deck composition changes after each draw,
so later probabilities depend on the cards already removed.



WORKSHEET 3: COIN TOSS COMPARISONS



EXPERIMENT



LEARNING PURPOSE:

Compare repeated trials and look for variation.

PREDICTION

In 20 tosses, I predict Heads: ____ Tails: ____

Will every round match? Why or why not?



Toss one fair coin 20 times in each round. Record a tally and total.
Complete three rounds.

ROUND AND OUTCOME	TALLY	TOTAL COUNT OF 20	RELATIVE FREQUENCY
Round 1 Heads			
Round 1 Tails			
Round 2 Heads			
Round 2 Tails			
Round 3 Heads			
Round 3 Tails			



TOTALS:

All rounds: Heads ____ / 60

Tails ____ / 60

1 Which round was closest to equal?

2 Describe one difference between the rounds.



WORKSHEET 3: COIN TOSS COMPARISONS



ANALYSE AND EXPLAIN



For a fair coin, $P(\text{Heads}) = \frac{1}{2}$ and $P(\text{Tails}) = \frac{1}{2}$.

- 1 How did your three rounds differ?

- 2 Which round was closest to the theoretical 10 Heads and 10 Tails?

- 3 Calculate the relative frequency of Heads across all tosses.

- 4 Did a run of the same outcome prove the coin was unfair? Explain.

- 5 Which round usually be closer to $\frac{1}{2}$ than 20 tosses? Why?

- 6 Write a conclusion using the words **variation**, **relative frequency** and **sample size**.

CHALLENGE

If Heads occurred 312 times in 600 tosses,
what was its relative frequency?



WORKSHEET 3: COIN TOSS COMPARISONS



ANALYSE AND EXPLAIN

ANSWERS — SAMPLE RESULTS



For a fair coin, $P(\text{Heads}) = \frac{1}{2}$ and $P(\text{Tails}) = \frac{1}{2}$.

1 How did your three rounds differ?

— Sample rounds: 12H/8T, 10H/10T and 9H/11T; the totals varied

2 Which round was closest to the theoretical 10 Heads and 10 Tails?

— Round 2; it was exactly 10 Heads and 10 Tails.

3 Calculate the relative frequency of Heads across all 60 tosses.

— $31/60 \approx 0.517$.

4 Did a run of 10 Heads or 10 Tails prove the coin was unfair? Explain.

— No. Short runs can occur by chance and do not prove unfairness.

5 Would 60 tosses usually be closer to $\frac{1}{2}$ than 20 tosses? Why?

— Yes, a larger sample usually reduces variation and approaches $\frac{1}{2}$.

6 Write a conclusion using the words **variation**, **relative frequency** and **sample size**.

— As sample size increases, relative frequency usually moves closer
to $\frac{1}{2}$, although variation still occurs.

CHALLENGE

If Heads occurred 312 times in 600 tosses,
what was its relative frequency?

— $312/600 = 0.52$.

WORKSHEET 4: EQUAL AND UNEQUAL DICE EXPERIMENT

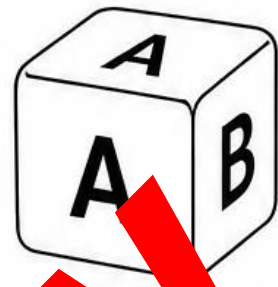
SETUP

Die A is a standard fair die with faces 1, 2, 3, 4, 5, 6.

Die B has labelled faces A, A, A, B, C, D.



DIE A



DIE B

PREDICTION

Most likely on Die A: _____

Most likely on Die B: _____ because _____



Roll each die 30 times. Tally each result and calculate relative frequency.

TABLE 1: DIE A — EQUAL CHANCES

OUTCOME	TALLY	TOTAL	RELATIVE FREQUENCY
1			
2			
3			
4			
5			
6			

TABLE 2: DIE B — UNEQUAL CHANCES

OUTCOME	FACE FRACTION	TALLY	TOTAL
A			
B			
C			
D			

Was Die A close to equal? _____

How did Die B show unequal chances? _____

WORKSHEET 4: EQUAL AND UNEQUAL DICE

ANALYSE AND EXPLAIN

Die A



Die A: each outcome has probability $\frac{1}{6}$.

Die B



Die B faces: A, A, A, B, C, D, so $P(A) = \frac{1}{2}$
and $P(B) = P(C) = P(D) = \frac{1}{6}$.

- 1 Compare your most and least frequent outcomes for Die A.

- 2 Why might Die A totals differ even though the chances are equal?

- 3 Which Die B outcome should occur most often? Explain using a fraction.

- 4 Compare the experimental relative frequency of A with $\frac{1}{2}$.

- 5 How could you decide whether a die is probably biased?

- 6 Write a conclusion comparing equal and unequal chance experiments.



CHALLENGE

Predict the expected frequencies for Die B in 120 rolls.

WORKSHEET 4: EQUAL AND UNEQUAL DICE

ANALYSE AND EXPLAIN

ANSWERS — SAMPLE RESULTS

Die A



Die A: each outcome has probability $\frac{1}{6}$.

Die B



Die B faces: A, A, A, B, C, D, so $P(A) = \frac{3}{6} = \frac{1}{2}$
and $P(B) = P(C) = P(D) = \frac{1}{6}$

- 1 Compare your most and least frequent outcomes for Die A.
Sample: 4 was most frequent (7); 2 was least frequent (1).

- 2 Why might Die A totals differ even though the chances are equal?
Random variation occurs in a small set of 10 rolls.

- 3 Which Die B outcome should occur most often? Explain using a fraction.
A, because 3 of the faces are A, so $P(A) = 3/6 = 1/2$.

- 4 Compare the experimental relative frequency of A with $\frac{1}{2}$.
Sample: 16, which is 0.533, which is close to $1/2$.

- 5 How would you decide whether a die is probably biased?
Roll many times and compare relative frequencies with the expected probabilities.

- 6 Write a conclusion comparing equal and unequal chance experiments.
Equal outcomes share the same theoretical chance; unequal outcomes do not.
Experimental results vary but usually approach those chances with more trials.



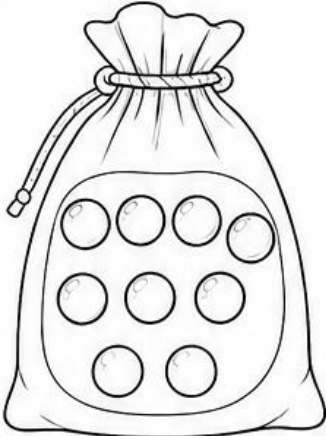
CHALLENGE

Predict the expected frequencies for Die B in 120 rolls.

A: 60; B: 20; C: 20; D: 20.

WORKSHEET 5: MARBLE PULL

EXPERIMENT



Bag contents:
5 red marbles,
3 blue marbles,
2 yellow marbles
(10 total).

PROBABILITY REFERENCE TABLE

COLOUR	FRACTION OF BAG	PREDICTED OUT OF 40
Red		
Blue		
Yellow		



Without looking, draw one marble, record its colour, replace it, and mix the bag. Repeat for 40 trials.

COLOUR	TALLY	TOTAL	RELATIVE FREQUENCY
Red			
Blue			
Yellow			



After 10 trials

Most frequent colour: _____

Relative frequency: _____



After 40 trials

Most frequent colour: _____

Relative frequency: _____

1

Did the most common colour match your prediction?

2

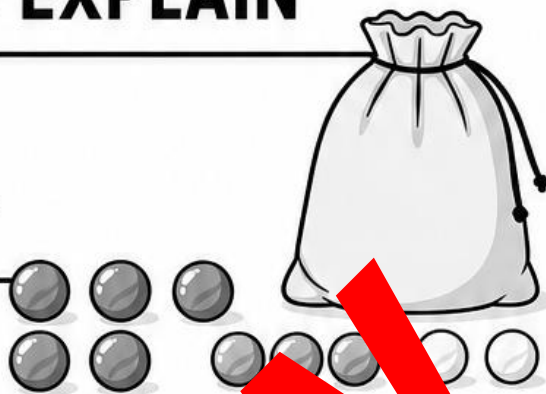
Why must the marble be replaced each time?

WORKSHEET 5: MARBLE PULL

ANALYSE AND EXPLAIN

Bag: 5 red, 3 blue, 2 yellow.

$$P(\text{Red}) = \frac{1}{2}, P(\text{Blue}) = \frac{3}{10}, P(\text{Yellow}) = \frac{1}{5}.$$



- 1 Which colour had the greatest theoretical chance? Explain.

- 2 Compare your experimental relative frequencies with the theoretical probabilities.

- 3 Why might 40 pulls not match the exact theoretical frequencies?

- 4 What would change if you did not replace each marble?

- 5 Predict the expected numbers of red, blue and yellow in 200 pulls with replacement.

- 6 Write a conclusion about how repeated trials can estimate probability.

CHALLENGE

If 18 of 40 pulls were red, how far was the relative frequency from $\frac{1}{2}$?

WORKSHEET 5: MARBLE PULL

ANALYSE AND EXPLAIN

ANSWERS – SAMPLE RESULTS

Bag: 5 red, 3 blue, 2 yellow.

$$P(\text{Red}) = \frac{1}{2}, P(\text{Blue}) = \frac{3}{10}, P(\text{Yellow}) = \frac{1}{5}.$$



- Which colour had the greatest theoretical chance? Explain.
Red; 5 of 10 marbles are red, so $P(\text{Red}) = \frac{1}{2}$.
- Compare your experimental relative frequencies with the theoretical probabilities.
Sample: Red $\frac{19}{40} = 0.475$, Blue $\frac{13}{40} = 0.325$, Yellow $\frac{8}{40} = 0.20$; all are close to the theoretical values.
- Why might 40 pulls not match the exact expected frequencies?
Random variation occurs in a sample of 40 pulls.
- What would happen if you did not replace each marble?
The composition and probabilities would change after each pull.
- Find the expected numbers of red, blue and yellow in 200 pulls with replacement.
Red 100, Blue 60, Yellow 40.
- Write a conclusion about how repeated trials can estimate probability.
With many repeated trials, relative frequencies usually approach the theoretical probabilities.

CHALLENGE

If 18 of 40 pulls were red, how far was the relative frequency from $\frac{1}{2}$?

$$\frac{18}{40} = 0.45; \text{ it is } 0.05 \text{ below } \frac{1}{2}.$$

ASSESSMENT: REPEATED CHANCE EXPERIMENTS

PART A — CONCEPTS AND CALCULATIONS

Name: _____

Date: _____

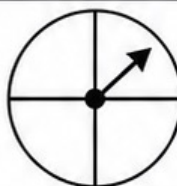
1. Which word describes an outcome that cannot happen? [1]

(A) impossible (B) unlikely (C) likely (D) certain

2. Write the probability of Heads on a fair coin as a fraction. [1]



3. A fair spinner has 4 equal sections; 3 are blue. Write $P(\text{Blue})$. [1]



4. True or False: Experimental results must exactly match theoretical probability. [1]

TRUE

FALSE

5. In 50 rolls, a 6 appeared 9 times. Write its relative frequency as a fraction. [1]



6. Which sample is more reliable for estimating probability: 20 trials or 500 trials? Explain briefly. [1]

7. A bag has 2 red and 8 green counters. Which colour is more likely? [1]



8. Explain the difference between theoretical probability and experimental relative frequency. [1]

9. A card is drawn and replaced. State why replacement matters. [1]



10. Circle the fair experiment. [1]

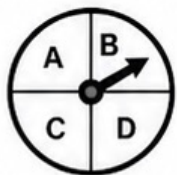


a balanced coin
tossed 100 times

OR



a coin placed
Heads-up each trial



ASSESSMENT: REPEATED CHANCE EXPERIMENTS

PART B — DATA, REASONING AND DESIGN



TASK 1 — INTERPRET DATA

[5 marks]

Outcome	A	B	C	D
Frequency in 80 spins	36	22	14	8

- a) Identify the most likely experimental outcome. _____ [1]
- b) Write the relative frequency of outcome B. _____ [1]
- c) Order the outcomes from least likely to most likely. _____ [1]
- d) Explain whether or not equal chance is supported by this data. _____ [2]
- _____
- _____

TASK 2 — COMPARE SAMPLES

[4 marks]

Class 1 tossed a coin 20 times: 14 Heads. Class 2 tossed a coin 200 times: 106 Heads.

- a) Calculate the relative frequency of Heads for Class 1 and for Class 2. _____ [2]
- Class 1: _____ Class 2: _____
- b) Which result is closer to $\frac{1}{2}$? Explain why larger samples often help. _____ [2]
- _____
- _____

TASK 3 — DESIGN A FAIR TEST

[6 marks]

Design an experiment to test whether a six-sided die is fair.

	Prediction [1]	_____							
	Method <i>Include at least 60 rolls</i> [2]	_____ _____ _____							
	Results Heads [1]	Roll	1	2	3	4	5	6	Total
		Frequency							
		(Add tally marks first, then totals.)							
	How you will decide [2]	_____ _____							

PART B: _____ / 15

TOTAL: _____ / 25

ASSESSMENT: REPEATED CHANCE EXPERIMENTS

PART A — CONCEPTS AND CALCULATIONS **ANSWERS**

Name: _____

Date: _____

1. Which word describes an outcome that cannot happen? [1]

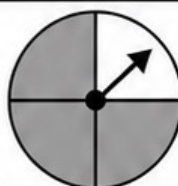
A impossible **B** unlikely **C** likely **D** certain

2. Write the probability of Heads on a fair coin as a fraction. [1]



1/2

3. A fair spinner has 4 equal sections; 3 are blue. Write $P(\text{Blue})$. [1]



3/4

4. True or False: Experimental results must exactly match theoretical probability. [1]

TRUE

FALSE

5. In 50 rolls, a 6 appeared 9 times. Write its relative frequency as a fraction. [1]



9/50

6. Which sample is more reliable for estimating probability: 20 trials or 500 trials? Explain briefly. [1]

500 trials; a larger sample usually gives a more reliable estimate.

7. A bag has 2 red and 8 green counters. Which colour is more likely? [1]



Green

8. Explain the difference between theoretical probability and experimental relative frequency. [1]

Theoretical probability is predicted from possible outcomes; experimental relative frequency comes from observed trials.

9. A card is drawn and replaced. State why replacement matters. [1]



Replacement keeps the possible outcomes and probabilities the same each draw.

10. Circle the fair experiment. [1]

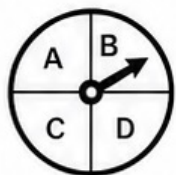


a balanced coin
tossed 100 times

OR



a coin placed
Heads-up each trial



ASSESSMENT: REPEATED CHANCE EXPERIMENTS

PART B — DATA, REASONING AND DESIGN



[5 marks]

TASK 1 — INTERPRET DATA

Outcome	A	B	C	D
Frequency in 80 spins	36	22	14	8

- a) Identify the most likely experimental outcome. A [1]
- b) Write the relative frequency of outcome B. $22/80 = 11/40 = 0.275$ [1]
- c) Order the outcomes from least likely to most likely. D, C, B, A [1]
- d) Explain whether or not equal chance is supported by this data. No. Equal chance would be about 20 each; the frequencies differ greatly. [2]

TASK 2 — COMPARE SAMPLES

[4 marks]

Class 1 tossed a coin 20 times: 14 Heads. Class 2 tossed a coin 200 times: 106 Heads.

- a) Calculate the relative frequency of Heads for Class 1 and for Class 2. [2]
Class 1: $14/20 = 0.70$ Class 2: $106/200 = 0.53$
- b) Which result is closer to $\frac{1}{2}$? Explain why larger samples often help. [2]
Class 2 is closer to $1/2$. Larger samples usually reduce random variation.

TASK 3 — DESIGN A FAIR TEST

[6 marks]

Design an experiment to test whether a six-sided die is fair.

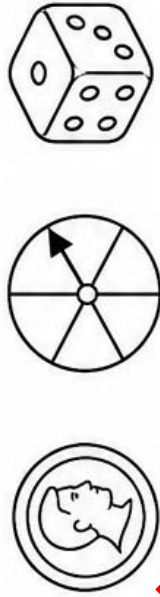
	Prediction [1]	Each face will occur about 1/6 of the rolls.																
	Method Include at least 60 rolls. [2]	Roll the same die at least 60 times in the same way; tally every result.																
	Results table Headings [1]	<table><tr><th>Face</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>Total</th></tr><tr><th>Frequency</th><td>11</td><td>9</td><td>10</td><td>8</td><td>12</td><td>10</td><td>60</td></tr></table> (Add tally marks first, then totals.)	Face	1	2	3	4	5	6	Total	Frequency	11	9	10	8	12	10	60
Face	1	2	3	4	5	6	Total											
Frequency	11	9	10	8	12	10	60											
	How you will decide [2]	Compare each relative frequency with 1/6; large repeated differences may suggest bias.																

PART B: 15 / 15

TOTAL: 25 / 25

REPEATED CHANCE EXPERIMENTS – ASSESSMENT RUBRIC

Student: _____ Date: _____



CRITERION	BEGINNING	DEVELOPING	ACHIEVING	CONFIDENT	EXCEEDING
1. Theoretical probability	Needs substantial support to identify outcomes. Ideas are limited or inaccurate.	Identifies some outcomes with support. Probability ideas are initially correct.	Lists all equally likely outcomes and calculates theoretical probabilities correctly and independently.	Calculates theoretical probabilities accurately and explains reasoning clearly.	Explains theoretical probability with insight and applies ideas to new situations.
2. Conducting repeated experiments	Needs substantial support to follow steps. Repeats are too few or not fair.	Follows steps with some support. Repeats are done but may not be fair or consistent.	Conducts a fair experiment. Uses a reasonable number of repeats independently.	Plans and runs a fair experiment carefully. Chooses an appropriate number of repeats and justifies it.	Plans efficient experiments and justifies choices. Adapts methods and applies to new situations.
3. Recording and calculating relative frequency	Needs substantial support to record results. Calculations are usually incorrect or missing.	Records some results. Calculates relative frequency with some support. Errors remain.	Records results clearly. Calculates relative frequency correctly and independently.	Organises data clearly and calculates relative frequency accurately and independently.	Uses efficient methods and checks accuracy. Calculates in different ways and explains choices.
4. Comparing results and explaining variation	Comparisons need substantial support. Explanation of variation is limited or missing.	Makes simple comparisons with support. Explains variation with limited detail.	Compares theoretical and experimental results. Explains variation using appropriate ideas.	Explains variation clearly using data and mathematical ideas.	Explains variation in depth using evidence. Connects results to other contexts or ideas.
5. Reasoning, fairness and conclusions	Conclusions need substantial support. Fairness ideas are limited.	States a conclusion with some support. Recognises basic fairness.	Draws a supported conclusion. Explains fairness and makes reasonable statements.	Draws a well-reasoned conclusion explaining fairness in depth.	Draws insightful conclusions. Justifies ideas with strong reasoning and applies to new contexts.

TOTAL: ____ / 25	STRENGTH	NEXT STEP
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KEY: Achieving indicates the expected Year 5 standard for this unit.

Conducting Repetitive Chance Experiments

PREVIEW



Learning Focus

- Predict outcomes before collecting data.
- Conduct the same chance experiment many times.
- Record frequencies accurately.
- Compare experimental results with theoretical probability.
- Explain variation in sample results.



Key Language

Chance experiment — an action with an uncertain result.

Event — an outcome or group of outcomes we are interested in.

Outcome — one possible result.

Trial — one repetition of the experiment.



Expected and Observed

Theoretical probability predicts likelihood from the possible outcomes.

Experimental frequency counts what actually happens.

Relative frequency = frequency / total number of trials.



Predict Before You Test

1. List all possible outcomes.
2. Decide whether the outcomes are equally likely.
3. Write a probability or expected frequency.
4. Test the prediction with repeated trials.



A Fair Coin

Possible outcomes: Heads and Tails.

$$p(\text{Heads}) = 1/2 \quad p(\text{Tails}) = 1/2$$

In 20 tosses, 10 Heads is expected but another total can occur.



Relative Frequency

If Heads occurs 18 times in 30 tosses:

relative frequency of Heads = $18/30 = 3/5 = 0.6$

It describes the observed result and guarantee for the next toss.



Why Samples Vary

Two groups can repeat the same fair experiment and record different totals

Random variation is expected.

A short streak is possible and cannot prove the equipment is unfair.



Sample Size Matters

Small samples can vary widely.

As the number of trials increases, relative frequencies usually become more stable and move closer to theoretical probabilities.

They do not need to match exactly.



A Fair Six-Sided Die

Outcomes: 1, 2, 3, 4, 5, 6

Each outcome has probability $1/6$

An even number has probability $1/2$.



Unequal Outcomes

Imagine a die labelled A, A, A, B, C, D.

$$p(A) = 3/6 = 1/2$$

$$p(B) = p(C) = p(D) = 1/6$$

A should occur most often over many trials.



Fair or Biased?

A fair spinner gives equal-sized regions to outcomes, meaning that each outcome has an equal chance.

A biased spinner gives some outcomes a greater chance.

Use design evidence to compare results together.



Playing Cards

A standard deck has 52 cards.

$$p(\text{red}) = 26/52 = 1/2$$

$$p(\text{heart}) = 13/52 = 1/4$$

$$p(\text{ace}) = 4/52 = 1/13$$

Problem: keep these probabilities constant.



Marbles With Replacement

Bag: 5 red, 3 blue, 2 yellow marbles.

$$p(\text{red}) = 1/2 \quad p(\text{blue}) = 3/10 \quad p(\text{yellow}) = 1/5$$

Replace and mix every time you pull. Each trial begins the same way.



Without Replacement

When an item is not replaced, the bag or deck composition changes.

The probabilities for the next trial change to

Trials are no longer independent conditions.



Compare Results

Ask:

- Which outcome occurred most and least often?
- How close were relative frequencies to theoretical probabilities?
- What variation appeared between rounds or groups?
- Would more trials change the estimate?



Design a Fair Test

- State a prediction.
- Use the same equipment and method every trial.
- Complete a suitable number of trials.
- Record every result in a tally or table.
- Compare relative frequencies with expected probabilities.



Review

PREDICT possible results.

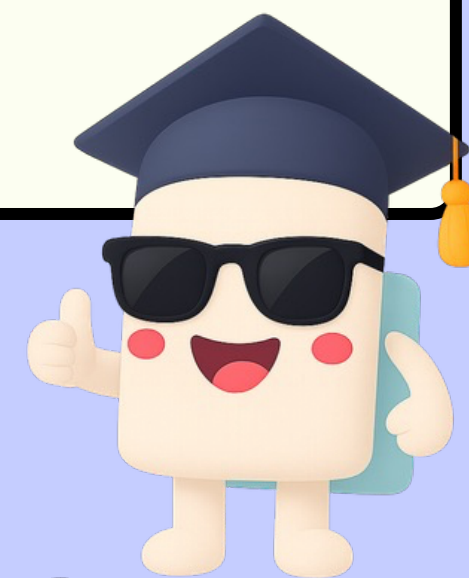
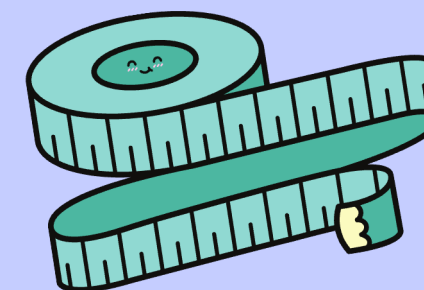
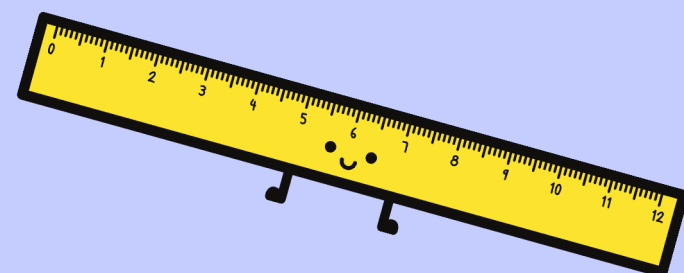
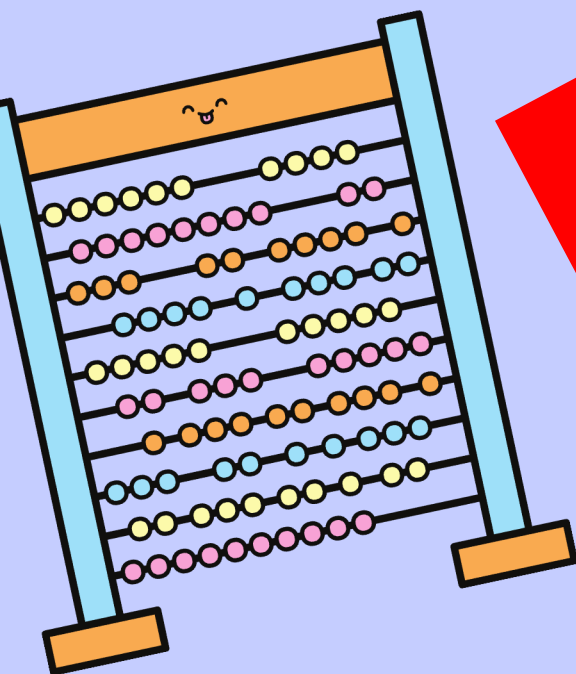
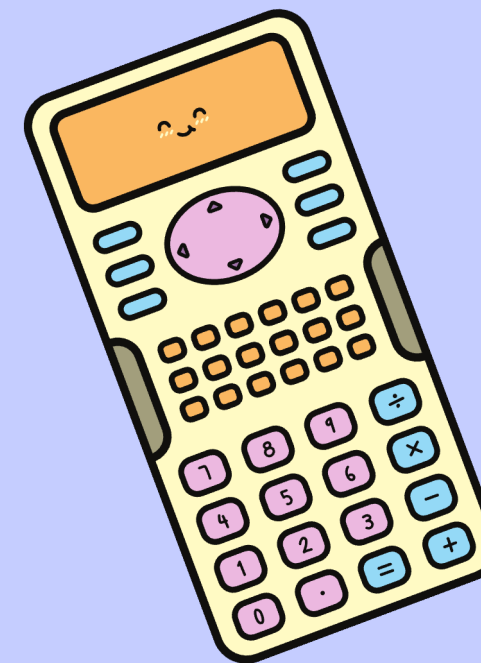
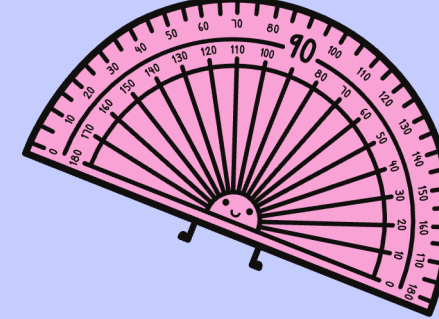
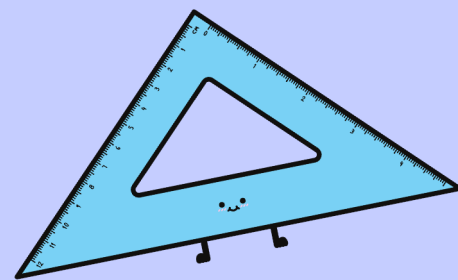
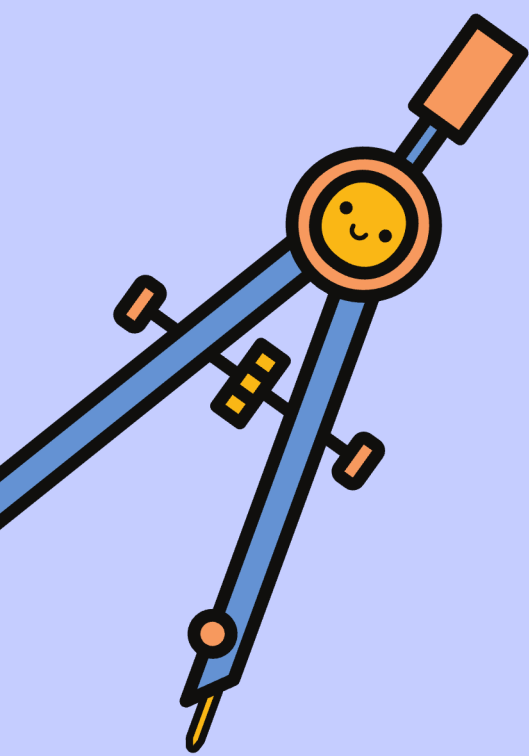
REPEAT the chance experiment.

RECORD frequencies accurately.

COMPARE observed and expected results.

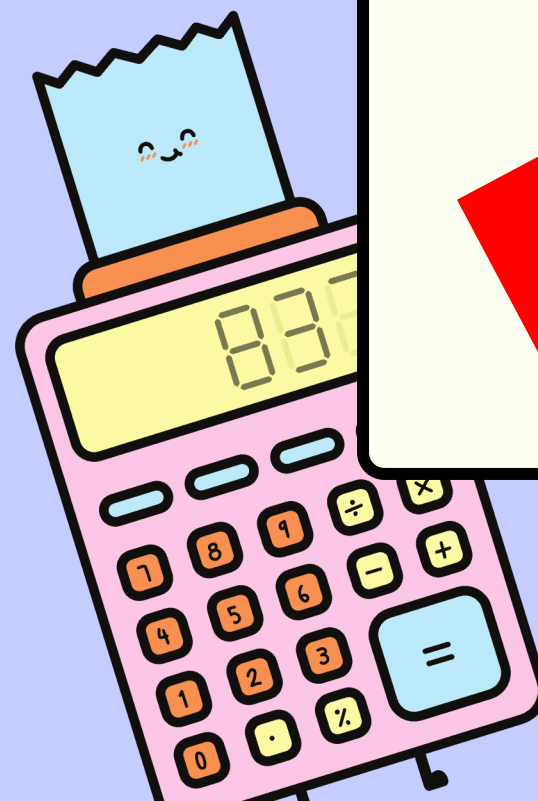
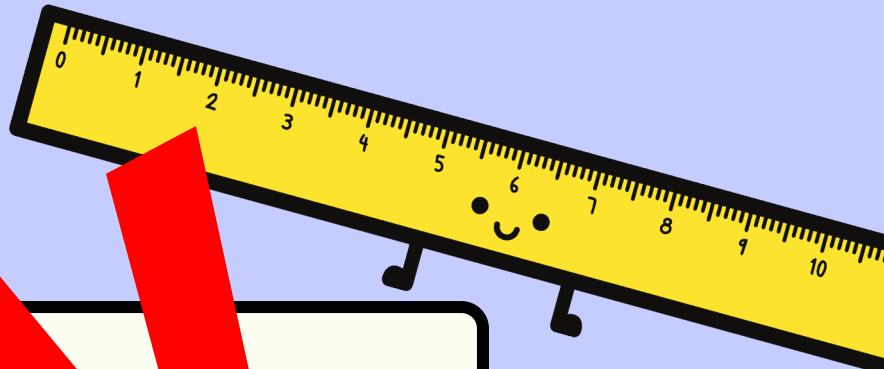
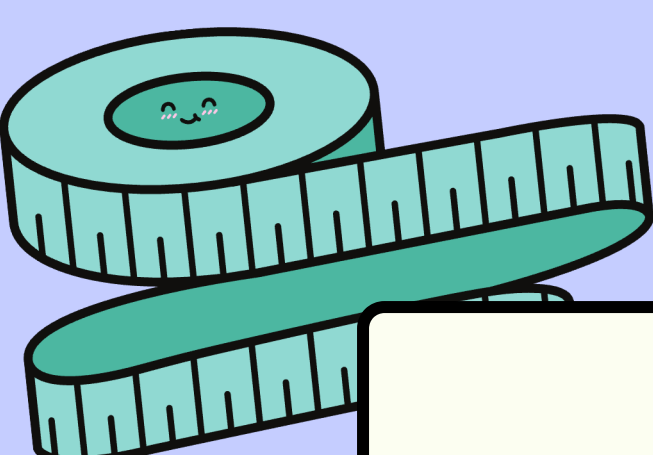
EXPLAIN variation in effect of sample size.





PREVIEW

Well Done
Now conduct your own repeated
chance experiments.



PREVIEW

Repeated Chance Experiments Quiz



Question 1 – True or False

A chance experiment can have known possible outcomes even though the next result is unknown.

TRUE or FALSE?



Answer 1

TRUE

We can list the possible outcomes, but we cannot know which one will occur next.



Question 2 – Multiple Choice

What is the theoretical probability of rolling an even number on a fair six-sided die?

- A. $1/6$
- B. $1/3$
- C. $1/2$
- D. $2/3$



Answer 2

C. $\frac{1}{2}$

The even outcomes are 2, 4 and 6. The probability is $\frac{3}{6} = \frac{1}{2}$.



Question 3 – Short Answer

A coin lands Heads 18 times in 30 tosses.

What is the experimental relative frequency of heads?



Answer 3

$$18/30 = 3/5 = 0.6$$

PREVIEW



Question 4 – Multiple Choice

Which spinner is biased?

- A. Four equal colour sections
- B. Two equal halves
- C. Eight equal number sections
- D. Sections size $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ and $\frac{1}{8}$



Answer 4

D

The sections are unequal, so the companies do not have equal chances.



Question 5 – True or False

Ten Heads in a row is impossible when tossing a fair coin

TRUE or FALSE?



Answer 5

FALSE

A long streak is unlikely, but it is possible.



Question 6 – Short Answer

Two groups use the same fair spinner for 30 trials and obtain different totals.

Why can this happen?



Answer 6

Random variation occurs in repeated chance experiments, especially with smaller samples.

PREVIEW



Question 7 – Multiple Choice

What usually happens when trials increase from 20 to 200?

- A. Variation becomes impossible
- B. Relative frequencies become more stable
- C. Every outcome occurs an equal number of times
- D. Theoretical probabilities change



Answer 7

B. Relative frequencies become more stable.

A larger sample usually gives a better estimate of theoretical probability.



Question 8 – Short Answer

What is the probability of drawing a red card from a standard 52-card deck?

PREVIEW



Answer 8

$$26/52 = 1/2$$

PREVIEW



Question 9 – True or False

Replacing a marble after every pull keeps the bag composition and probabilities constant.

TRUE or FALSE?

PREVIEW



Answer 9

TRUE

Each trial begins with the same set of possible outcomes.



Question 10 – Multiple Choice

Which procedure is the fairest test of a die?

- A. Roll until a 6 appears
- B. Roll 100 times in the same way and record every result
- C. Ignore results that are 1 or 2 if the die is 1 or 2
- D. Change dice halfway through

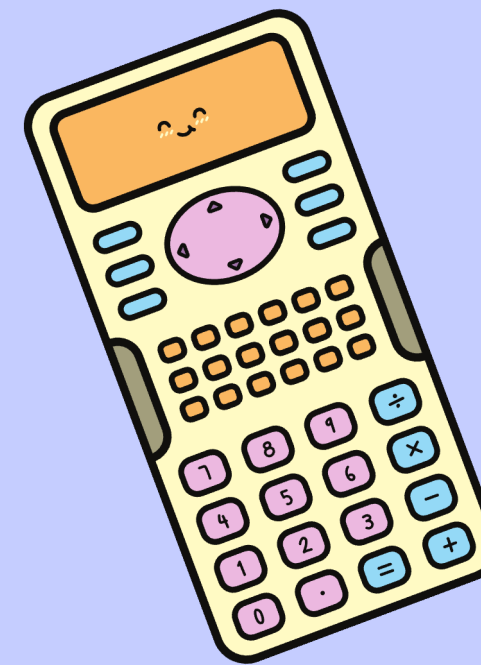
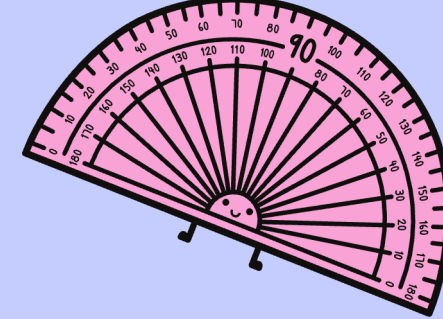
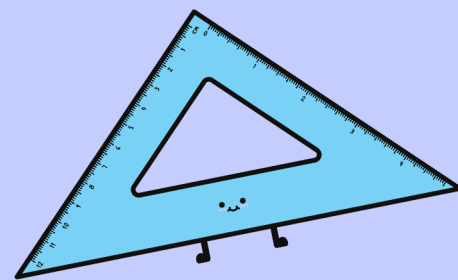
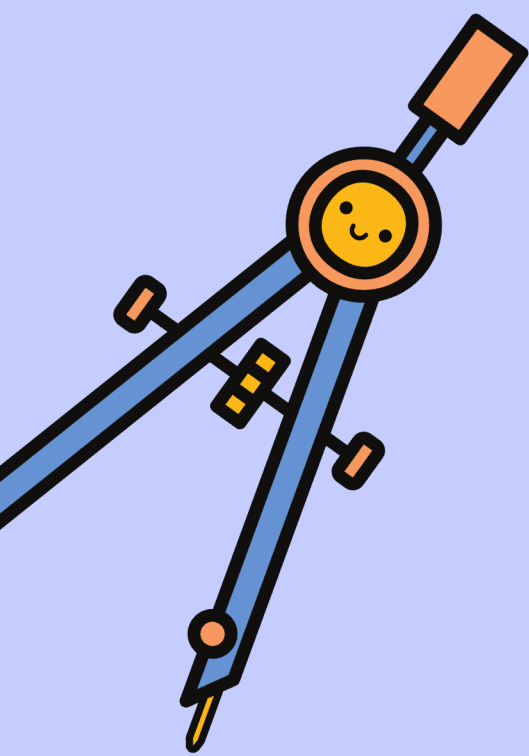


Answer 10

B

Use one consistent method, maintain records and keep a complete record of results.





PREVIEW

Well done!
You have completed the quiz.

