

## PRINTABLE MATHS ACTIVITY PACK

# PROBABILITY GAMES & EXPERIMENTS

Predict • Play • Test • Analyse

| PROBABILITY             | GAMES            | EXPERIMENTS              |
|-------------------------|------------------|--------------------------|
| Scale & vocabulary      | Coins & dice     | Record outcomes          |
| Sample spaces           | Spinners & cards | Experimental probability |
| Fractions & percentages | Counters         | Compare theory & results |
| Fair / unfair games     | Design a game    | Analyse variation        |

**Suggested age:** 10–14 years | **Grades:** 5–8

**Includes:** probability basics, sample spaces, hands-on experiments, game-based challenges, fairness investigations, game design, probability and data analysis, plus answer key.

A practical, low-prep resource designed to make probability active, visual and meaningful.

## TEACHER / PARENT GUIDE

Use the activities individually or as a mini probability unit.

| STEP | GUIDANCE                                                                        |
|------|---------------------------------------------------------------------------------|
| 1    | Introduce probability vocabulary and the 0–1 probability scale.                 |
| 2    | Ask students to predict before they play or experiment.                         |
| 3    | Run repeated trials and record every outcome carefully.                         |
| 4    | Calculate experimental probability and compare it with theoretical probability. |
| 5    | Discuss why results vary and whether games are fair.                            |

**Key idea:** Experimental probability can differ from theoretical probability because of chance variation. Increasing the number of trials often makes experimental results closer to the theoretical model.

**Vocabulary:** outcome • event • sample space • theoretical probability • experimental probability • equally likely • fair • unfair • trial • random

# 1 • PROBABILITY SCALE & VOCABULARY

Build the foundations.

**A. Place each event on the scale: 0 = impossible, 1 = certain.**

| EVENT                                                | PROBABILITY |
|------------------------------------------------------|-------------|
| The sun rises tomorrow.                              | _____       |
| Rolling a 7 on a standard six-sided die.             | _____       |
| Picking red from a bag containing only red counters. | _____       |
| Getting heads on a fair coin.                        | _____       |
| Rolling an even number on a standard die.            | _____       |

**B. Match the terms.**

| TERM                    | MEANING                                      |
|-------------------------|----------------------------------------------|
| Outcome                 | A. All possible results                      |
| Event                   | B. One result of a trial                     |
| Sample space            | C. A collection of outcomes being considered |
| Theoretical probability | D. Probability predicted mathematically      |

**C. What does *equally likely* mean?**

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## 2 • SAMPLE SPACES & PROBABILITY

List outcomes before calculating.

A. One coin toss: Sample space = { \_\_\_\_\_ }

P(heads) = \_\_\_\_\_ P(tails) = \_\_\_\_\_

B. One die: Sample space = { \_\_\_\_\_ }

P(4) = \_\_\_\_\_ P(odd) = \_\_\_\_\_ P(number > 4) = \_\_\_\_\_

C. Two coin tosses: List all ordered outcomes: \_\_\_\_\_

Number of outcomes = \_\_\_\_\_ P(exactly one head) = \_\_\_\_\_

D. A fair spinner has 8 equal sections numbered 1–8.

P(even) = \_\_\_\_\_ P(multiple of 3) = \_\_\_\_\_ P(number < 5) = \_\_\_\_\_

**Challenge:** Why is it useful to write a sample space before finding a probability?

### 3 • GAME 1: COIN FLIP EXPERIMENT

Predict → toss → record → compare.

**Materials:** one fair coin. Toss 50 times. Record the number of heads and tails.

| OUTCOME | COUNT |
|---------|-------|
| Heads   | _____ |
| Tails   | _____ |
| TOTAL   | 50    |

1. Experimental  $P(\text{heads}) = \frac{\text{Heads}}{50} = \frac{\text{Heads}}{50} \times 100\%$

2. Experimental  $P(\text{tails}) = \frac{\text{Tails}}{50} = \frac{\text{Tails}}{50} \times 100\%$

3. Theoretical  $P(\text{heads}) = \frac{1}{2} = 50\%$

4. Were your results exactly the same as the theoretical probability? \_\_\_\_\_

5. Explain one reason your results may differ.

## 4 • GAME 2: DICE DATA LAB

Investigate how often different outcomes appear.

Roll a fair six-sided die **60 times**. Tally every result.

| ROLL      | 1 | 2 | 3 | 4 | 5 | 6 | TOTAL |
|-----------|---|---|---|---|---|---|-------|
| TALLY     |   |   |   |   |   |   |       |
| FREQUENCY |   |   |   |   |   |   |       |

1. Experimental  $P(3)$  = \_\_\_\_\_

2. Experimental  $P(\text{even})$  = \_\_\_\_\_

3. Theoretical  $P(\text{even})$  = \_\_\_\_\_

4. Which result appeared most often? \_\_\_\_\_

5. Would another 60 rolls give exactly the same frequencies? Explain.

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## 5 • GAME 3: SPINNER CHALLENGE

Compare prediction with experimental results.

**A spinner has 10 equal sections: 4 blue, 3 green, 2 yellow and 1 red.**

| COLOUR | THEORETICAL | PERCENT |
|--------|-------------|---------|
| Blue   | 4/10        | ____ %  |
| Green  | 3/10        | ____ %  |
| Yellow | 2/10        | ____ %  |
| Red    | 1/10        | ____ %  |

**Now spin 50 times.**

| COLOUR | COUNT | EXPERIMENTAL PROBABILITY |
|--------|-------|--------------------------|
| Blue   | _____ | _____                    |
| Green  | _____ | _____                    |
| Yellow | _____ | _____                    |
| Red    | _____ | _____                    |
| TOTAL  | 50    | 1                        |

**Which colour was most likely theoretically? \_\_\_\_\_ Did your experiment agree? \_\_\_\_\_**

## 6 • GAME 4: CARD PROBABILITY

Use a standard 52-card deck.

Assume 52 cards, 4 suits and 13 cards in each suit.

| EVENT                                         | PROBABILITY |
|-----------------------------------------------|-------------|
| Drawing a heart                               | _____       |
| Drawing a spade                               | _____       |
| Drawing an ace                                | _____       |
| Drawing a red card                            | _____       |
| Drawing a face card (J, Q or K)               | _____       |
| Drawing a card greater than 9 (10, J, Q or K) | _____       |

**Challenge:** Which is more likely—drawing a red card or a face card? Explain.

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## 7 • COUNTER BAG EXPERIMENT

Explore experimental probability.

A bag contains 5 blue counters and 3 yellow counters. Replace the counter after every draw. Run 40 trials.

| COLOUR | COUNT | EXPERIMENTAL P | THEORETICAL P |
|--------|-------|----------------|---------------|
| Blue   | _____ | _____          | 5/8           |
| Yellow | _____ | _____          | 3/8           |
| TOTAL  | 40    | 1              | 1             |

1. Which experimental probability was closer to its theoretical value? \_\_\_\_\_

2. Did you get exactly 25 blue and 15 yellow? \_\_\_\_\_

3. Repeat for another 40 trials. Compare the combined 80-trial results with the first 40.

\_\_\_\_\_

## 8 • FAIR OR UNFAIR?

Use probability to evaluate games.

**Game A: Coin toss. Player A wins heads; Player B wins tails. Fair or unfair? Explain.**

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**Game B: Die roll. Player A wins 1 or 2; Player B wins 3, 4, 5 or 6. Fair or unfair? Explain.**

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**Game C: An 8-section fair spinner gives Player A 1–4 and Player B 5–8. Fair or unfair?**

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**Make Game B fair. Write new rules.**

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## 9 • DESIGN YOUR OWN PROBABILITY GAME

Create, calculate and test.

**Mission:** Design a game using a coin, die, spinner or counters. Include at least two possible outcomes.

**Game name:** \_\_\_\_\_

**Materials:** \_\_\_\_\_

**Rules:**

\_\_\_\_\_  
\_\_\_\_\_

**Theoretical probabilities:**

| OUTCOME      | FAVOURABLE | TOTAL | PROBABILITY |
|--------------|------------|-------|-------------|
| A            | _____      | _____ | _____       |
| B            | _____      | _____ | _____       |
| C (optional) | _____      | _____ | _____       |

**Is your game fair? Why?**

\_\_\_\_\_

## 10 • PROBABILITY MASTER CHALLENGE

Show your reasoning.

1. A fair die is rolled.  $P(\text{even and greater than 3}) =$  \_\_\_\_\_
2. Two fair coins are tossed.  $P(\text{two heads}) =$  \_\_\_\_\_
3. A bag has 6 red, 4 blue and 5 green counters.  $P(\text{blue}) =$  \_\_\_\_\_
4. Using the same bag,  $P(\text{not green}) =$  \_\_\_\_\_
5. A 12-section fair spinner has 5 orange sections. What percentage are not orange? \_\_\_\_\_
6. A student rolls a die 120 times and gets a 6 on 27 occasions. Experimental  $P(6) =$  \_\_\_\_\_
7. Compare that result with theoretical  $P(6) = 1/6$ . What do you notice?

**Explain one answer in detail:**

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## 11 • RESULTS & REFLECTION

Turn experimental results into conclusions.

A spinner experiment of 100 trials produced:

| COLOUR  | BLUE | GREEN | YELLOW | RED |
|---------|------|-------|--------|-----|
| RESULTS | 42   | 31    | 18     | 9   |

### 1. Find each experimental probability.

| COLOUR | PROBABILITY |
|--------|-------------|
| Blue   | _____       |
| Green  | _____       |
| Yellow | _____       |
| Red    | _____       |

2. Which occurred least often? \_\_\_\_\_

3. A theoretical model gives probabilities 0.4, 0.3, 0.2 and 0.1. Which experimental result is closest to each model?

4. Overall, do the results appear reasonably close to the model? Explain.

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## ANSWER KEY • 1–6

Teacher / parent reference.

1. Scale: 1, 0, 1,  $\frac{1}{2}$ ,  $\frac{1}{2}$ . Vocabulary: Outcome = one result; Event = collection of outcomes; Sample space = all possible results; Theoretical probability = predicted probability.
2. Coin: {H,T};  $P(H)=\frac{1}{2}$ ,  $P(T)=\frac{1}{2}$ . Die: {1,2,3,4,5,6};  $P(4)=\frac{1}{6}$ ;  $P(\text{odd})=\frac{1}{2}$ ;  $P(>4)=\frac{1}{3}$ . Two coins: {HH,HT,TH,TT}; exactly one head =  $\frac{1}{2}$ . Spinner: even =  $\frac{1}{2}$ ; multiple of 3 =  $\frac{1}{4}$ ; less than 5 =  $\frac{1}{2}$ .
3. Coin experiment: theoretical heads/tails =  $\frac{1}{2}$  each; experimental answers depend on student results.
4. Dice experiment: theoretical  $P(\text{even})=\frac{1}{2}$ ; experimental answers depend on results.
5. Spinner: blue 40%, green 30%, yellow 20%, red 10%; experimental results vary.
6. Cards: heart  $\frac{1}{4}$ ; spade  $\frac{1}{4}$ ; ace  $\frac{1}{13}$ ; red  $\frac{1}{2}$ ; face card  $\frac{3}{13}$ ; greater than 9 =  $\frac{4}{13}$ . Red is more likely.

## ANSWER KEY • 7–11

Teacher / parent reference.

7. Counter bag: theoretical blue =  $\frac{5}{8}$ ; yellow =  $\frac{3}{8}$ . Experimental answers depend on trials.

8. Game A fair ( $\frac{1}{2}$  vs  $\frac{1}{2}$ ). Game B unfair ( $\frac{1}{3}$  vs  $\frac{2}{3}$ ). Game C fair ( $\frac{1}{2}$  vs  $\frac{1}{2}$ ). A fair Game B could give Player A 1–3 and Player B 4–6.

9. Game design: answers vary; check calculations and fairness reasoning.

10. Master Challenge: 1 =  $\frac{1}{3}$ ; 2 =  $\frac{1}{4}$ ; 3 =  $\frac{4}{15}$ ; 4 =  $\frac{2}{3}$ ; 5 =  $\frac{7}{12} = 58\frac{1}{3}\%$ ; 6 =  $\frac{27}{120} = \frac{9}{40} = 0.225 = 22.5\%$ . 7: experimental probability is higher than  $\frac{1}{6}$ .

11. Blue = 0.42, Green = 0.31, Yellow = 0.18, Red = 0.09. Least often: red. Compared with 0.4, 0.3, 0.2, 0.1, the differences are 0.02, 0.01, 0.02 and 0.01; overall the results are reasonably close.

**Marketplace positioning:** A hands-on Probability Games & Experiments resource combining theoretical probability, sample spaces, games, repeated trials, experimental probability, fairness, data analysis and mathematical reasoning.