MONTH 10

Probability & Game Fairness

Predict, Test & Decide

Month 10 explores how mathematics helps us reason about uncertain events. Students build sample spaces, calculate theoretical probability, collect experimental results, compare games, and decide whether rules give players equal chances.

WHY THIS MONTH MATTERS

Students move from solving individual problems toward organizing evidence, selecting representations, and explaining strategies that can be reused in unfamiliar situations.

Students Should Be Able To:

- List all possible outcomes systematically.
- Express probability as a fraction.
- Compare theoretical and experimental results.
- Recognize equally likely outcomes.
- Decide whether a game is fair.
- Revise rules using mathematical evidence.

Skills We Will Practice

- Sample spaces
- Fractions and ratios
- Theoretical probability
- Experimental probability
- Game analysis
- Evidence-based revision

This Month's Activities

- The Sum of Seven
- Spinner Prediction
- Two-Coin Sample Space
- Mystery Marble Bag
- Even or Odd?
- Experiment vs. Theory

Connection to Month 12

The month develops a different kind of mathematical maturity: organizing possibilities, evaluating uncertainty, or interpreting evidence. These habits will be essential during the final multi-topic Math Mania Challenge.

ACTIVITY 1

The Sum of Seven

Solve, represent, and explain your reasoning.

THE CHALLENGE

Two six-sided dice are rolled. What is the probability that the sum is 7?

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

WHAT TO RECORD

Count favorable outcomes and all possible outcomes.

Hint: Look for the six ordered pairs that total 7.

FINISHED EARLY? TRY THESE CHALLENGES

1. What is the probability that two dice total 8?

2. Which sum is more likely: 2 or 7? Explain with outcome counts.

Show Your Strategy

FINAL ANSWER: _____

ACTIVITY 2

Spinner Prediction

Solve, represent, and explain your reasoning.

THE CHALLENGE

A spinner has 8 equal sections: 3 teal, 3 gold, and 2 navy. What is the probability of landing on teal?



WHAT TO RECORD

Equal sections create equally likely outcomes.

Hint: Probability = favorable sections / total sections.

FINISHED EARLY? TRY THESE CHALLENGES

1. What is the probability of not landing on navy?

2. If one teal section becomes navy, what is the new probability of teal?

Show Your Strategy

FINAL ANSWER: _____

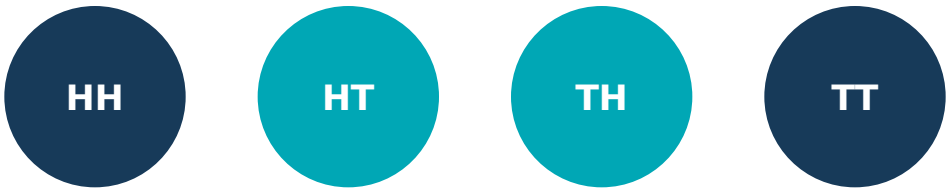
ACTIVITY 3

Two-Coin Sample Space

Solve, represent, and explain your reasoning.

THE CHALLENGE

Two fair coins are flipped. What is the probability of getting exactly one head?



WHAT TO RECORD

List HH, HT, TH, and TT.

Hint: HT and TH are different outcomes.

FINISHED EARLY? TRY THESE CHALLENGES

1. What is the probability of at least one head?

2. What is the probability that both coins match?

Show Your Strategy

FINAL ANSWER: _____

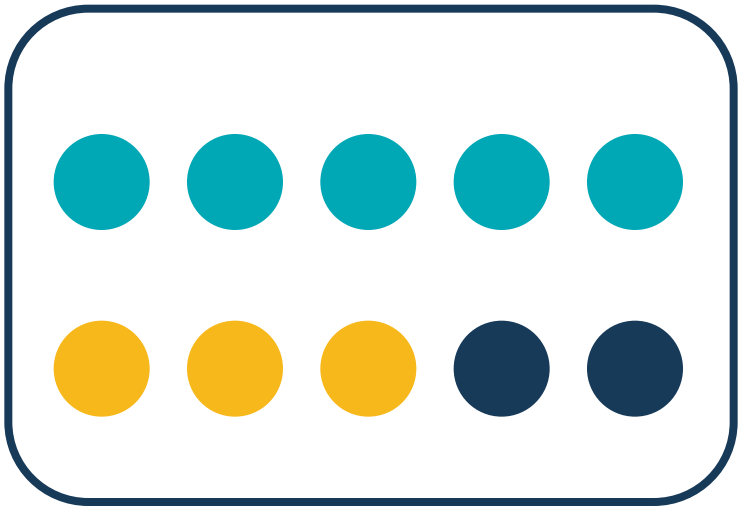
ACTIVITY 4

Mystery Marble Bag

Solve, represent, and explain your reasoning.

THE CHALLENGE

A bag contains 5 teal, 3 gold, and 2 navy marbles. What is the probability of drawing a marble that is not gold?



WHAT TO RECORD

Assume one marble is drawn without looking.

Hint: Count teal and navy as favorable outcomes.

FINISHED EARLY? TRY THESE CHALLENGES

1. Without replacement, what is the probability that two draws are both teal?

2. What color is most likely on the first draw, and why?

Show Your Strategy

FINAL ANSWER: _____

ACTIVITY 5

Even or Odd?

Solve, represent, and explain your reasoning.

THE CHALLENGE

Player A scores on an even die roll. Player B scores on an odd die roll. Is the game fair? Explain.



Player A: even **Player B: odd**

WHAT TO RECORD

Compare the number of even and odd faces.

Hint: A fair game gives both players the same probability.

FINISHED EARLY? TRY THESE CHALLENGES

1. Player A wins on 1-4; Player B wins on 5-6. Is this fair?

2. Design two different winning sets that make the game fair.

Show Your Strategy

FINAL ANSWER: _____

ACTIVITY 6

Experiment vs. Theory

Solve, represent, and explain your reasoning.

THE CHALLENGE

A spinner lands blue 14 times in 40 spins. The theoretical probability of blue is 3/8. Compare the experimental and theoretical probabilities.



Experimental 35% **Theoretical 37.5%**

WHAT TO RECORD

Convert both probabilities to decimals or equivalent fractions.

Hint: Experimental results may be close without being identical.

FINISHED EARLY? TRY THESE CHALLENGES

1. At probability 3/8, how many blue results are expected in 200 spins?

2. Must 200 spins produce exactly the theoretical percentage? Explain.

Show Your Strategy

FINAL ANSWER: _____

FINAL ACTIVITY

Design a Fair Game

Plan, represent, test, and communicate.

YOUR MISSION

Create a game using one die, two coins, or an equal-section spinner. Write the rules, list the complete sample space, calculate each player's chance of winning, test the game at least 20 times, and revise any rule that creates an unintended advantage.

Project Checklist

- Write a clear question or goal.
- Choose an organized mathematical representation.
- Show calculations and label evidence.
- Explain the strategy or conclusion.
- Check the result and identify a limitation or possible revision.

Planning Space

INSTRUCTOR SECTION

Month 10 Answer Key

Probability & Game Fairness

1. The Sum of Seven

6 favorable outcomes out of 36; 6/36 = 1/6.

2. Spinner Prediction

3 teal sections out of 8; probability 3/8.

3. Two-Coin Sample Space

HT and TH; 2/4 = 1/2.

4. Mystery Marble Bag

7 non-gold marbles out of 10; probability 7/10.

5. Even or Odd?

Fair: 3 even faces and 3 odd faces, so each player has probability 1/2.

6. Experiment vs. Theory

14/40 = 0.35; 3/8 = 0.375. Experimental is 0.025 lower.

Project

Answers vary. A valid design must show equal intended winning probabilities or explain the revised rules.

INSTRUCTOR SECTION

Month 10 Extension Answers

Solutions for the finished-early questions

1. The Sum of Seven

Challenge 1: Five outcomes; probability 5/36.

Challenge 2: Seven: 6 outcomes versus 1 for a sum of 2.

2. Spinner Prediction

Challenge 1: 6/8 = 3/4.

Challenge 2: 2/8 = 1/4.

3. Two-Coin Sample Space

Challenge 1: HH, HT, TH: 3/4.

Challenge 2: HH or TT: 2/4 = 1/2.

4. Mystery Marble Bag

Challenge 1: 5/10 x 4/9 = 2/9.

Challenge 2: Teal, because 5 of 10 marbles are teal.

5. Even or Odd?

Challenge 1: No. A has 4/6; B has 2/6.

Challenge 2: Any three-face split, such as {1,2,6} and {3,4,5}.

6. Experiment vs. Theory

Challenge 1: 200 x 3/8 = 75.

Challenge 2: No. Experimental results vary, even over many trials.