AFTERSCHOOL TRAINING TOOLKIT

Math Games

What's the Chance? (Teacher's Guide)

Have you ever wondered if games are fair? Here is a chance to play a game based on probability, and learn how to determine your chances of winning the game.

What's the Chance? is a game based on probability. Play this game with a partner. In order to play, you will need to use a game board that looks like this, a marker, and an even-sided number cube or die:

1	1	2	1 Start Here	2	1	1

Begin by placing the marker on the center box, labeled *1 – Start Here*. Player 1 begins by rolling the die. If an even number is rolled, the marker is moved one space to the right; if an odd number is rolled, the marker is moved one space to the left. Each player's turn consist of three rolls of the die and corresponding marker moves. **At the end of each turn**, a point is scored by one of the players. If the marker ends on an orange box, Player 1 receives a point. If the marker ends on a blue box, Player 2 receives a point. At the end of each turn, return the marker to the *1 – Start Here box*. Players alternate turns.

A game consists of 10 turns – 5 turns for each player. At the end of 10 turns, the player with the most points is the winner.

Before you begin, think about whether the game *appears* to be fair. Why do you think so? Who do you predict will win?

You might want to use a table like the one below and tally marks to keep track of points. Play at least 10 games to see if any patterns emerge. Your Game 1 row might look something like this, where Player 1 is the winner:

	Player 1	**Player 2**
Game 1	~~||||~~ |	||||

	Player 1	Player 2
Game 1		
Game 2		
Game 3		
Game 4		
Game 5		
Game 6		
Game 7		
Game 8		
Game 9		
Game10		

Questions:

1. Based on your experimental data, do you think the game is fair? Why or why not? If you think the game is unfair, how could you modify the game to make it a fair game?
   The game is not a fair game, although experimental results will vary. Player #2 has a 75% chance of winning, while Player #1 has only a 25% chance of winning.

   Students will create various fair games. The idea is to find a game where each player has an equal chance of winning.

2. Create a list of all the different possible outcomes for Players 1 and 2. For example, EVEN, EVEN, ODD is one possible outcome, and Player 2 would win.

Outcome	Winner
EVEN, EVEN, EVEN	Player #1
EVEN, EVEN, ODD	Player #2
EVEN, ODD, EVEN	Player #2
EVEN, ODD, ODD	Player #2
ODD, EVEN, EVEN	Player #2
ODD, EVEN, ODD	Player #2
ODD, ODD, EVEN	Player #2
ODD, ODD, ODD	Player #1

3. What is the theoretical probability of Player 1 winning a game? How about Player 2 winning a game? Use a list or tree diagram to help you decide.

The list created in Question 3 can be used for students to explain that, out of 8 possible outcomes, Player #2 will win 6 of the games, and Player #1 will win 2 of the games (theoretically). Here is a tree diagram showing the theoretical probability:

Roll 1	Roll 2	Roll 3	Probability	Winner
		EVEN	1/8	Player #1
	EVEN			
		ODD	1/8	Player #2
EVEN				
		EVEN	1/8	Player #2
	ODD			
		ODD	1/8	Player #2
		EVEN	1/8	Player #2
	EVEN			
		ODD	1/8	Player #2
ODD				
		EVEN	1/8	Player #2
	ODD			
		ODD	1/8	Player #1

Each event is equally likely, with a probability of 1/8. Out of the 8 events, Player #2 wins six times, and Player #1 wins two times. This leads to our theoretical probabilities: the probability of Player #1 winning is 2/8, or 1/4. The probability of Player #2 winning is 6/8, or 3/4.

4. How does the theoretical probability compare to the experimental probability (your results from actually playing the game)? Explain why the experimental results might be different than the theoretical probability.
   Answers will vary, based on the results of the experiments.

Extension Activities

Part 1. Add one square on either end of the game board, so that it looks like this:

2	1	1	2	1 Start Here	2	1	1	2

Play the game as described above. However, each turn consists of 4 rolls of the die. A game is still 10 turns – 5 turns for each player. Players alternate turns. If the marker lands on an orange box, Player 1 scores a point. If the marker lands on a blue box, Player 2 scores a . At the end of 10 turns, the player with the most points is the game winner.

Before you play the game, predict who you think will win the most games. Why do you think so?

Play 10 games, and record your results.

Questions:

1. Based on your experimental data, do you think the game is fair? Why or why not? If you think the game is unfair, how could you modify the game to make it a fair game?

   The game is not a fair game, although experimental results will vary. Player #1 has an 87.5% chance of winning, while Player # has only a 12.5% chance of winning.

   Students will create various fair games. The idea is to find a game where each player has an equal chance of winning.

2. Create a list of all the different possible outcomes for Players 1 and 2. For example, EVEN, EVEN, ODD, EVEN is one possible outcome, and Player 1 would win.

Outcome	Winner
EVEN, EVEN, EVEN, EVEN	Player #2
EVEN, EVEN, EVEN, ODD	Player #1
EVEN, EVEN, ODD, EVEN	Player #1
EVEN, EVEN, ODD, ODD	Player #1
EVEN, ODD, EVEN, EVEN	Player #1
EVEN, ODD, EVEN, ODD	Player #1
EVEN, ODD, ODD, EVEN	Player #1
EVEN, ODD, ODD, ODD	Player #1
ODD, EVEN, EVEN, EVEN	Player #1
ODD, EVEN, EVEN, ODD	Player #1
ODD, EVEN, ODD, EVEN	Player #1
ODD, EVEN, ODD, ODD	Player #1
ODD, ODD, EVEN, EVEN	Player #1
ODD, ODD, EVEN, ODD	Player #1
ODD, ODD, ODD, EVEN	Player #1
ODD, ODD, ODD, ODD	Player #2

There are sixteen equally likely outcomes.

3. What is the theoretical probability of Player 1 winning a game? How about Player 2 winning a game? Use a list or tree diagram to help you decide.

   The list created in Question 3 can be used for students to explain that, out of 16 possible outcomes, Player #2 will win 2 of the games, and Player #1 will win 14 of the games (theoretically).
   Each event is equally likely, with a probability of 1/16. Out of the 16 events, Player #2 wins two times, and Player #1 wins fourteen times. This leads to our theoretical probabilities: the probability of Player #1 winning is 14/16, or 7/8. The probability of Player #2 winning is 2/16, or 1/8.

4. How does the theoretical probability compare to the experimental probability (your results from actually playing the game)? Explain why the experimental results might be different than the theoretical probability.
   Answers will vary, based on the results of the experiments.

Part 2. Create your own game, based on ideas similar to *What's the Chance?*