Name_____ Date _____

Chapter 7 Performance Task

Fair and Unfair Carnival Games

How can someone use theoretical probability to his or her advantage?

You and your friends are in charge of setting up a carnival booth at a fundraiser. Together your team designs and creates a Rock Papers Scissors board. The board is covered in a grid of 24 envelopes. Inside each envelope is a slip of paper with the word "Rock," "Paper," or "Scissors." Each word is used exactly 8 times.

For $1, a student can come up and show "Rock," "Paper," or "Scissors" and then open an envelope at random. If the student beats the envelope, he or she receives a dollar back. If the student loses or ties, the dollar is donated to the fundraiser.

1. How much money should your team expect to raise if 100 students play and they all show "Paper?"

2. Is the probability in Exercise 1 theoretical or experimental? Explain your reasoning.

3. If you knew that all students show "Rock," how could you design the board so that the carnival makes money $\frac{7}{8}$ of the time? 50% of the time?

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Chapter 7

Performance Task (continued)

Fair and Unfair Carnival Games

4. Your team decides to change the rules of the game. Now, if a student ties with the envelope, the student gets to have a second chance to play. The student gets to choose whether he or she wants to keep all 24 envelopes to choose from *or* eliminate the envelope he or she just opened. If the student decides to keep all 24 envelopes, your team will rearrange the slips of paper in the envelopes first. If the student happens to tie again, the student's dollar is donated to the fundraiser and his or her turn is over. Which would be a better choice for the student if he or she wants the dollar back? Which would be a better choice for your team if you want to raise more money? Justify your answers using probabilities.

5. Design an "unfair" carnival game using a spinner or a number cube. Calculate your classmates' theoretical probability of winning. Have a classmate play your game and record his or her experimental probability of winning.

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Chapter 7 Performance Task (continued)

Fair and Unfair Carnival Games

Instructional Overview	
Launch Question	How can someone use theoretical probability to his or her advantage?
Summary	Students will apply their knowledge of theoretical and experimental probability to analyze whether a carnival game is fair. Students will then compare the probabilities of winning the carnival game with dependent and independent events. Students will summarize their knowledge of probability by creating unfair carnival games.
Teacher Notes	Students may be unaware of how to play Rock Paper Scissors. Model this game with students. You may need to review the definition of a compound event and re-discuss the difference between dependent and independent events. Discuss with students how these events are present in this carnival game task. Present students with the following example for extra practice with these terms: "I am choosing 2 students to be my class leaders. Could the same person be picked twice? How would that affect the probability of you getting chosen? What would the sample space look like? What is the probability you are chosen?"
Supplies	Copies of the task, spinners, number cubes
Mathematical Discourse	Do you have a greater chance of winning a carnival game that uses independent events or dependent events?
Writing/Discussion Prompts	1. State a time when you saw someone use theoretical probability to his or her advantage. 2. After playing a classmate's "unfair" carnival game, what was the "unfair" part of it? Give your classmate a recommendation on how to make the game fair.

Curriculum Content	
Content Objectives	• The student will use experimental probabilities to make predictions. • The student will use theoretical probabilities to find quantities. • The student will compare experimental and theoretical probabilities.
Mathematical Practices	• Create sound arguments and analyze the arguments of others. Students will make their own "unfair" carnival games based on theoretical probabilities and evaluate their classmates' games. • Construct visual and conceptual mathematics tools. Students will apply their knowledge of independent and dependent probabilities to games based on chance using things such as spinners and number cubes. • Solve problems carefully and accurately. Students will compute theoretical probabilities based on expected experimental probabilities.

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Chapter 7 Performance Task (continued)

Rubric

Fair and Unfair Carnival Games	Points
1. about \$67	**2** Calculation correct
2. theoretical; It is the probability of an event occurring from a sample space of equally likely outcomes.	**2** Probability and explanation correct **1** Probability correct but explanation incorrect
3. For a student to lose with "Rock" $\frac{7}{8}$ of the time, the board should have 21 total "Paper" and "Rock" envelopes, because solving $\frac{7}{8} = \frac{x}{24}$ results in $21 = x$; For a student to lose with "Rock" 50% of the time, the board should have 12 total "Paper" and "Rock" envelopes, because solving $\frac{50}{100} = \frac{x}{24}$ results in $12 = x$.	**4** Both correct answers that reference calculations **2** One correct answer that references calculations **1** Attempt at answers without reference to calculations
4. It would be a better choice for the player to not use all 24 envelopes if he or she wants the dollar back; It would be a better choice for your team to use all 24 envelopes in order to raise more money; The player has a $\frac{1}{3} \approx 0.33$ probability of winning when all 24 cards are being used. The player has a $\frac{8}{23} \approx 0.35$ probability of winning if one of the cards is removed.	**4** Two correct arguments for the player and the game operators that references calculations **2** One correct argument for the player or the game operators that references calculations **1** Argument that references no calculations
5. *Sample answer:* A student rolls a number cube with 1 even number and 5 odd numbers on it. If the roll is an odd number, the student donates \$1 to the fundraiser; $\frac{1}{6}$; $\frac{1}{3}$	**4** Thoughtful game that references probabilities **2** Well-written game without reference to probabilities **1** Poorly written game without reference to probabilities
Mathematical Practices: Create sound arguments and analyze the arguments of others. Students will make their own "unfair" carnival games based on theoretical probabilities and evaluate their classmates' games as well.	**4** The student uses knowledge of all types of probabilities to create his or her own game as well as critique and play classmates' games. Award partial credit as needed.
Total Points	**20 points**