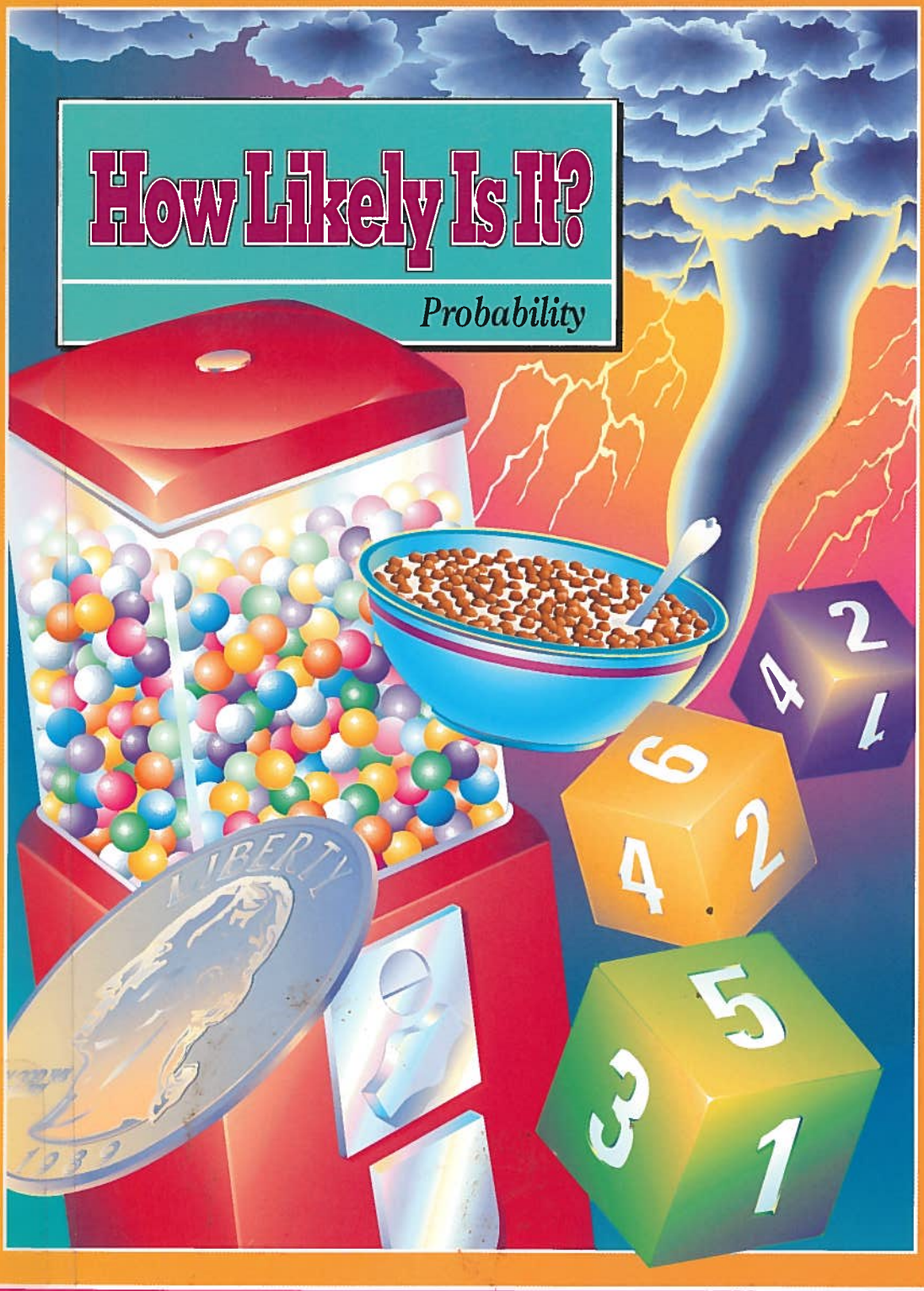
S. A. D.

Connected Mathematics • Data

How Likely Is It?

Probability



READY REF
372.7
HOW
Grade 6

Dale Seymour Publications®

Lappan, Fey, Fitzgerald, Friel, and Phillips

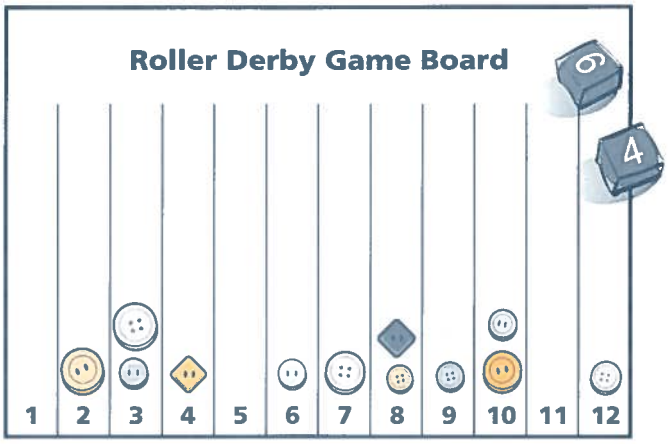
INVESTIGATION 5

Analyzing Games of Chance

Have you ever figured out a strategy for winning a game? In this activity, you will play a two-team game called Roller Derby. As you play, think about strategies for winning and the probabilities associated with those strategies.

5.1 Playing Roller Derby

In a game of Roller Derby, two teams compete. Each team needs a game board with columns numbered 1 through 12, a pair of number cubes, and 12 markers (like pennies, buttons, or small blocks).



Roller Derby Rules

1. Each team places its 12 markers into the columns in any way it chooses.
2. Each team rolls a number cube. The team with the highest roll goes first.
3. Teams take turns rolling the two number cubes and removing a marker from the column with the same number as the total shown on the cubes. If the column is empty, the team does not get to remove a marker.
4. The first team to remove all the markers from its board wins.

Problem 5.1

What is a good strategy for placing your markers in the 12 columns on the game board?

Play the game at least twice before answering this question. As you play, keep a record of the strategies you use.

Problem 5.1 Follow-Up

1. **a.** Find a systematic way to list all the possible outcomes (number pairs) of rolling two number cubes and the sums for each of these outcomes. Analyze your list carefully before answering b–e.
   b. What sums are possible when you roll two cubes?
   c. Which sum or sums occur most often?
   d. How many ways can you get a sum of 6? A sum of 2?
   e. Are all the sums equally likely? Explain.
2. Now that you have analyzed the possible outcomes, do you have any new ideas for a strategy for winning Roller Derby? Explain. If time allows, play the game again using your new strategy.

As you work on these ACE questions, use your calculator whenever you need it.

Applications

1. Eleanor is playing Roller Derby with Carlos. Eleanor placed all of her markers in column 1, and Carlos placed all of his markers in column 12. What is the probability that Eleanor will win? What is the probability that Carlos will win? Explain your reasoning.

2. When you play the game of Monopoly®, you sometimes end up in "jail." One way to get out of jail is to roll a double (two cubes that match). What is the probability of getting out of jail on your turn by rolling a double? Use your list of possible outcomes of rolling two number cubes to help you answer this question. Explain your reasoning.

Connections

In 3–9, use your list of possible outcomes of rolling two number cubes to help you answer the question.

3. When two number cubes are rolled, what is the probability that their sum will be 3?

4. When two number cubes are rolled, what is the probability that their sum will be greater than 9?

5. When two number cubes are rolled, what is the probability that their sum will be a multiple of 4?

6. When two number cubes are rolled, what is the probability that their sum will be a common multiple of 2 and 3?

7. When two number cubes are rolled, what is the probability that their sum will be a prime number? Explain.

8. Which has a greater probability of being rolled on a pair of number cubes—a sum that is a factor of 6 or a sum that is a multiple of 6? Explain.

9. Humberto and Kate are playing a game called Odds and Evens. To play the game, they roll two number cubes. If the sum is odd, Humberto scores a point. If the sum is even, Kate scores a point. Is this a fair game of chance? Why or why not?

10. Suppose that Humberto and Kate play a game called Evens and Odds. (This game is similar to the game in question 9, except it involves *products* instead of *sums.*) To play the game, they roll two number cubes. If the product is odd, Kate scores a point. If the product is even, Humberto scores a point.

    a. Make an organized table of the possible products of two number cubes.

    b. What is the probability that Kate will win? What is the probability that Humberto will win? Explain your reasoning.

    c. Is this a fair game? If it is fair, explain why. If it is not fair, tell how you could change the points scored by each player so that it would be fair.

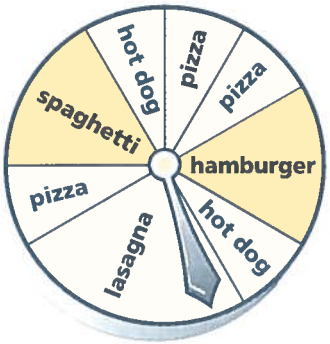
    d. What is the probability that the product rolled will be a prime number?

    e. What is the probability that the product rolled will be a factor of 30?

    f. What is the probability that the product rolled will be greater than 18?

11. The cooks at Kyla's school made the spinners shown below to help them determine the lunch menu. They let the students take turns spinning to determine the daily menu. In a–c, decide which spinner you would choose, and explain your reasoning.

Spinner A



Spinner B

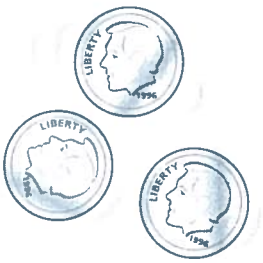
a. Your favorite lunch is pizza.

b. Your favorite lunch is lasagna.

c. Your favorite lunch is hot dogs.

12. Abigail and Christopher are playing a game with two coins. To play the game, they each flip a coin at the same time. If the two coins match, Christopher gets a point; if they do not match, Abigail gets a point. Is this a fair game of chance? Explain your reasoning.

13. Alex and Fumi are playing a game with three coins. To play the game, they flip all three coins at the same time. If the three coins match, Fumi gets a point. If they do not all match, Alex gets a point. Is this a fair game of chance? Explain your reasoning.



Extensions

14. Make up three probability questions that can be answered by looking at your list of possible outcomes of rolling two number cubes. Then answer your own questions.

In 15–18, suppose Selina has just rolled three number cubes.

15. What is the probability that all three cubes match? Explain your reasoning.

16. What is the probability that the sum of the cubes is less than 5? Explain your reasoning.

17. What is the probability that the sum of the cubes is more than 2? Explain your reasoning.

18. What is the probability that the product of the cubes is prime? Explain your reasoning.

Mathematical Reflections

In this investigation, you played a game of chance that involved rolling a pair of number cubes and computing the sum of the cubes. These questions will help you summarize what you have learned:

1. What are the possible outcomes when you roll one number cube? Is each of these outcomes equally likely?
2. When you roll a pair of number cubes, how many different pairs of numbers can occur? Is each pair equally likely?
3. In the Roller Derby game, you added the numbers on the faces of two number cubes. How many different sums were possible? Were they all equally likely? Explain.
4. Suppose you roll two number cubes and add the results. What is the sum of the probabilities of all of these outcomes? Explain your answer.

Think about your answers to these questions, discuss your ideas with other students and your teacher, and then write a summary of your findings in your journal.