

# Problem of the Month

## Fair Games

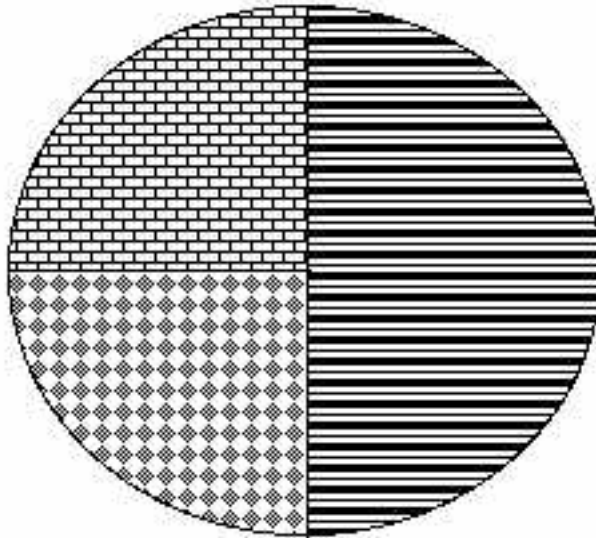
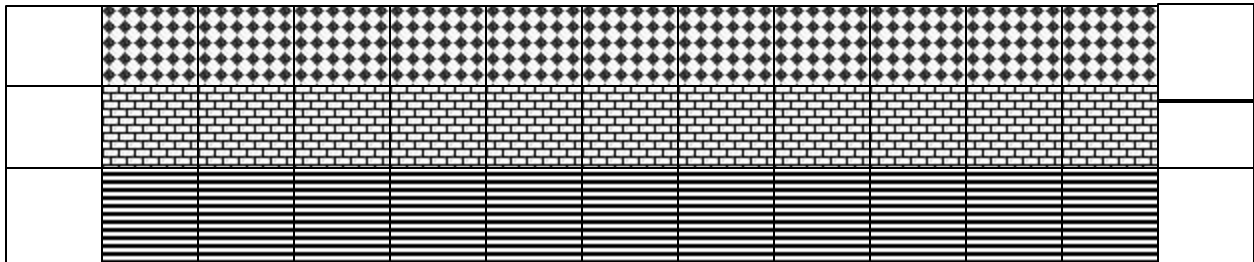
### The Race

**Rules:**

There are three players Brick, Stripe and Diamond. Each player puts a token on the Start square of their pattern path. The players take turns by spinning the spinner. The player whose pattern comes up on the spinner, moves that player's token one space on the game board, the other players do not move their tokens. The game continues as each player takes turns with the spinner and a move is made, until one player reaches the Finish Line. That player wins.

**Start**

**Finish**



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### Level A:

What is a fair game? Explain.

In groups of three, play *The Race* game five times. Keep track of who won each game, who came in second and who came in third.

Which player won the most? How many times?

Which player came in second the most?

Is this a fair game? Explain why this game is fair or not fair.

How could you change this game to make it better?

### Level B:

Play *The Race* game five times. This time keep track of each spin listing who moved each time.

Draw a bar graph showing the outcome of the spins. Label the horizontal axis by pattern and the vertical axis by the number of spins the each pattern occurred.

How many more times did Stripe move than Brick?

Between Brick and Diamond, which player moved more times in all 10 games?

How much of the spinner is a stripe pattern?

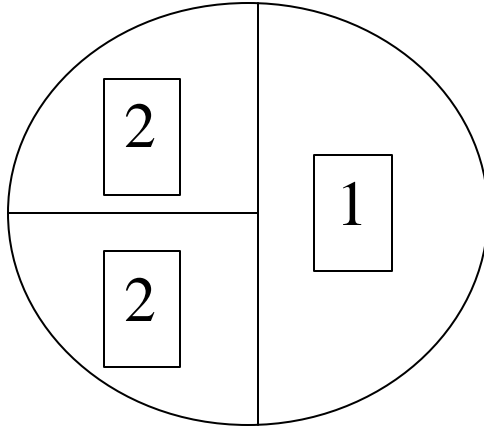
How much of the spinner is a diamond pattern?

How much of the spinner is a brick pattern?

How could you change the spinner to make the game more fair?

### Level C:

Your friend Alex says that he can make the game more fair. He makes a second spinner with numbers on it. He says the number stand for the number of spaces a token is moved. He modified the rules as follows: First the pattern spinner is spun to find out who moves. Then the number spinner is spun to find out how many spaces the token is moved. Below is the spinner he made.



What is the probability that Diamond comes up on the first spinner? Explain.

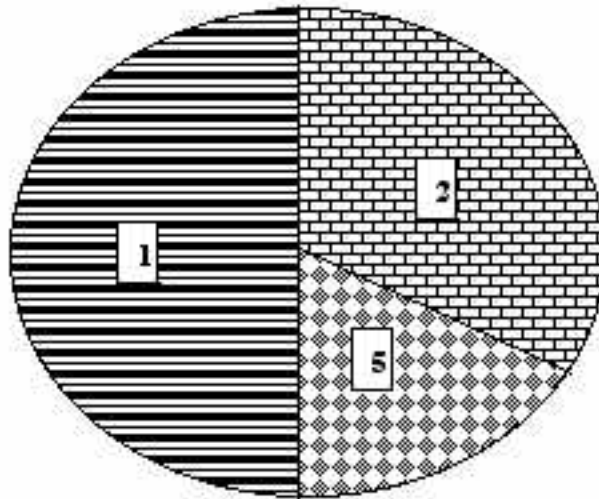
What is the probability that 1 comes up on the second spinner? Explain.

What is the probability that Stripe moves 1 space on any turn? Explain.

What is the probability that Brick moves 2 spaces on any turn? Explain.

Alex says that the new spinner makes the game fair because Stripe will mostly move 1 space and the Brick and Diamond players will mostly move 2 spaces. Explain why you either agree or disagree with Alex.

**Level D:**



Another friend, Dolores, says that she made the game fair by drawing just one new spinner, but using both patterns and numbers on the same spinner. When the spinner is spun the player with that pattern moves the number of spaces indicated in that sector of the spinner. She said she made the spinner by first drawing the diameter and then making the central angle of the brick sector 120 degrees.

What is the probability of Brick moving on any spin?

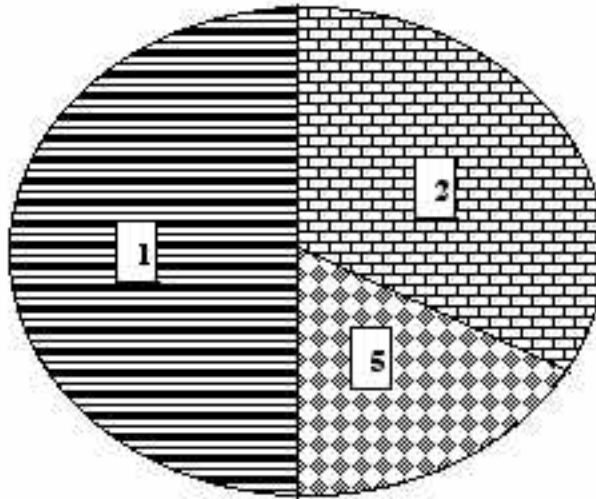
How many times would Diamond have to move to win a game?

How much bigger in area is the Stripe sector to the Diamond sector?

Dolores' spinner makes the game unfair. Use mathematics to explain why her game is unfair.

How could you change the spinner to make her game fair?

**Level E:**



Dolores has already made several copies of her spinner. You don't want to hurt her feelings by not using her spinner, but you need to make sure the game is fair. You decide to make a new track in the shape of an oval where racers near the inside of the track have fewer spaces to travel than racers near the outside of the track. Design an oval track that can be used with Dolores' spinner. Design the game board track so that the game will be fair to all players, but Dolores' spinner isn't changed.

Use mathematics to justify why your game board makes the game fair to all players.

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# Fair Games

### Primary Version Level A

**Materials:** The Race game board and spinner, paper clip and brad to make the spinner and Brick, Stripe and Diamond tokens for each group.

**Discussion on the rug:** (Teacher starts a discussion about fair games) "What makes a game fair?" "Tell us about a game that is unfair?" (Teacher demonstrates how to play the game) "Each player takes a turn spinning the spinner. The pattern the spinner points to gets to move. They move their racer one square. Then it is time for the next player to spin and that pattern gets to move next. Keep playing until someone gets to the finish line."

**In small groups:** (Each group plays the game several times, switch patterns after each game. Have them indicate the pattern that was first, second and then third for each game.) (After the games, the teacher polls the class and records the outcomes for the entire class)

"Which pattern won the most? How many times?"

"Which pattern came in second the most?"

(Teacher asks the following questions)

"Is this a fair game?"

"Why this game is fair or not fair?"

"How could you change this game to make it better?"

(At the end of the investigation have students either discuss or dictate a response to this summary question above)