

A MATHEMATICIAN AT PLAY

It all depends on the roll of the dice

What have you been doing during this summer vacation? Did you sit around a table with your friends and family and play a board game or two? If you had, then you most probably would have encountered some dice.

Daniel Finkel uses this simple cube to pose some tricky questions...

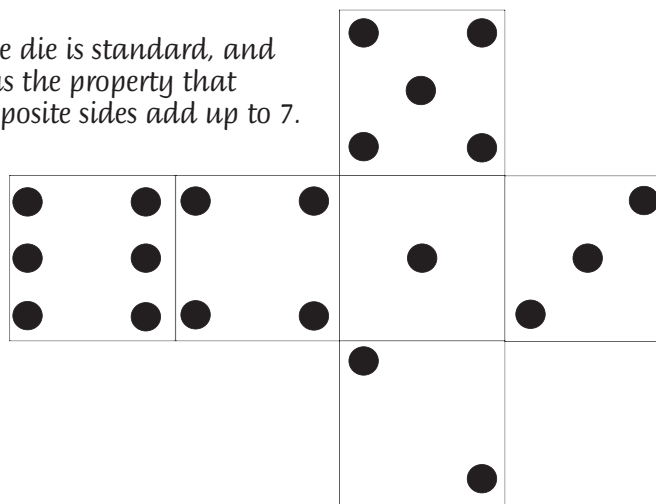
One of the great mathematical ideas from the last few centuries is group theory. Group theory is at once a study of symmetry and a framework for developing new systems that resemble numbers with respect to addition or multiplication, yet admit stranger possibilities than we're normally used to.

In mathematics, we think about symmetry not as an adjective, but as a verb. Symmetry is a kind of action, a way of moving something so it looks (at least in some respects) the same after the action than it did before. A Rubik's cube is a good example: twist a side, and the cube is still the same geometrically, even though some specific smaller cubes have moved and the coloration looks different.

Today's puzzles feature a different kind of cube. We're going to explore what happens when we roll a die around a grid. There are at most four different moves: roll left (L), right (R), up (U), or down (D).

In each case, the die will roll onto a neighbouring square, and rotate 90 degrees as it rolls, so an adjacent face points up.

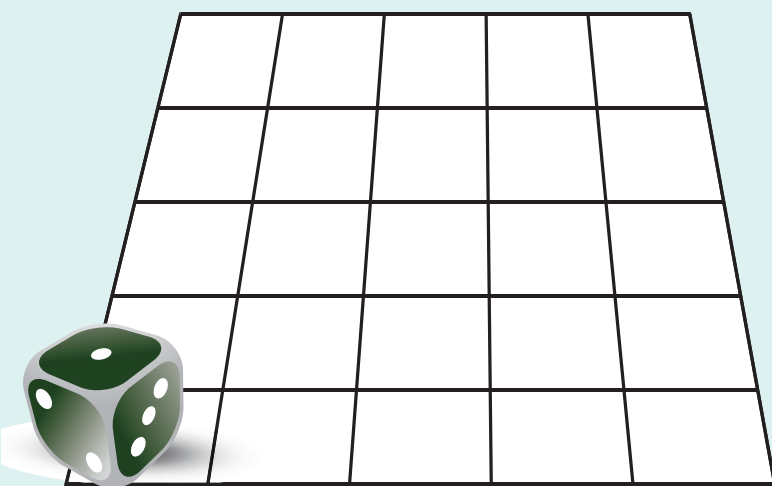
The die is standard, and has the property that opposite sides add up to 7.



In case you don't have a die at your disposal, cut out the following and make a die for yourself!

PUZZLE 1

Start with the die in the bottom left corner of a 5 by 5 grid as pictured.



If you roll it R, R, R, R, U, U, U, U the die will end with a 1 face up.

Find other sequences of 8 rolls that put the die in the top right corner of the grid, with a 2, 3, 4, 5, or 6 face up.

PUZZLE 2

Starting again from the bottom left corner, what is the minimum number of rolls it would take to have the die take a tour of the board and let it have the 1 face up in every single square at some point on the trip?

Dan Finkel is the founder of Math for Love, an organisation devoted to transforming how math is taught and learned. He is the creator of mathematical puzzles, curriculum, and games, including the best-selling Prime Climb and Tiny Polka Dot.