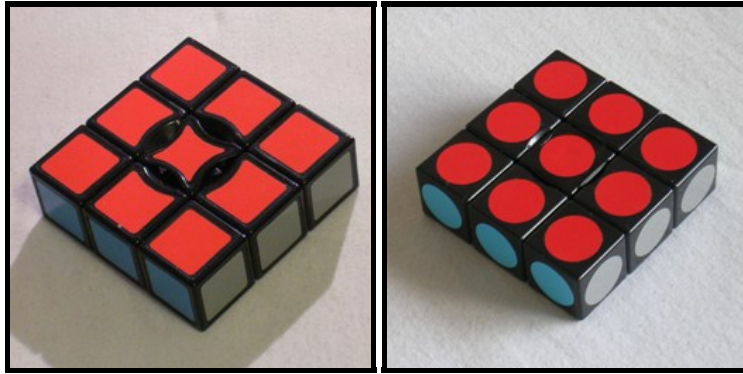


# The Super 3x3x1 / The Super Floppy



This puzzle is generally known as the Super Floppy, as it is a [Floppy Cube](#) which also allows quarter turns. This allows the corner pieces to move to locations above and below the edge pieces, changing the shape of the puzzle. It was also invented by Katsuhiko Okamoto.

There are two versions of the puzzle. The official version has an internal mechanism that blocks you from twisting a side consisting of only an edge piece without any corners. The imitation version lacks that mechanism, and by allowing you to twist an edge piece in isolation makes this easy puzzle much easier.

## The number of positions:

There are 4 corners which can be in any of 12 locations. The edge pieces don't travel, but do have 4 orientations each. This gives a total of  $12 \cdot 11 \cdot 10 \cdot 9 \cdot 4^4 = 3,041,280$  positions. All of these are attainable.

Suppose we consider only the shape of the puzzle, ignore the colours. Then there are  $12 \text{-choose-} 4 = 12!/(8!4!) = 495$  ways the corners can be arranged if the puzzle has a fixed orientation. The puzzle as a whole has 8 orientations, so there are about  $495/8$  possible shapes. Some shapes have symmetry, so to calculate the exact number we need to apply Burnside's Lemma. This gives 72 distinct shapes. Only 18 shapes are mirror symmetric and the rest form 27 mirror image shape pairs.

I have used a computer search to find God's Algorithm, i.e. the shortest solution for each position. Every position of the official super floppy can be solved in at most 15 moves (or 17 if a half turn is considered to be two moves). The result for both metrics is shown in the following table:

	Face turn metric																Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Q	0	1															1
u	1	8															8
a	2	4	40														44
r	3		40	128													168
t	4		10	240	224												474
e	5			144	736	704											1,584
r	6			24	904	2,016	2,144										5,088
t	7				424	3,136	6,880	4,568									15,008
u	8				53	2,712	11,440	17,744	10,560								42,509
r	9					984	10,848	36,568	42,424	20,960							111,784
n	10					64	6,160	39,460	94,382	88,920	32,896						261,882
m	11						1,352	23,840	112,112	199,504	142,976	36,864					516,648
e	12							31	6,228	66,146	222,228	289,752	158,296	25,168			767,849
t	13								744	17,736	112,880	254,816	255,056	102,624	13,184		757,040
r	14								4	1,120	20,056	88,432	160,112	126,672	35,040	1,792	433,228
i	15									24	992	7,440	26,848	51,248	29,408	2,432	118,392
c	16									1	20	160	672	2,408	3,936	1,792	9,565
	17										8						8
<b>Total</b>	<b>1</b>	<b>12</b>	<b>90</b>	<b>536</b>	<b>2,341</b>	<b>9,616</b>	<b>38,855</b>	<b>129,156</b>	<b>344,505</b>	<b>665,560</b>	<b>816,480</b>	<b>637,848</b>	<b>308,120</b>	<b>81,568</b>	<b>6,016</b>	<b>576</b>	<b>3,041,280</b>

The eight QTM antipodes are positions with solved corners, three edges that need a half turn, and one that needs a quarter turn.

For the imitation super floppy need at most 13 moves to solve (or 16 if a half turn is considered to be two moves). The results are as follows:

	Face turn metric													Total	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
Q	0	1													1
u	1	8													8
a	2	4	40												44
r	3		40	160											200
t	4		10	256	512										778
e	5			144	1,152	1,376									2,672

t u r n  m e t r i c	6		24	1,120	3,920	4,064											9,128
	7			464	5,488	13,408	10,288										29,648
	8			53		21,394	40,096	20,128									85,267
	9				1,096		17,280	72,848	96,120	31,168							218,512
	10				60	7,416	64,948	195,408	171,600	32,720							472,152
	11					1,344	31,416	185,480	357,784	185,120	17,792						778,936
	12					29	6,336	86,232	325,300	345,328	80,224	1,792					845,241
	13						528	18,272	126,056	241,456	95,360	3,360					485,032
	14						4	980	15,640	54,652	34,464	2,192	32				107,964
	15							8	408	2,592	2,368	256					5,632
	16								1	48	16						65
	<b>Total</b>	<b>1</b>	<b>12</b>	<b>90</b>	<b>584</b>	<b>3,301</b>	<b>15,536</b>	<b>64,935</b>	<b>226,464</b>	<b>602,629</b>	<b>1,027,956</b>	<b>861,916</b>	<b>230,224</b>	<b>7,600</b>	<b>32</b>	<b>3,041,280</b>	

If you ignore the colours and consider only the shape of the puzzle, then it takes at most 6 moves to solve. The results are as follows:

		Face turn metric							
		0	1	2	3	4	5	6	Total
Q T M	0	1							1
	1		4						4
	2			18					18
	3			8	64				72
	4				64	64			128
	5				12	64	96		172
	6					4	80	16	100
<b>Total</b>	<b>1</b>	<b>4</b>	<b>26</b>	<b>140</b>	<b>132</b>	<b>176</b>	<b>16</b>	<b>495</b>	

**Links to other useful pages:**

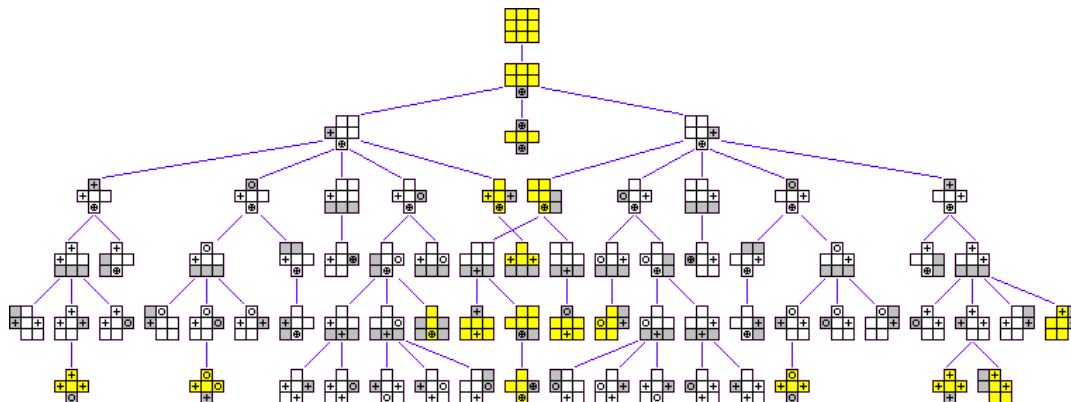
[Gentosha Toys](#) is the manufacturer of this puzzle.

**Solution:**

**Phase 1:** Solve the shape, i.e. make it flat.

- Do any moves necessary to bring together an empty corner location and a corner piece that is sticking out.
- Hold the puzzle so that the front right corner location is empty, and the front edge has a corner piece sticking out above or below it.
- If the front left corner location is empty, then you can just turn the front to bring the corner that is sticking out into the main layer. If on the other hand the front left corner location is full, then turn the left side to make that corner location empty. Turn the front to insert the corner at the front right location. Finally turn the left side back to where it was.
- Repeat steps a-c until no more corners are sticking out.

The tree diagram below shows all possible shapes, and you can use it to solve the shapes optimally. The shapes coloured yellow are symmetric, the others occur in mirror image pairs, one on each side.



**Phase 2:** Solve the pieces.

- Solve the corners. Note that colour on the outside of an edge piece does not change when that side is rotated. Therefore the outside colour of the four edges can be used as reference points for placing the corner pieces. It is very easy to put one corner in place, then one of the adjacent corners without moving the first, and finally swapping the last two by a single move if necessary.
- If there is an edge piece that is not yet solved, then hold the puzzle so that the edge is at the front. Look at the side colours to see how much the edge needs to be twisted, and do one of the following:
  - Quarter turn clockwise: R F R' F' L F L'
  - Half turn: R F2 R' F2 R F R' F
  - Quarter turn anti clockwise: R F' R' F L F' L'
 On the imitation super floppy there is a much easier way, namely to do R L so that the front edge piece is free, rotate the front edge piece to solve it, and then R' L' to restore the sides.
- Repeat step b until all the edges are solved.

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