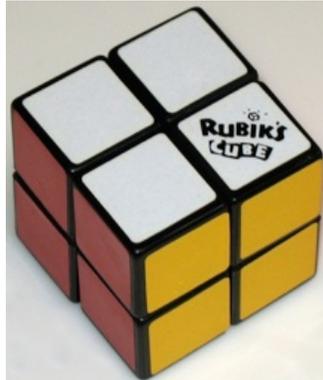# Rubik's 2x2x2 Pocket Cube

First patented by Rubik 1983, other patents cover different internal mechanisms.
(plastic, 1.5 inches)

Rubik 2x2x2 Three Step Solution

> ***Notation:*** L (left), R (right), F (front), B (back), U (up), and D (down)
> for 90 degree clockwise rotations of that face; - means counterclockwise.
> Corners are named with three letters.

1. Solve the down layer.

   *** No need to remember sequences; after playing with the puzzle it becomes easy. Get three corners correct, move two of the correct ones 90 degrees, move the fourth into position, and move the two back. If the 4th is rotated so it won't position correctly, do a 180 degree turn of that side and then you can reposition it to try again.

2. Put up the layer corners in correct locations (but possibly rotated incorrectly):

   Use the following sequence exchange two corners:

   UFL <-> UFR: **(F U) (F- U-) (L- U- L)**

   Note: A quick way to do UBL <-> UFR is to precede this by **L** and skip the final **L**.

3. Fix the up layer so all corners are rotated correctly:

   Position the cube so the up front right corner is not correct and repeat these two steps until all up corners are correct:

   A. Repeat until the up front right corner is correct:

   (R- D-) (R D)

   *** The down layer will be mixed up, but it will become correct again at the end; don't forget the final D of this sequence.

   B. Rotate the up layer so the up front right corner is not correct.

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Notes About The Rubik 2x2x2 Three Step Solution

Step 2 - a simpler but slower *randomized solution:*

As summarized on the next page, this step could be replaced by:

Step 2. If possible, rotate the up layer to be correct, except some corners may by be rotated; otherwise, mix up and go back to Step 1 using a different color on the bottom.

(Starting from a random position, there is a 1 in 6 chance that this test succeeds. So even if a quick mix and starting with a different bottom is not completely random, once you get reasonably fast at doing Step 1, it shouldn't take too long.)

Step 2 - making it faster:

This step can be used three times for a diagonal exchange. However, since it does not change the upper back left corner, it is faster to do UBL <-> UFR by preceding the transformation with **L** and skipping the final **L**.

Step 2 - using a Rubik 3x3x3 move:

The "corner cycle" move of a Rubik 3x3x3 solution can be used for this step.

Step 3 - making it faster:

Every iteration of the corner rotator exchanges UFR and DFR, and repeating it 6 times returns the cube to exactly where it was. Step 6A will use the corner rotator 2 times if the top color is on the right side of the UFR corner, but 4 times if it is on the front, in which case it is faster to do the reverse sequence 2 times:

reverse corner rotator: **D- R- D R**

Step 3 - why it works:

- Step 3A affects only 4 corners by exchanging two front right corners and also exchanging the two back down corners.
- Doing Step 3A twice leaves corners in the same positions, except those four corners are rotated, and doing Step 3A six times leaves the corners the same as when you started.
- On the up layer Step 6 only modifies the front right corner.
- Since Step 3 started with the bottom corners correct, once three of the four top corners have been fixed, fixing the fourth top corner must leave the bottom corners correct. This is because when at every 6th move the two back bottom corners are correct, all that is left that could be incorrect are the two front right corners, but due to parity considerations, a completely solved puzzle except for two adjacent rotated corners is not possible.
- This transformation also works for a *Rubik 3x3x3* cube (and is the last step of the layer by layer solution presented on that page). The only edge pieces that are affected are FR, RD, BD, which are on the lower two layers; they return back to where they were after 6 moves.

Rubik's 2x2x2
A Slow But Easy Randomized Solution
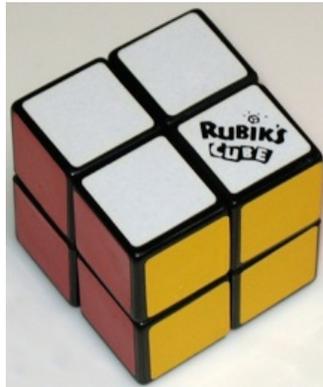
1. Solve the bottom layer.

2. If possible, rotate the top layer to be correct, except some corners may by be rotated; otherwise, mix up and go back to Step 1 using a different color on the bottom.

3. Fix the top layer so all corners are rotated correctly:

Reposition the cube so the top front right corner is not correct, and repeat these two steps until all up corners are correct:

A. Repeat until the top front right corner has the correct color on top:

(R- D-) (R D)

Where **R** and **D** mean to rotate the right and down (bottom) layers 90 degrees clockwise, or **R-** and **D-** mean to rotate the right and bottom layers counterclockwise.

B. Rotate the top layer 90 degrees counterclockwise.

A Three Step Solution from a Manufacturer's Booklet

SEQUENCES

The diagrams below show the <u>Bottom Half</u>. (That is, the view you would have if you tilt the whole puzzle away from you.)

Diagonal Swapper*

Swaps two diagonally opposite pieces. The other two pieces on the Bottom Half remain in their original places.

Front ▷; Left ▽; Bottom ▷; Left △;
Bottom ◁; Front ◁; Bottom ◁.

Shunter*

Moves a triangle of pieces counter-clockwise. The fourth piece remains in its original place.

Back ◁; Left ▽; Bottom ▷; Left △;
Back ▷; Left ▽; Bottom ◁; Left △.

Shifter*

Flips three pieces to reorient them while keeping them in their original location. The fourth piece remains unaffected.

Back ◁; Bottom ▷; Back ▷; Bottom ▷; Back ◁;
Bottom ▷; Bottom ▷; Back ▷; Bottom ▷; Bottom ▷.

FLIP
FLIP FLIP
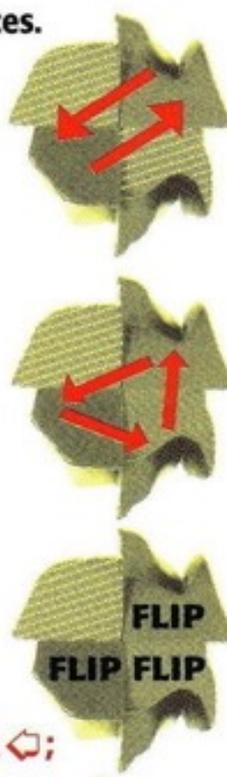
(From the booklet that came with Rubik 2x2x2 *Homer Simpson*.)

Step 2:

FRD <-> BLD: **F L D L- D- F- D-**   ("diagonal swapper")

FRD -> BLD -> BRD -> FRD: **B L D L- B- L D- L-**   ("shunter")

Step 3:

FRD-, BRD-, BLD-:   **R- D- R D- R- D2 R D2**   ("shifter")

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Some Fun With the Step 3A Sequence

Call Step 3A **S**, and its reverse **S-**:

$$\textbf{S} \; = \; \textbf{(R- D-)} \; \textbf{(R \; D)}$$

$$\textbf{S-} \; = \; \textbf{(D- R-)} \; \textbf{(D \; R)}$$

Consider interleaving a do-nothing sequence of **U**'s into a do-nothing sequence of **S**'s:

do nothing with two S's followed by two S-'s ┈┈➤ **S   S   S-   S-**

do nothing by rotating the top layer 360 degrees ┈┈➤ **U   U   U²**

———————————————

bottom layer unchanged but top layer is modified ┈┈➤ **S U S U S- U² S-**

Here is how this sequence cycles three corners A,C,D on the top layer (and the cube is returned to where it was if you do it three times), or if it is followed by a **U**, it exchanges two corners B and C on the top layer (X denotes the corner below A at the start):

A,C,D have been cycled

B and C have been exchanged

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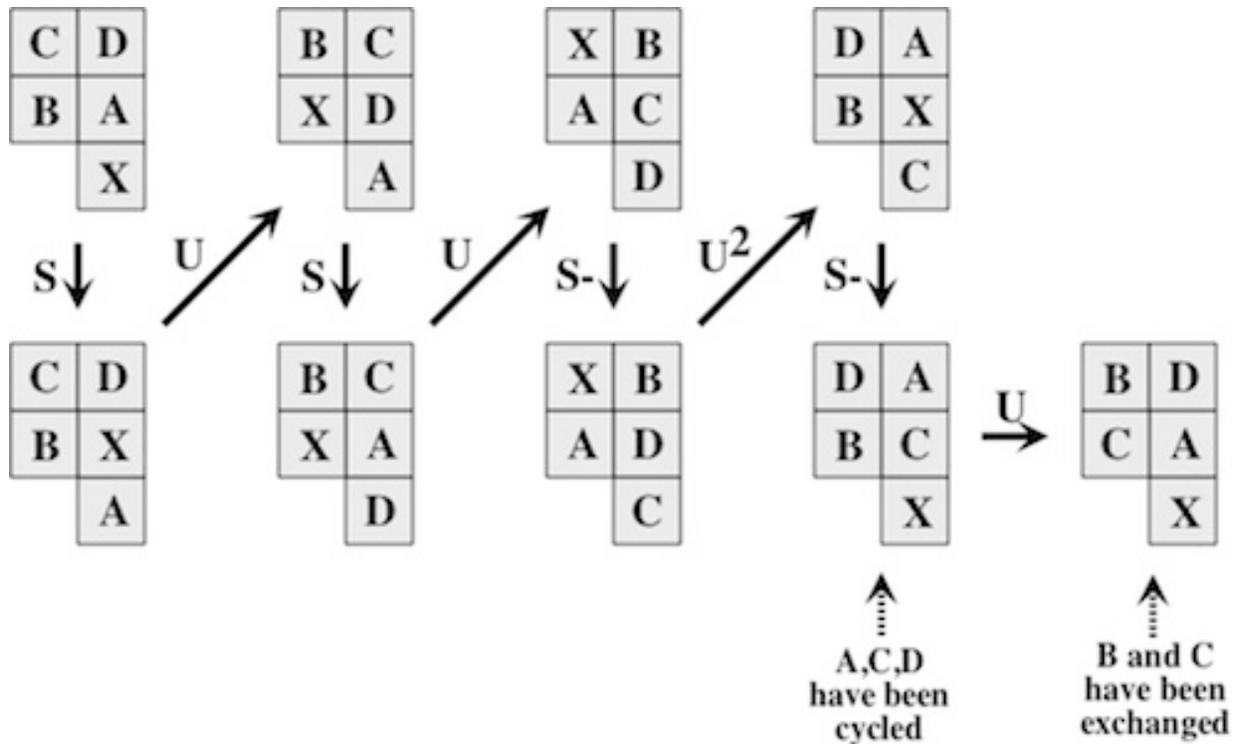
Other Fun Sequences

Notation: R (right), F (front), and D (down) for 90 degree clockwise rotations of those faces, and - for counterclockwise instead of clockwise. A 2 means do it twice. Corners are denoted with three letters (e.g., BLD = back left down corner).

Sequences for exchanging corners:

FLD <-> FRD: **F D F- D- R- D- R**

FLD <-> BRD: **R F D F- D- R- D-**

FRD <-> BLD: **F- R- D- R D F D-**

Sequences for rotating corners (+ / - denote clockwise or counter clockwise):

FLD-, BLD+: **R- D- R F- D R- D R D2 F2**

FLD+, BLD-: **F2 D2 R- D- R D- F R- D R**

FLD-, BRD+: **R2 D- R D2 R- D2 R D- R2 D**

FRD-, BRD-, BLD-: **R- D- R D- R- D2 R D2**

FRD+, BRD+, BLD+: **D2 R- D2 R D R- D R**

FRD-, BRD+, BLD-, FLD+: **R2 D2 R D2 R2 D**

FRD+, BRD-, BLD-, FLD+: **R D F R2 D2 F2 D F- D R2**

These transformations are done from the point of view of the top layer solved and then solving the bottom layer, because it makes the puzzle easier to hold with the left hand and manipulate with the right hand (no moves of the up, left, or back layers needed).

Jaap's Page presents the above transformations along with many more, including transformations to make specific patterns.

Rubik's 2x2x2 - 25 Years Later

Plastic, stickerless, made in China, purchased from Amazon.com in 2015.
(*DaYan*, sold by *Maxin*, comes in a fitted box, 1.8" square)

In the early 2000's, smoother working versions of Rubik's 2x2x2 were widely available, with screws / springs for adjustable tension and smooth turning even when layers are not exactly aligned (beveled interior corners in conjunction with the spring action give a minimal degree of automatic alignment). Even dimension Rubik cubes, of which the 2x2x2 is the smallest, don't use a central axis like standard odd dimension designs such like the *Rubik's 3x3x3* cube. Here are photos of the one shown above apart:

Rubik's 2x2x2 Star Wars

The Darth Maul figure is large (4 inches high) with a smooth mechanism. The others are small (between 2.25 and 2.5 inches high) from Kellogg's cereal boxes in the 2002 time frame; each has two related star wars episode II figures, one on each side.
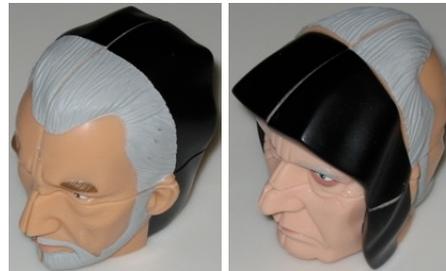

Darth Maul

Darth Vader / Anikin Skywalker

Obiwan Young / Obiwan Older

Lea / Amidala

Dooku / Emperor

Trooper / Jango

R2D2 / C3PO

Rubik's 2x2x2 Cartoon Characters

Mickey Mouse
(Disney, Spain,
circa 1990?, 5",
sold by Mefferts 2006)

Donald Duck
(Disney, Spain,
circa 1990?, 4")

Bugs Bunny
(Warner Brothers,
1999, PUZZLE
HEADZ LTD, 3.5")

Scooby Doo
(Warner Brothers,
1999, PUZZLE
HEADZ LTD, 3.75")

Batman
(Warner Brothers
1999, PUZZLE HEADZ
LTD, 3.75")

Joker
(Warner Brothers
1999, PUZZLE
HEADZ LTD, 4")

Tom
(Warner Brothers,
1999, PUZZLE
HEADZ LTD, 3")

Jerry
(Warner Brothers,
1999, PUZZLE
HEADZ LTD, 3")

Tasmanian Devil
(Warner Brothers,
1999, PUZZLE HEADZ
LTD, 3.25")

Tweety
(Warner Brothers,
1999, PUZZLE
HEADZ LTD, 2.75")

Mars Marvin
(Warner Brothers,
1999, PUZZLE
HEADZ LTD, 3.25")

*Hanshin Tigers
Japan Baseball*
(circa 2000, 3")

Homer Simpson
(circa 2000, 5")
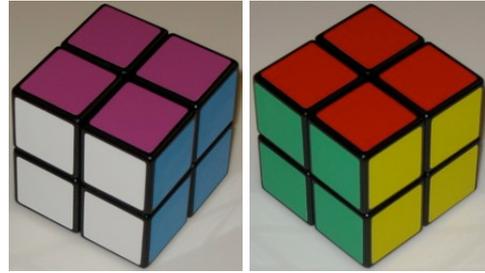
Bart Simpson
(circa 2000, 4.5")
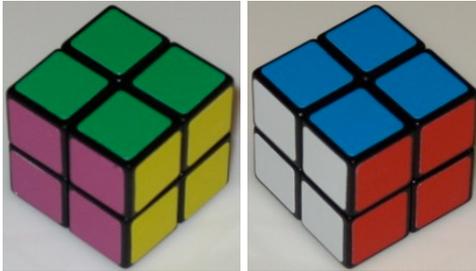
Dog, Kitty, Penguin
(China, 2006, all three are 4.25")

Rubik's 2x2x2 Other Versions

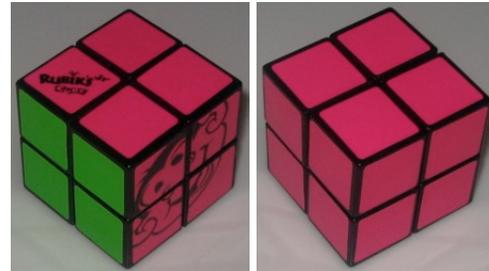*Rubik's Pocket Cube* (1980's, 1.5")

Eastsheen (2006, 2")

Tiny Size (2006, 1")

Keychain (2006, 1")

2007 Calendar Cube (2")

Rubik's Junior (2006, 1.5")

Popeye (1980's, 2.2")

Smaller Size Popeye (1980's, 2")

Harry Potter (circa 2000, 2.25")

Australian Road Signs (circa 2000, 2.25")

Rubik's 2x2x2 Further Reading:

Jaap's Page, from: http://www.geocities.com/jaapsch/puzzles/cube2.htm

Rubiks.com booklet, from: http://www.rubiks.com/World/Rubiks%20downloads.aspx

Rubiks.com assembly diagram, from: http://www.rubiks.com/World/Rubiks%20downloads.aspx

Rubik Patent, from: www.uspto.gov - patent no. 4,378,117

Li Patent, (Eastsheen Mechanism) from: www.uspto.gov - patent no. 5,826,871

Patermann EP Patent (Mickey Mouse), EP712,649.

Khoudry International Patent (K-Ball), IP25874.

Kremmer Patent (Darth Maul), from: www.uspto.gov - patent no. 6,217,023

Nicholas Patent (uses magnets), from: www.uspto.gov - patent no. 3,655,201