How to Solve a 3x3 Rubik's Cube

A Guide for Beginner Cubers

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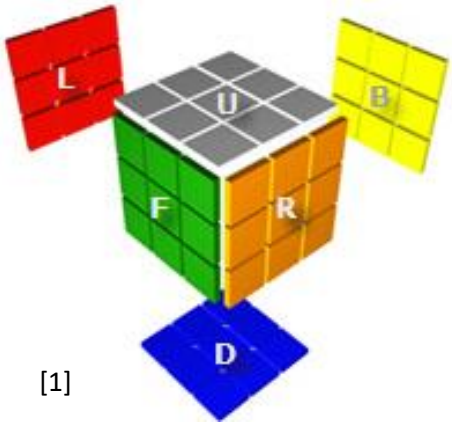
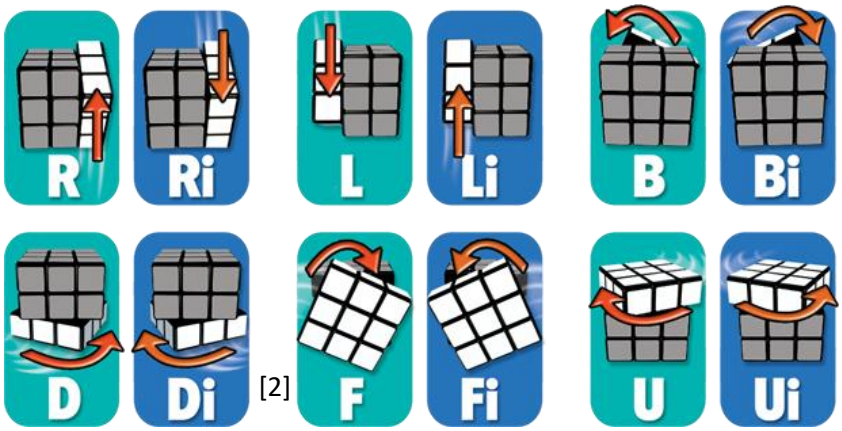
The Cube Itself

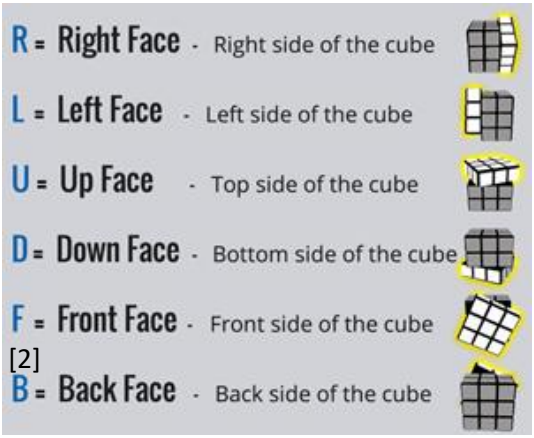


[1]



[2]

When holding your Rubik's cube, the side of the cube that is facing you is called the "Front Face". This will be your basis for determining the other sides of the cube. From the image above, the difference faces can be seen, and the table to the right shows the names of the sides that will be used throughout this instruction set.



[2]

When talking about an algorithm (a process to be followed to solve a problem) we will use the notation seen above. If the face designation is followed by an 'i' (inverted), this designates that we will be rotating the respective side of the cube counterclockwise. In the absence of the 'i', this designates a clockwise rotation. A key thing to remember is that this rotation is made with respect to the side we are denoting. For example, if the algorithm starts with 'R Li' this means that we will rotate the right face clockwise and the left face counterclockwise as if we were looking at the sides individually. The diagram above can help to distinguish between the variety of rotations for each face.

On the cube there are three types of pieces that make up a face. The center pieces are at the center of each face and do not move at all. The edge and corner pieces do move and will be the pieces that are aligned to solve each layer. The image below shows the location of each type of piece on the faces. These are essential to keep in mind throughout this tutorial.

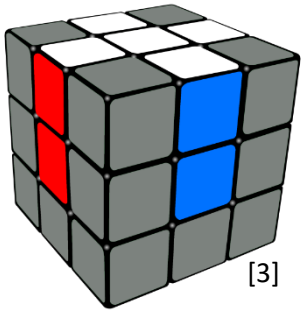
Center Piece

Corner Piece

Edge Piece

[2]

Layer One – The White Cross


[3]

For future solves of the Rubik's cube, it is good to keep in mind that you can start with any color you desire. However, for this solve, we will be using the white side as the first side to be solved.

The first step to solving the first of the three layers is to create the white cross. This means aligning the white edge pieces with their corresponding adjacent colors. This can be seen completed in the image to the right.

This step is the easiest of all steps because you don't have to worry about mixing up pieces that are already aligned. This is also the only step that doesn't have specific algorithms to complete the setup. The best way to solve this part of the cube is to remember that blue and green are always opposite of each other and so are red and orange (if you're using a standard Rubik's cube). It is best to solve for either orange and red, then blue and green, or vice versa. This will help you practice getting the white cross more easily.

The best way to complete this step, is to line up the white edge piece with its corresponding adjacent color, then rotate the adjacent color side until the white edge piece lines up with the center white piece. This step may take a little practice, but there are many ways to do it and it's best to find what is comfortable for you.

Finishing Layer One – The Corners

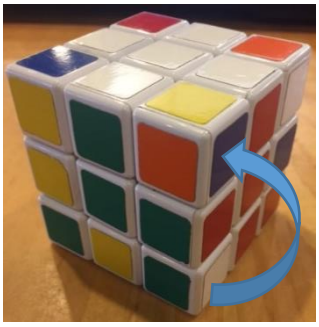
Once you have the white cross, the next step is to solve the individual corners and there is only one algorithm you need to remember for this step.

There are four main steps to putting each corner into the correct place:

1. Find the corner with the three corresponding colors as position of the sides.
2. Place the corner below where it needs to go.
3. Perform the algorithm below until the corner is in the correct spot with all colors aligned.

4. Repeat these steps for each corner.

An example of the situation is shown visually to the right. The sides in play are the white, green, and red sides and the matching corner piece is placed below where it belongs. In this case, you will only need to use the algorithm once because of the specific placement of the corner piece. However, for other orientations, you may have to perform the algorithm up to five times to get the corner in the position you desire.



[2]

Once you have completed these four corners you will have successfully completed your first layer of the Rubik's cube.

Layer Two – Left and Right Movements

Once you have completed layer one of the cube, turn the cube over so that the white side now becomes the "Down Face" and begin solving for the second layer. For this layer, we will be aligning the edge pieces that match the second layer between the center pieces.

There are five main steps to completing this layer:

1. Find an edge piece that does not have yellow attached to it (yellow is the 3rd layer color) so we will not need any yellow in this.
2. Align the edge piece with the matching color.
3. Determine which way the piece much go (left or right) to be matched up with the second color.
4. Use the algorithm for the corresponding direction.
5. Repeat until the second layer is complete

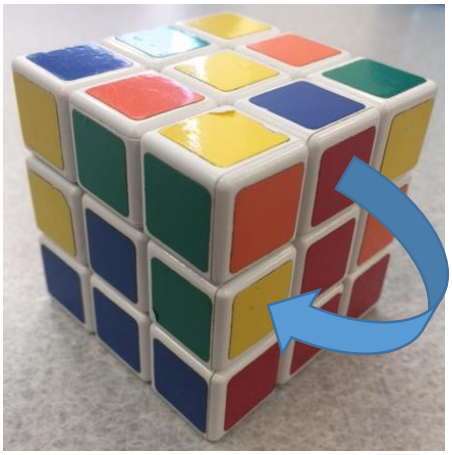
If an edge piece you need is in a spot that another piece needs to go, simply use the algorithm to replace it with a different piece (it does not matter which piece) and then put it where it belongs.

There are two algorithms to keep in mind for this layer that are used to move a piece to the left or to the right. Below are examples of both situations with their corresponding algorithms.

Rightward Movement

[2]

Leftward Movement

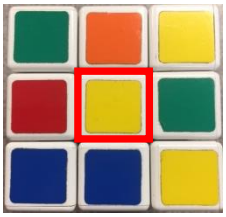


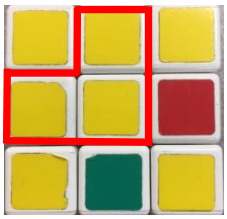
[2]

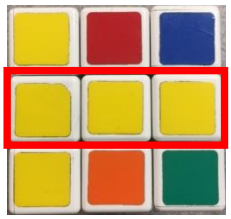
Once this is complete, your second layer should be finished and you are ready to move onto layer three.

Layer Three – The Yellow Cross

Once you have completed layers one and two, it is time to complete the final steps in solving the last layer of the cube. Like the first step, we need to solve the yellow cross on side opposite of the white face. An important thing to keep in mind when doing this is that the edge pieces do not need to perfectly line up to complete the cross. There are two steps in completing the cross, and the first step is to make the cross, then the second step is to align the edge pieces.


The Dot


The L


The Line


The Cross

The four orientations above are what you will see and be looking for once you have completed layer two. If you have any of the first three, holding them in the orientation depicted with the yellow face as the 'UP' face, perform the following algorithm:

Each time you complete the algorithm, you will see a new pattern until you finally get the cross. If you are starting with The Dot, you will see all the orientations and need to complete the algorithm three times (two times starting with The L and a single time starting with The Line).

Layer Three – The Edge Pieces

Now that you have successfully made the yellow cross, we must orient the edge pieces to be in the proper places. There are a few steps and a single algorithm to complete this step.

1. Rotate the 'UP' face until two (or all) of the edge pieces are lined up with their respective sides
2. If all four edge pieces are already aligned, skip to "Layer Three – The Corner Pieces".
3. If two edge pieces are aligned, hold the cube such that:
    a. If the two sides are adjacent, one of the aligned faces is on the 'BACK' face and the other is on the 'RIGHT' face.
    b. If the two sides are opposite of each other, one of the aligned faces is on the 'BACK' face and the other is on the 'FRONT' face.
4. Perform the following algorithm:

5. Rotate the 'UP' face to align the edge pieces again.
6. Repeat the algorithm if necessary.

Layer Three – The Corner Pieces

You have reached the final layer of the Rubik's cube and there's only one new algorithm to learn before you are done. The final step of solving the Rubik's cube is to align the corner pieces where they belong. There are a few steps to this procedure:

1. Find at least one corner piece that is in the correct placement (all colors on the corner pieces match with the colors of the adjacent sides), but may be rotated out of place.
2. If all corner pieces are aligned, skip to step 6.
3. Hold the correctly positioned corner such that it's in the bottom right corner of the 'UP' face.
4. Perform the following algorithm with the yellow face as the 'UP' face:

5. Repeat the algorithm until all corner pieces are in their correct positions, but not necessarily oriented correctly.
6. Hold the cube such that one of the corner pieces you need to orient correctly is in the top right corner of the 'FRONT' face.
7. Perform the following algorithm with the yellow face as the 'UP' face until the piece is oriented correctly:

8. Once the corner piece is oriented correctly, rotate the 'UP' face clockwise until the next misoriented piece is in the top right corner.
9. Repeat steps 7 and 8 until all corner pieces are aligned.
10. Cheer!

If you completed all the steps correctly, you have finally completed your first Rubik's cube solve.

CONGRATULATIONS

Image Sources

1. http://www.sciencebuddies.org/science-fair-projects/project_ideas/Math_p023.shtml
2. https://www.rubiks.com/blog/how-to-solve-the-rubiks-cube-stage-1
3. http://www.learnhowtosolvearubikscube.com/how-to-solve-a-rubiks-cube-solution-overview/