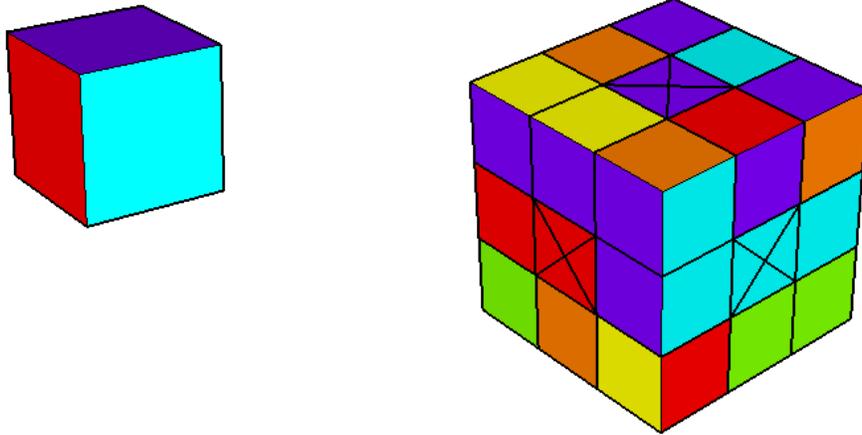# Rubik's Cube in SketchUp

This project shows how to start with one cube, and use it to build a Rubik's cube, which you can spin and try to solve.

*For this project, it helps to have some basic knowledge of SketchUp (though detailed instructions are provided). In particular, it's important to know how to zoom, rotate, and pan the view. If you need more information on how to get started, and a description of some basic tools, please read 3DVinci's Getting Started Guide (PDF).*

*PC users: go to http://www.3dvinci.net/SketchUp_Intro_PC.pdf.*
*Mac users: go to http://www.3dvinci.net/SketchUp_Intro_MAC.pdf.*

## Step 1: Build the Cube

1. For the base of the cube, activate the **Rectangle** tool. Draw the rectangle on the "ground," and pay attention to the numbers listed in the **Dimensions** field at the lower right corner of the SketchUp window. Either click to complete the rectangle (of any size) or don't click the second corner yet.

2.  To size the rectangle to be a square, type two identical numbers separated by a comma. I'm using 50, 50. These numbers will appear in the **Dimensions** field - don't click in this field, just type and the numbers will appear. Press Enter to complete the square.
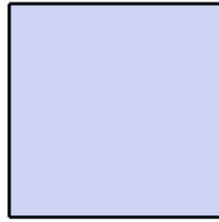
3.  Orbit so that you are no longer looking straight down onto the square. Active the **Push/Pull** tool, click the square, start to move it up, then type 50 (or whatever number you used for the square dimensions) and press Enter. Now we have a perfect cube, with all sides the same length.
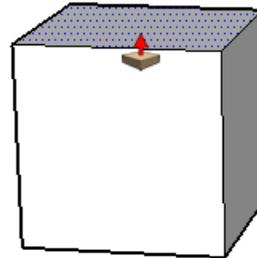
4.  Click the **Paint Bucket** tool and paint each face with a different color - six colors for six faces.
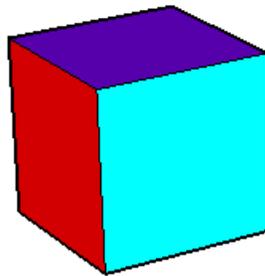
5. Because the cube will be repeated several times (26 times to be exact), it should be made into a component. As a component, each cube can be selected and moved or rotated as a single object, rather than as a collection of edges and faces. It also means that adjacent cubes will not "stick" to one another. Activate the **Select** tool and select the entire cube.
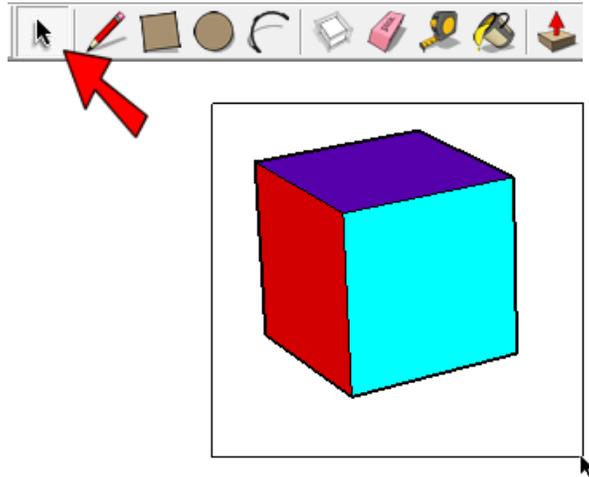
6. Right-click on any selected face and choose **Make Component**. Enter any name you like, make sure **Replace selection** is checked, and click **Create**.
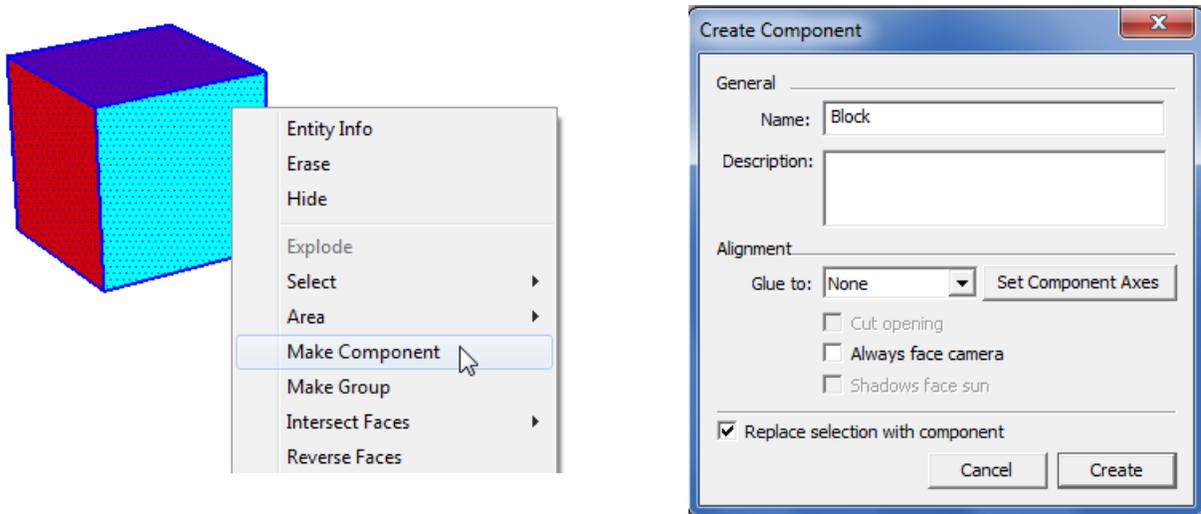
Once the component is created, it is highlighted in blue because it is selected. Leave it selected for the next step.
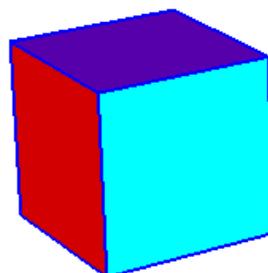
7. This cube will be copied to create the stack of cubes. Activate the **Move** tool, and press the Ctrl key (PC) or the Option key (Mac) to add the "plus" sign to the cursor. (You don't have to keep this key pressed, just tap it once.) For the two copy points, click Points 1 and 2 shown below - be sure to click corner points.
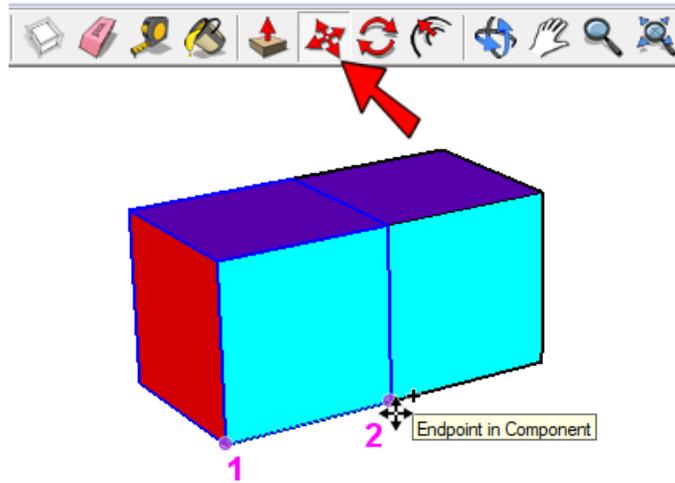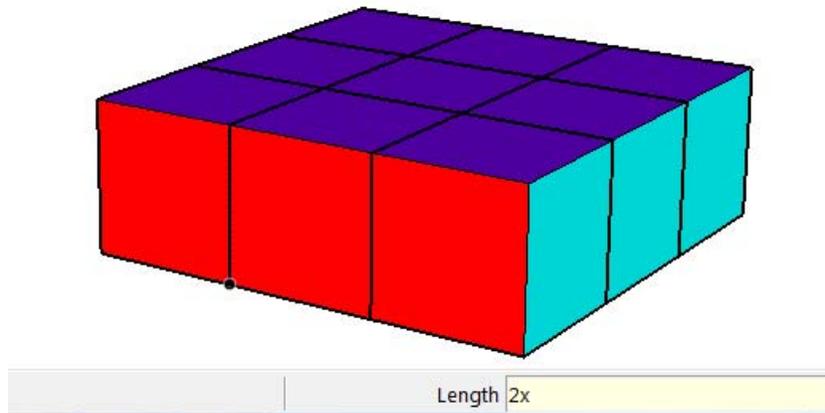
8. Three cubes are needed along this row, so type 2x (for two copies) and press Enter.
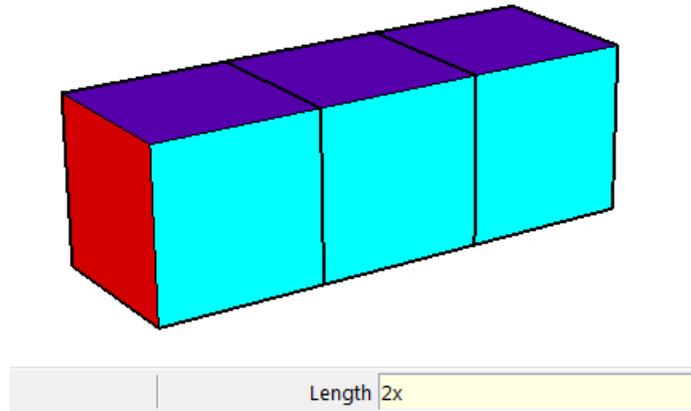
9. Now select all three cubes, activate **Move** with the Ctrl / Option key, and make a copy of the entire row.
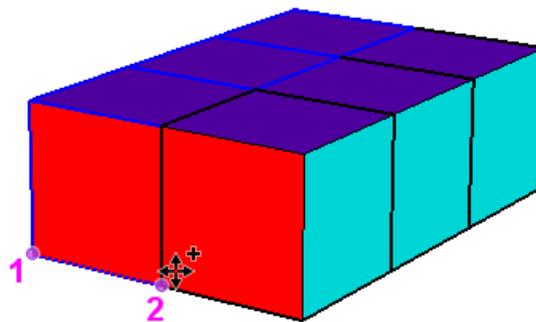
10. Enter 2x to complete the set of 9 cubes.

Length 2x

11. Now do the same in the vertical direction: select all 9 cubes, use **Move** with Ctrl / Option to make one copy straight up, then enter 2x to add the second copy. Now all of the cubes are in place, ready to spin!
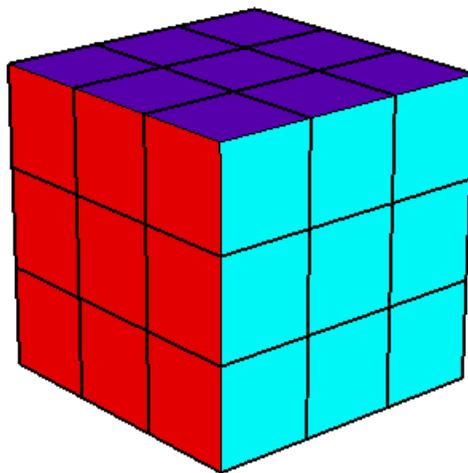
# Step 2: Twist and Play

1. Because the **Rotate** tool will be used to spin sets of cubes around, it's helpful to mark the center of each face of the overall cube. There are a few ways to do this, but the easiest is with a large "X" on the center cube on each face. Activate the **Line** tool and create two diagonal lines on one of the center cubes.
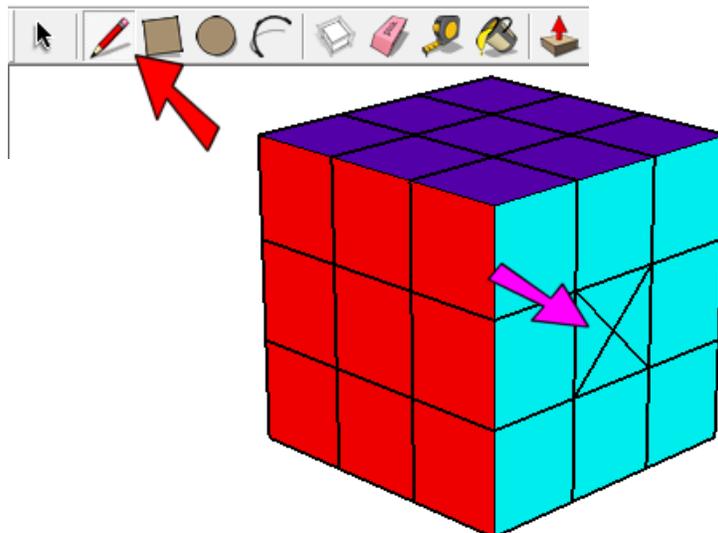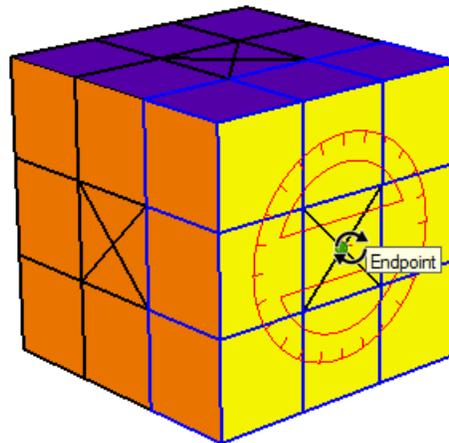
2. Go around the cube and place an "X" on each face - be sure there are 6 total.
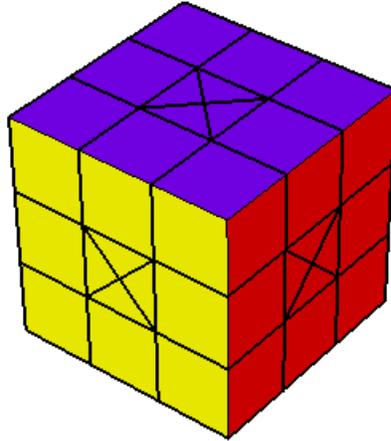
3. Now we're ready for the first spin. Activate **Select** and press and hold the Shift key, so that you can select multiple objects. Click all 9 cubes on one side - at this point all 9 have the same outside color.
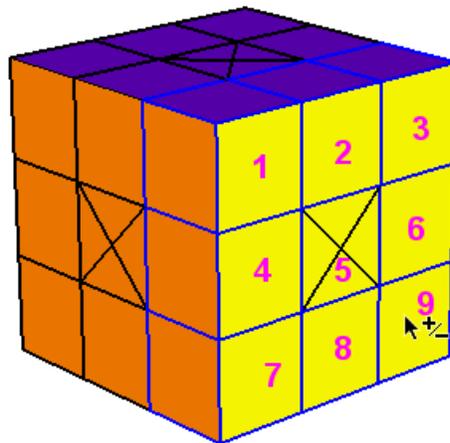
4. Activate **Rotate**, and place the protractor at the center of the "X" on the face you'll be turning.

5. Click anywhere to start the rotation, and start turning the cubes, noting the angle in the **Angle** field in the lower right corner. Click to finish the rotation when the angle is either 90, 180, or 270.



Angle 90.0
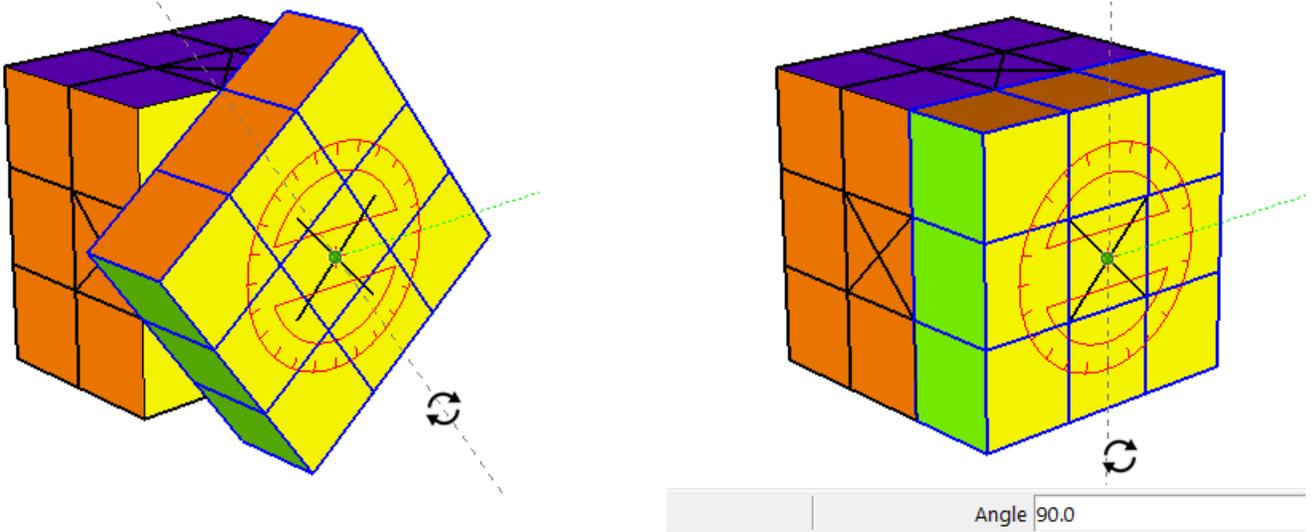
6. Turning other faces is done the same way, but now there will be different colors along each face. I'm selecting the 9 cubes shown below - some orange and some green. - and rotating them counter-clockwise 90 degrees.
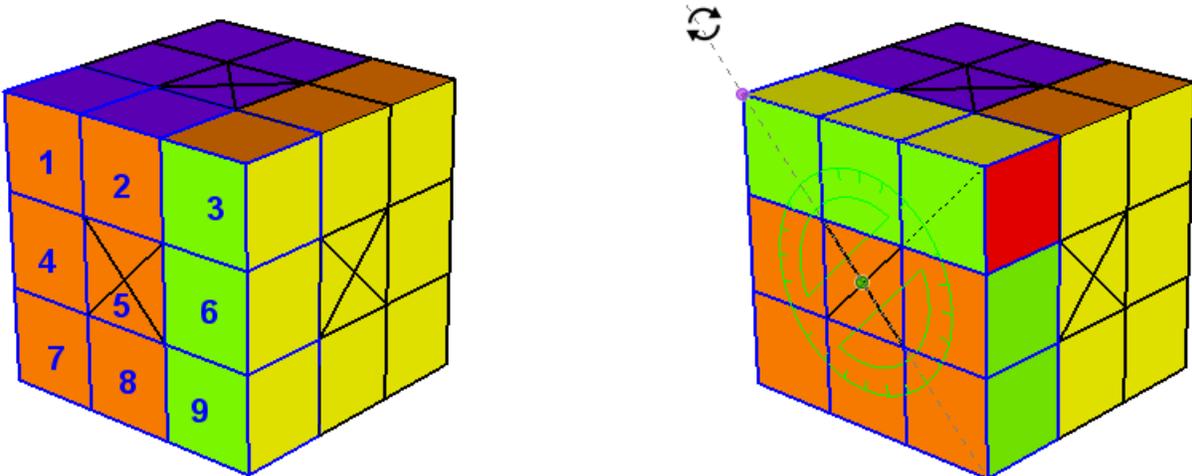
7.  After a few more rotations, I have a real mess on my hands. Can you solve it? (I'm quite sure I can't!)
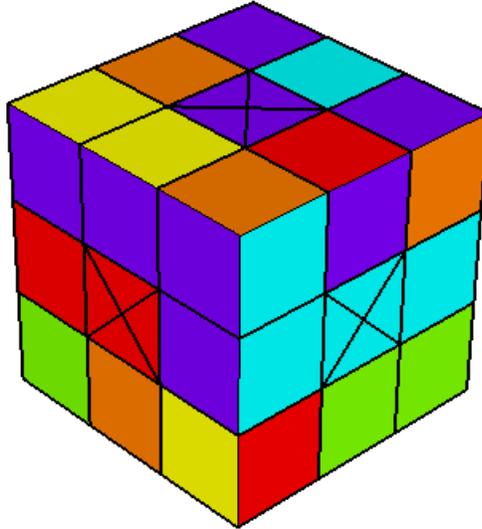


Of course, solving the cube is done the same way: select 9 cubes along any side and start turning. But here's where this differs from an actual Rubik's cube: if you get frustrated you can always use **Undo** (Ctrl+ Z or Cmd +Z) to get back to the "clean" cube! Or you can erase all cubes but one, and start building the whole cube from scratch (yes, this is cheating...)