How to Make a Rubik’s Cube Mosaic

A Comprehensive Tutorial from You Can Do the Rubik’s Cube

YouCanDoTheCube.com
Rubik’s Cube Mosaics

A Rubik’s cube has six faces and six different colors, and one single face can have more than a million arrangements. You can create amazing mosaics using only 6 colors in specific arrangements. In fact, it’s quite common for some of the best mosaics to be limited to only 4 colors.
Purpose:
You CAN Design Rubik’s Cube Mosaics

This presentation has been prepared to show how you can do your own Rubik’s cube mosaics using 25-100 Rubik’s cubes.
You can see many commendable and award-winning Rubik’s cube mosaics designed by students [here].

Pac Man Ghost by The Grayson School

Four Wondrous Seasons from Sunflower Elementary
Computer algorithm vs. manual creation

You could use an automated online resource such as this website to design mosaics. Such websites use algorithms that can instantly generate large, appealing mosaics with minimal need for revision, but for anything under 200 cubes, a person can manually design a mosaic that is much more gratifying.

Plus, of course, you can take honest pride in a design that you made yourself.
How to Make a Rubik’s Cube Mosaic

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Foundations of Rubik’s Cube Art

Part 1: Color
Understanding the Color Palettes

Only 6 colors are available on a Rubik’s cube, but those colors lend themselves well to the artistry of mosaics, because the colors include:

• all three primary colors (red, yellow, and blue)
• two of the secondary colors (orange and green)
• two pairs of complementary colors:
  • red ⇔ green
  • orange ⇔ blue
Choosing a Color Palette

When making a mosaic, you should decide on a color palette before you begin the design. To some extent this decision depends on the selected image, but to a greater extent it is an artistic choice.

The color palettes shown here are used routinely in Rubik’s mosaics. It might seem surprising that given only 6 colors many artists choose to reduce it even further to 5 or even 4 colors, but each of these palettes can be very effective.
Choosing a Color Palette

Here are examples of 100-cube mosaics with specific palette choices.
How to Use the Color Palette: Complementary Colors

Complementary colors contrast with each other more than any other color and, when intermixed, can trigger the perception of a brown color, especially when seen as part of a larger mosaic or when seen from a distance.
How to Use the Color Palette: Complementary Colors

Complementary colors also make each other look brighter when placed in large areas side-by-side.
How to Use the Color Palette: Highlight Colors

The colors of the Rubik’s cube also provide three pairs of colors useful for natural highlights.

When used together, the colors can effectively portray the interplay of light and color seen with reflections and shadows.

Using only white for bright areas and only blue for shadows can work, but using the highlight color pairs usually creates a more natural appearance.
Applying Highlight Colors

Highlight colors frequently show reflections of light. The colors provide the additional benefit of breaking up large sections of solid color to provide an illusion of depth and texture.
Part 2: Applying Color

Foundations of Rubik's Cube Art
Applying the Colors

When it comes to applying color from a color palette, a common strategy (and the way most automated algorithms are applied) is to use the darkest color for black and continue down in gradation to white. Many designers will convert a full-color photo to black-and-white expressly for this purpose.
Applying the Colors

Typically, though, a full-color photo is best to use when designing a mosaic manually. You can better attend to the boundless nuances of color and the overall image in a way that computers cannot.
Applying the Colors

When you begin coloring in a mosaic template, you can naturally color match. Yellow in your source image will be yellow in your mosaic and so on, but at some point you will need to approximate.

How you approximate colors will depend on your palette choice, the size of the mosaic, the size of the area to be colored, and your own artistic instinct, but the general strategies are standard:

1) Select the closest approximation of the six colors
2) Use a blend of intermixed colors
3) Use a purposeful false color
4) Follow the gradation pattern of your palette from dark to light.
Applying the Colors

Consider an image of an ordinary apple as a mosaic. With a small, 25-cube mosaic, it is generally best to simply represent the subject with the most obvious colors. Extensive detail is often prevented by the limited area. Applying only the most essential highlights is often quite sufficient.

The detail of yellow veins in the leaf is not practical at this scale (25 cubes).

The apple has a larger surface area than the leaf, so the highlighted reflection on the apple can be represented with varying precision at the artist’s discretion.
Applying the Colors

A 100-cube mosaic of an ordinary apple involves many more stylistic choices. Of course, you could make a representational image by doing the entire shape solid red, but what if you want more depth and detail?

What Rubik’s color should this bright patch be? Red? White? Red and white? Orange?

What Rubik’s color should this dark patch be? Red? Red and Green? Blue?
Applying the Colors

Here are some basic apple mosaics, each done with a different color strategy.

The images are all reduced in size which simulates distance from the mosaic. Reducing the size of the image also curtails superficial comparison and enhances the effect of the color choices.

The apple that is best at this point is largely subjective, and any one of them could be further refined for greater precision.
Foundations of Rubik’s Cube Art

Part 3: Illusions
Pixelation

Mosaics made with Rubik’s cubes are inherently pixelated. Rubik’s cube mosaics are made only with single color squares. Smaller mosaics in particular can appear blocky because each square is a significant fraction of the whole image.

Many mosaic designers embrace this intrinsic pixelation by doing images of subjects that are supposed to be pixelated such as familiar characters from older video games including Mario, Pac-Man and Space Invaders.
Using Pixelation to Simulate Colors

You can use pixelation to your advantage by using combinations of colors and lines. Sometimes a particular combination of colors will create an illusion of color difference or evoke a perception of colors that are not even on the cubes.

Although one may appear brighter, these orange squares are the same color.

Although one may appear yellowed, these green squares are the same color.
Using Pixelation to Simulate Colors

In this 600-cube mosaic, Bailey the Bulldog (by Bailey Rubik’s Cube Club, Bailey Middle School, Pensacola, FL), you may perceive that the dog has a fleshy pink lip, but the “pink” squares are actually orange with red and white intermixed.
Playing Tricks on the Eyes with Illusions

The eyes send visual input to the brain, and the human brain automatically seeks and completes patterns and familiar shapes, because that increases the speed of perception. Due to its efficiency, the brain may perceive things that are not actually as they seem.

Many illusions exploit the brain’s optimized perception. With the Kanizsa Triangle shown here, most people see two triangles and three circles – except that there are no circles or triangles.
Playing Tricks on the Eyes with Illusions

These mosaics take advantage of the brain’s inclination to complete patterns and familiar shapes.

How do you know Ringo Starr has a nose? The white of the face is all contiguous. The brain perceives the familiar shape of a nose because of the orange shading and partial yellow lines.

Where does Harrison Ford’s left cheek (right side) stop? The “missing” yellow squares could have been added, but minimizing such lines sometimes enhances the image.
Playing Tricks on the Eyes with Illusions

This mosaic also takes advantage of the brain’s inclination to complete patterns and familiar shapes.

In this rendition of John Lennon, neither white circle is actually complete, but you likely perceive complete, intact glasses.

In this example, not completing the white circles allowed for adding more color to emphasize the face and shading.
Review of Foundations of Rubik’s Cube Art

Decide which color palette is most suitable for you and your picture
Use the color palette, complementary colors, and highlights to enhance the appearance of your mosaic.
Use pixelated squares of color to represent the familiar cube colors and to simulate additional colors
When suitable, use colors and (the absence of) lines to create useful illusions
Designing a Rubik’s Cube Mosaic

Part 1: Selecting an Image
Criteria for selecting an image

Selecting the right inspirational source image can be a challenge in itself. Of course, you might consider choosing a subject/image that is already pixelated and therefore easy to render in a mosaic – which is why Mario and Pac-Man are frequent subjects of Rubik’s cube mosaics. However, most likely you will want to go beyond such subjects.
Criteria for selecting an image

Many aspects of an image can influence your choice and the viability of making the image into a 25-100 cube mosaic:

- Color
- Contrast
- Orientation of subject
- Scale
Criteria for selecting an image

**Color:** Rubik’s cube mosaics are easiest to design when the selected image primarily uses colors that are on the Rubik’s cube. Notably, though, black and white images also readily lend themselves to adaptation as mosaics, because you can determine the color palette for the gradations of gray.

Workaround strategies if the image has few cube colors: Use color-mixing/pixelation techniques and tricks; use a limited palette such as ROYW to avoid color issues; use false colors
Criteria for selecting an image

Contrast: The subject and background need to be manifestly different colors without small details in the background. Pictures with distinct backgrounds are easier to adapt into mosaics. For example, portraying a green frog sitting on a green leaf would be an unreasonable challenge with Rubik’s cubes.

Workaround strategies if contrast is poor: Omit the background; use a limited palette and save one color for the background; use false colors
Criteria for selecting an image

**Orientation of subject matter:** Diagonal lines can be troublesome to represent with Rubik’s cubes, and this includes things that simply appear to be diagonal. A tipped head in a photo makes the mouth diagonal, which can be hard to smoothly portray, and it can make a person’s eyes seem diagonal which, even when done right, can look very wrong in the final mosaic.

Workaround strategies if the desired image is not ideally oriented: Rotate the image before using it to design a mosaic.
Criteria for selecting an image

Scale: The size of the image and the subject need to be at a scale that can be reasonably and identifiably represented by the number of cubes you have. With 25 cubes, you can portray a small boat; with 100 cubes, you can portray a good sailboat; with 600 cubes, you can portray the Titanic.

Workaround strategies: Zoom in on the most interesting and definitive aspects of your image. For example, instead of trying to do the entire State of Liberty with only 100 cubes, consider doing just the torch or just the face. You will get more satisfying detail by focusing your mosaic on a manageable portion.
Preparing the Selected Image

Once you have selected your source image, you should consider adjusting the photo to match your purpose and vision.

Resize, rotate, and crop the photo so that your mosaic has good scale and orientation.
Time to Design Your Mosaic

Now that you have selected and adjusted your image to suit your plans for a mosaic, you are ready to actually design your mosaic.
Designing a Rubik’s Cube Mosaic

Part 2: Designing the Mosaic
Methods of Designing a Mosaic

• Paper template and 5 colored pencils
  (Obviously you don’t need a white pencil)
  Just print a template your planned size and begin coloring
• Paper template and photo guide with grid overlay
• Spreadsheet template and your imagination
• Spreadsheet template and a photo guide
• Excel Spreadsheet template and a background photo
  The advantage to using a spreadsheet is the ease of changing colors, re-centering your image, and saving your image for future use.
Designing a Mosaic with a Template and Your Imagination

This is the easiest method in many ways, because the subject matter and details do not have to be realistic. Rules of color can be used at the whim of the artist.

25-cube mosaics

100-cube mosaics
Designing a Mosaic with a Template and Your Imagination

These links will give you access to templates that you can print and/or use online.

- Grid paper for 25-cube mosaic using 3x3 cubes
- Grid for 25-cube mosaic using 3x3 cubes
- Grid for 100-cube mosaic using 3x3 cubes
- Grid for 225-cube mosaic using 3x3 cubes
- Grid for 36-cube mosaic using 2x2 cubes
Designing a Mosaic Using a Spreadsheet and a Photo Guide with Grid Overlay

Find and print a photo you want to use for your mosaic. (For this strategy, you can use a picture from a magazine.)

Get a large (gallon-size or bigger), clear zipper bag, and, using a Sharpie, make a 1 cm grid.

Put the photo in the bag behind the grid, and use the grid to guide how you color the template.
Designing a Mosaic Using a Spreadsheet

Create a spreadsheet template by re-sizing the columns and rows to make squares.

Add borders to 3x3 sections to make it clear where the cubes are and how many you will need to build your mosaic plan.

Begin coloring the template using cell colors.
Designing a Mosaic Using a Spreadsheet and a Photo Guide

Find and save a photo you want to use for your mosaic.

In a spreadsheet with a mosaic template, insert the photo. Resize the photo to your desired scale, and place it next to the template.

Begin coloring the template using the photo as a guide.
Review and Revise

Always review and revise your work to improve the design.

I fixed the pattern so that it was consistent all over the pineapple.

I made the pineapple rounder and completely redesigned the leaves.
Designing a Mosaic Using a Spreadsheet and a Photo Background

Find a photo you want to use for your mosaic. Size and save it to match the size of your template.

In Excel*, under Page Layout, click background to add your selected photo to the background of your template.

Begin coloring the template right over the background image.

*The background feature is not presently available in Google Sheets
Review and Revise

Always review and revise your work to improve the design.
Designing Your Mosaic: Review and Revise

After you’ve finished designing your mosaic, take a break from the design process and return later to review and revise your mosaic design. During the initial design, it is easy to focus on small details, and it is helpful to step back to look at the big picture. Often the first draft of a design needs small changes to improve the overall appearance of the mosaic.

First Draft

Final Draft

I made the eyes less intense, which I felt was truer to the photo. I also improved the color blends above the eyes and around the nose.
Other Methodologies

As demonstrated, using paper or spreadsheets is generally easy for all ages and abilities. Furthermore, these methods employ tremendous artistic freedom.

Other methods are significantly more dependent on software and reduce artistic freedom.

• Automated online mosaic generators, as previously mentioned, are most effective when designing mosaics with at least 400 cubes but even then the generated mosaics often benefit from manual editing.

• Mosaics can also be designed using advanced photo editing software such as Adobe Photoshop. This software utilizes precise sizing, color conversion, and editing tools to directly convert images to Rubik’s mosaics. The results of these efforts vary greatly but can be exceptional.
Designing a Rubik’s Cube Mosaic

Part 3: Building and Displaying the Mosaic
Building Your Mosaic

• Once you’ve designed your mosaic, you’re ready to build!
  • Remember to begin with the correct center square when you make each face.
  • Double-check your mosaic before you take pictures. It’s easy to have one cube turned the wrong way.

• If your design is for a class or another group to build:
  • Use a projector to display the entire mosaic and let students discuss how to build it. This develops communication skills and teamwork.
    -or-
  • Print the mosaic (an advantage of having the design in a spreadsheet) with vertical and horizontal page breaks so that each page only has 4 cubes. Then students build only the cubes assigned to them.
Displaying Your Mosaic

• Stack the cubes to make a free-standing mosaic. A small number of cubes can stand easily for others to see (and for picture posing)
• Lay the mosaic cubes flat on a table or on the floor. This is especially good in an area where there is an overlook from the stairs or the 2nd floor.
• Use a large cardboard box to help support a standing mosaic
• Build an easel or stand specifically for Rubik’s cube mosaics
Share Your Rubik’s Cube Mosaic

Be sure to share your Rubik’s cube mosaic on your favorite social platforms!

Share with You Can Do the Rubik’s Cube:

- https://www.facebook.com/YouCanDoTheRubiksCube
- https://twitter.com/YouCanDoRubiks
- https://vimeo.com/youcandothecube
Enjoy Designing Rubik’s Cube Mosaics!
Templates and Documents

- Grid paper for 25-cube mosaic using 3x3 cubes
- Grid for 25-cube mosaic using 3x3 cubes
- Grid for 100-cube mosaic using 3x3 cubes
- Grid for 225-cube mosaic using 3x3 cubes
- Grid for 36-cube mosaic using 2x2 cubes
Mosaic References

Unless otherwise specified, all mosaics featured in this presentation are designed by David Leith, a Rubik’s Cube Ambassador.

Pac Man Ghost by all students at The Grayson School, Radnor, PA: 100 cubes


Bailey the Bulldog by Bailey Rubik’s Cube Club, Bailey Middle School, Pensacola, FL: 600 cubes
Music (for the Cheetah mosaic)

Royalty free music selected from Bensound.com

A Day to Remember

♫ ♪ ♩