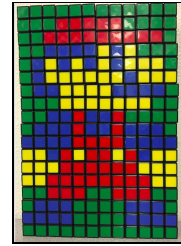


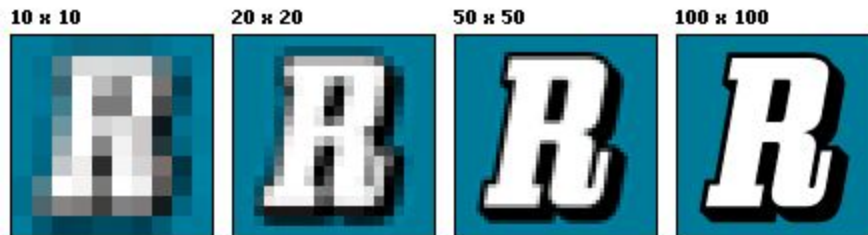
Creating a Rubik's® Cube Mosaic: Pixels and Resolution

All digital images are composed of millions of squares or pixels. Students may be familiar with Minecraft or photographs where faces are blurred out. Both of these are examples of enlarging the pixels, resulting in lower resolution. The better the resolution of the image the more pixels per square unit. Creating mosaics using Rubik's® Cubes is a great lesson in resolution and area.



YCDTRC Mosaic Contest
1st place- 24 Cubes
San Luis Middle School

Below is an example of improving resolution as the number of pixels per square unit increases.



https://en.wikipedia.org/wiki/Image_resolution

In this lesson, students will apply the skill of solving the upper face of a Rubik's® Cube to a given pattern to convert their drawings to Rubik's® Cube mosaics.

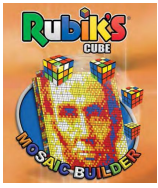
The pages that follow may be individual lessons of 10 - 15 minutes or stations in your classroom. Each student page is followed by a Teacher Notes page.

Standards Addressed in this Lesson:

According to the National Coalition for Core Arts Standards (<http://www.nationalartsstandards.org>), students use critical thinking and problem solving skills in creating and analyzing art. Art is a unique method of communication. More information about art standards can be found at <http://www.nationalartsstandards.org/content/conceptual-framework>.

Common Core Mathematical Practices:

- 1 Make sense of problems and persevere in solving them.
- 2 Reason abstractly and quantitatively.
- 3 Construct viable arguments and critique the reasoning of others.
- 6 Attend to precision.
- 7 Look for and make use of structure.



Creating a Rubik's® Cube Mosaic: Pixels and Resolution

Materials:

30 Rubik's® Cubes for each student or group of students

Handout for each student or group

Graph paper - use link below for free download

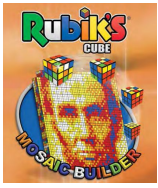
<http://www.vertex42.com/WordTemplates/printable-graph-paper.html>

red, green, blue, yellow, orange colored pencils, markers, or crayons

Background knowledge:

Students should be familiar with the vocabulary of the Rubik's® Cube (edge, corner, center cubes and upper, down, front, back, left & right faces). They will apply the skill of solving the upper face of the Rubik's® Cube to a given pattern to convert their drawings to Rubik's® Cube mosaics.

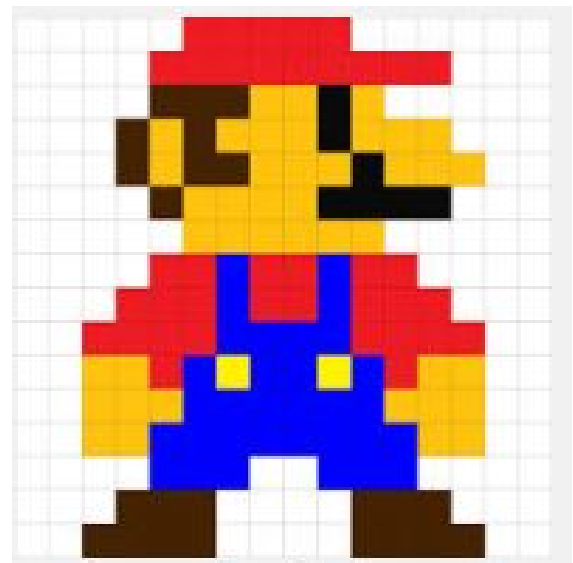
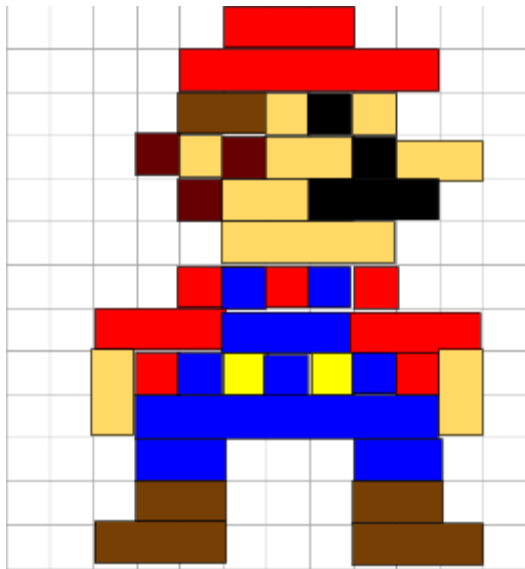
A summary of the necessary steps for solving the upper face of the Rubik's® Cube is at the end of this document.



Creating a Rubik's® CubeMosaic: Pixels and Resolution

Mosaics are pictures or designs that are made up of small pieces, usually glass, stone, or tile. Digital pictures like a computer screen or TV are mosaics. Those images are made up of tiny dots of light called **pixels**. You are going to see how the number of pixels in a picture affects the **resolution** or level of detail of the images you see.

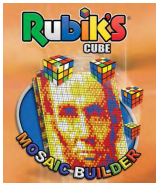
Compare the two images of Mario. Which one do you like better? Why?



Count the number of squares in each row that make Mario's...

Number of squares	Left Mario	Right Mario
hat		
face		
shirt		
pants		
1 shoe		

How does the number of squares affect the detail?

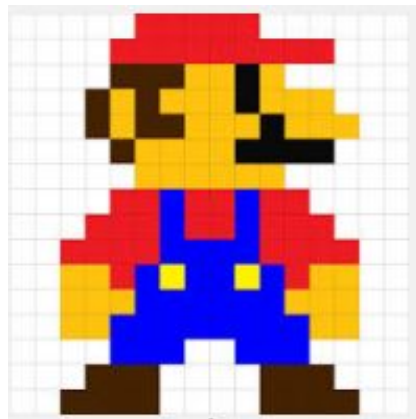
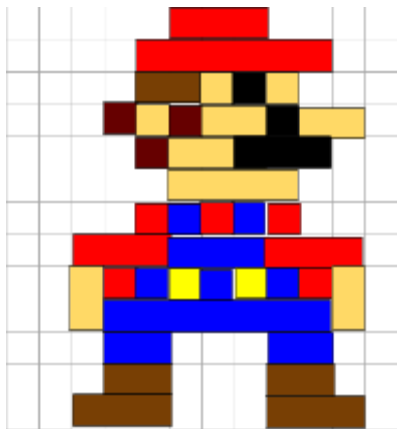


Creating a Rubik's® CubeMosaic: Pixels and Resolution

Teacher Notes: The goal of this page is to have students recognize that the more pixels in an image the better the resolution. Students may also comment on the size of the pixels. The smaller the pixels, the better the resolution. The next student page focus more on this.

Mosaics are pictures or designs that are made up of small pieces, usually glass, stone, or tile. Digital pictures like a computer screen or TV are mosaics. Those images are made up of tiny dots of light called **pixels**. You are going to see how the number of pixels in a picture affects the **resolution** or level of detail of the images you see.

Compare the two images of Mario. Which one do you like better? Why? The image on the right has both more pixels and smaller pixels, making it the better image.

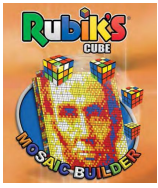


8-bit mario by ~raivcesleinadnayr on deviantART

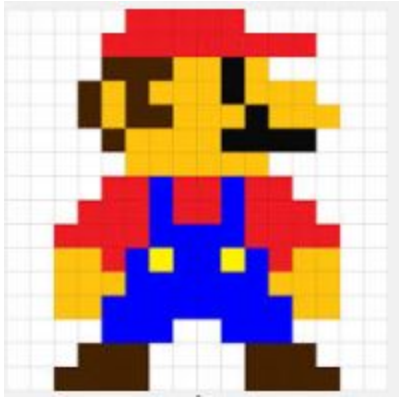
Count the number of squares in each row that make Mario's...

Number of squares	Left Mario	Right Mario
hat	9	14
face	12 (not including eye, ear, & moustache)	25
shirt	11	24
pants	21 including buttons	34
1 shoe	5	7

How does the number of squares affect the detail? The more squares the better the resolution. Also, the smaller pixels provide greater resolution. This point may be more clearly made on the next student page.



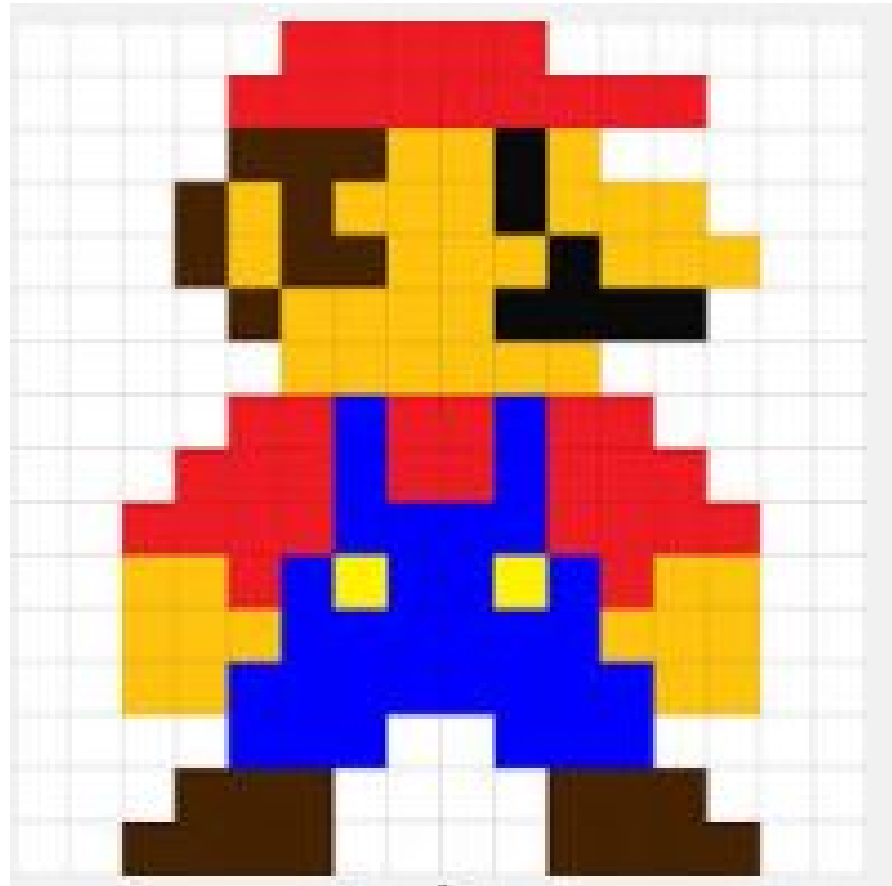
Creating a Rubik's® Cube Mosaic: Pixels and Resolution



Compare these two images of Mario. Which do you like better? Why?

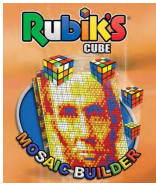
Compare the size of the squares in each drawing. About how many smaller squares does it take to make a bigger square?

Fill in the table below. What do you notice?



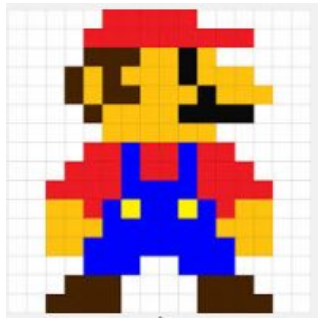
Number of squares	Left Mario	Right Mario
hat		
face		
shirt		
pants		
1 shoe		

How does the size of the squares affect the resolution of the image?



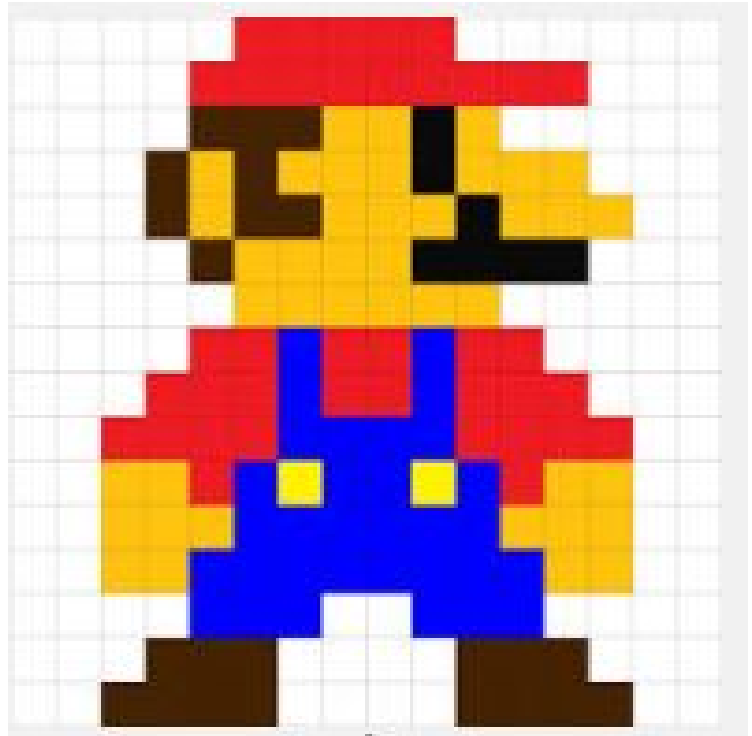
Creating a Rubik's® Cube Mosaic: Pixels and Resolution

Teacher Notes: The goal of this page is to have students recognize that the smaller pixels in an image the better the resolution.



Compare these two images of Mario. Which do you like better? Why?

Answers may vary here as there is not a huge difference in the resolution.



Try to get students to recognize that the smaller image a little sharper than the larger. You may want to further illustrate the point by projecting an image and enlarging and shrinking the image. The smaller the pixels, the more per square unit, which results in a sharper image. Try uploading a simple image, say a team logo, to the mosaic builder, <http://mosaic.twisttheweb.com/>, and

show students how the number of cubes used changes the resolution of the image. Below is a sample of the Boston Red Sox logo.

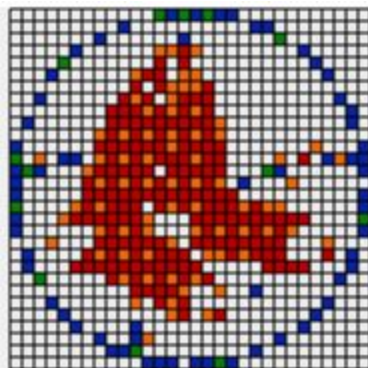


Image using 100 cubes

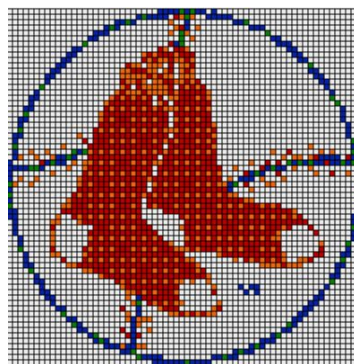
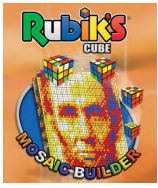


Image using 500 cubes

Compare the size of the squares in each drawing. About how many smaller squares does it take to make a bigger square? There are about 4 smaller squares for every larger square.

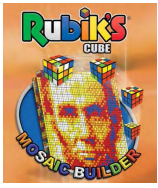


Creating a Rubik's® Cube Mosaic: Pixels and Resolution

Fill in the table below. What do you notice? In this case, the number of pixels is the same. The smaller image was enlarged to make the larger image.

Number of squares	Left Mario	Right Mario
hat	14	14
face	25 (not including eye, ear, & moustache)	25
shirt	24	24
pants	34 (including buttons)	34
1 shoe	7	7

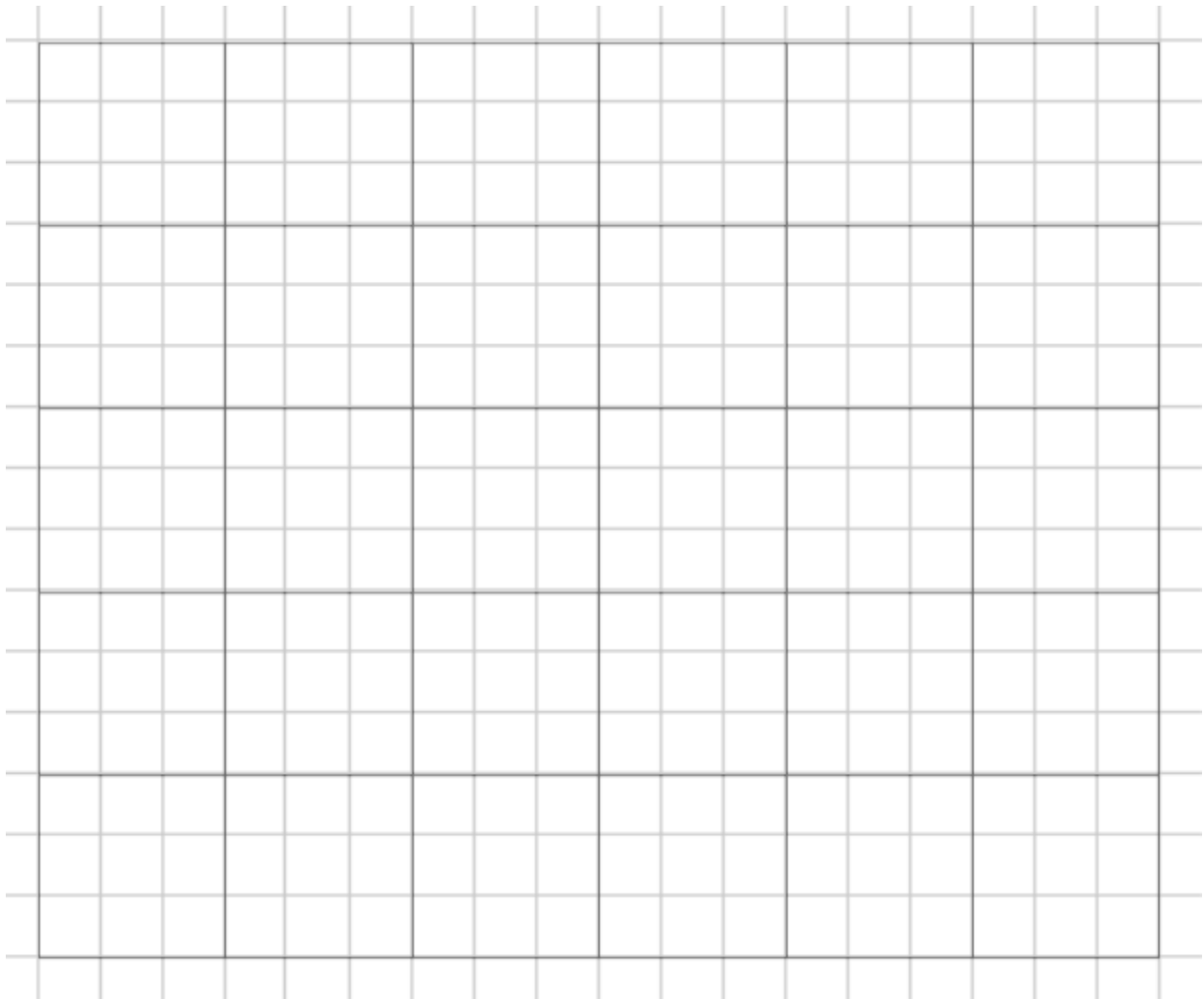
How does the size of the squares affect the resolution of the image? The smaller the squares or pixels, the sharper the resolution.



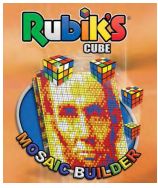
Creating a Rubik's® Cube Mosaic: Pixels and Resolution

To create a Rubik's® Cube mosaic, you will need to make a drawing on grid paper.

1. Your drawing must fit on the grid.
2. Each square of the drawing must be completely filled with the same color.
3. Only the colors red, white, blue, orange, yellow, and green can be used in your drawing.



Each of the big squares will be the upper face of a Rubik's® Cube. How many cubes will you need to create your mosaic?

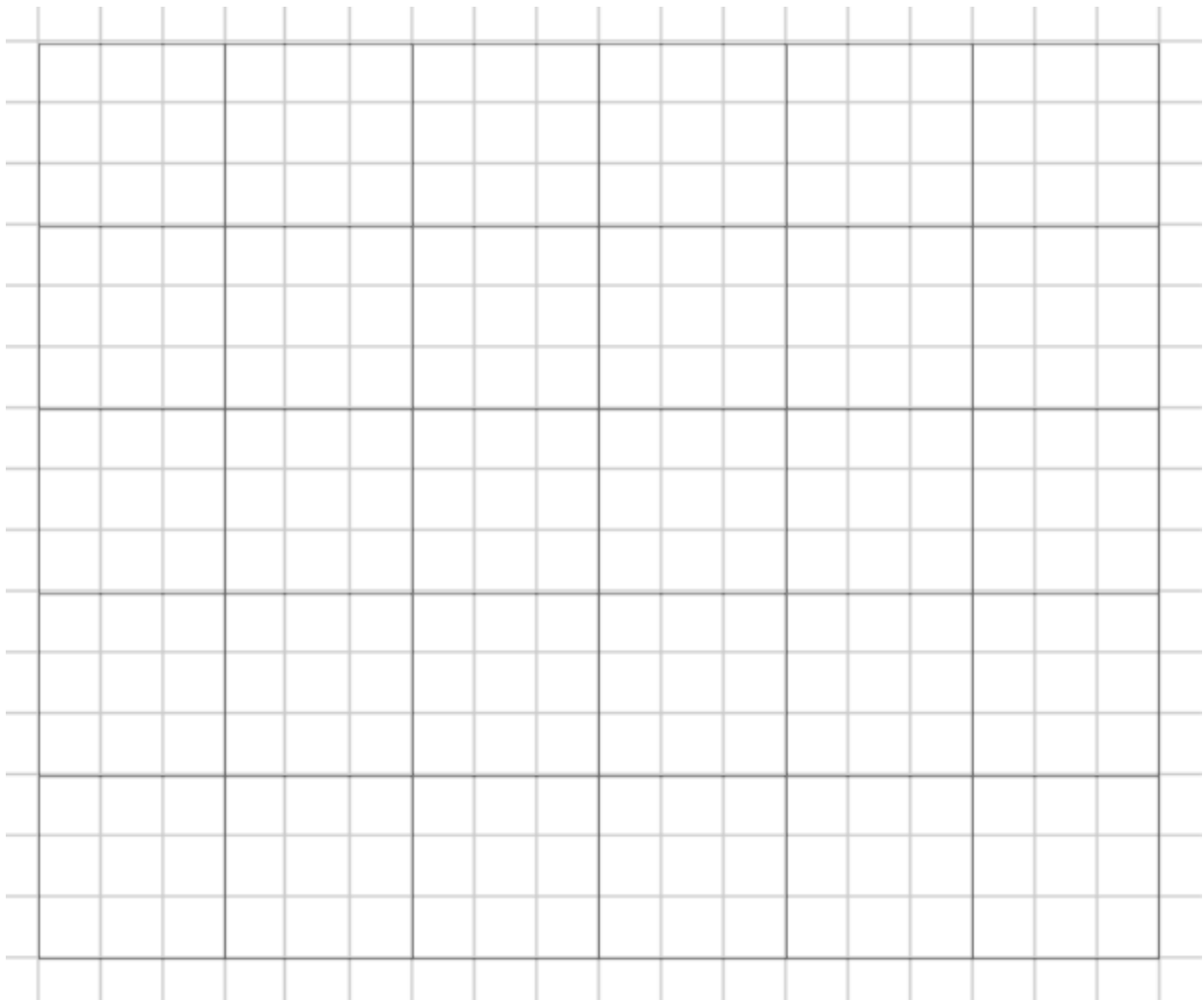


Creating a Rubik's® Cube Mosaic: Pixels and Resolution

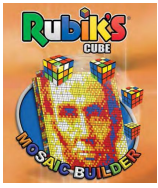
Teacher Notes: You may want to have students make a second copy of their drawing on the grid paper so they can cut the second one up into the outlined 3x3 squares. This will allow them to concentrate on only one cube face at a time while still having the intact original to show how the squares, and the cubes, fit together to make the drawing.

To create a Rubik's® Cube mosaic, you will need to make a drawing on grid paper.

- Your drawing must fit on the grid.
- Each square of the drawing must be completely filled with the same color.
- Only the colors red, white, blue, orange, yellow, and green can be used in your drawing.

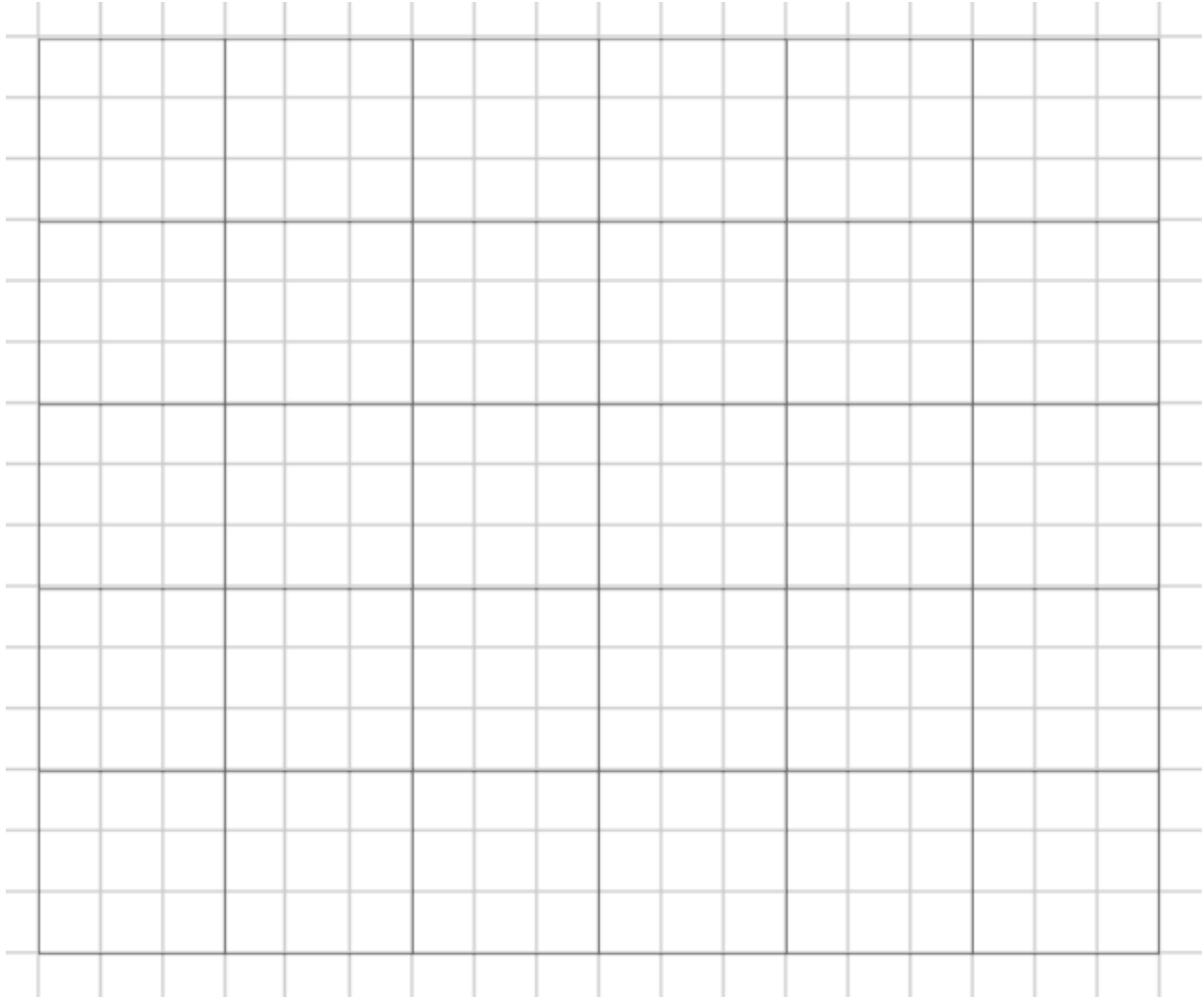


Each of the big squares will be the upper face of a Rubik's® Cube. How many cubes will you need to create your mosaic? **No more than 30 cubes**



Creating a Rubik's® Cube Mosaic: Pixels and Resolution

Teacher Notes: You may want to make or have your students make outlines of 3x3 squares on larger sheets of grid paper to make larger mosaics.



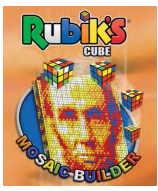
At this point, students should be able to solve any of the mosaics in the YCDTRC Beginner or Intermediate Mosaic Guides. In addition to sample mosaics, there are tips for organizing larger mosaics.

<http://www.youcandothecube.com/downloads/Read-Mosaic-Builder-Beginners-Guide.pdf>

<http://www.youcandothecube.com/downloads/Read-Mosaic-Builder-Guide.pdf>

Try uploading a photo into the mosaic builder on our website. The simpler the image and the more cubes you have, the better the end result. Try it!

<http://mosaic.twisttheweb.com/>

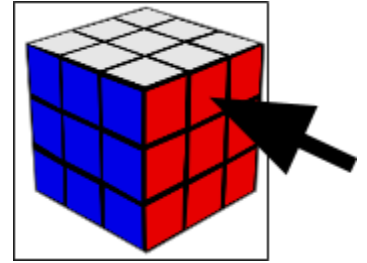


Creating a Rubik's® Cube Mosaic: Pixels and Resolution

How to Solve the Upper Face

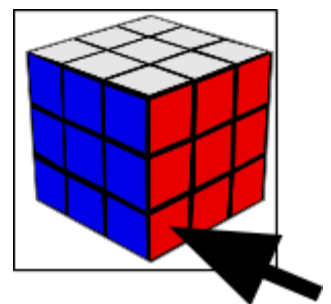
Identify the color of the upper face by looking at the center square.

1. Solve the edges first.
2. Rotate the entire cube so that the edge piece you want to change is on the right of the upper face. You might need to turn the right face until the cube you want is on the upper face.
3. To flip the edge, do these steps:



Repeat #2 and #3 until all the edges are in the correct position.

4. Solve the corners.
5. Rotate the down face until the corner you want is in the lower right of the front face. The color that you want to move to the upper face should be on the right face.
6. To swap the corners, follow these steps:



Repeat #5 and #6 until all the corners are in the correct position.