The Mount FUJI WAVE of MATH

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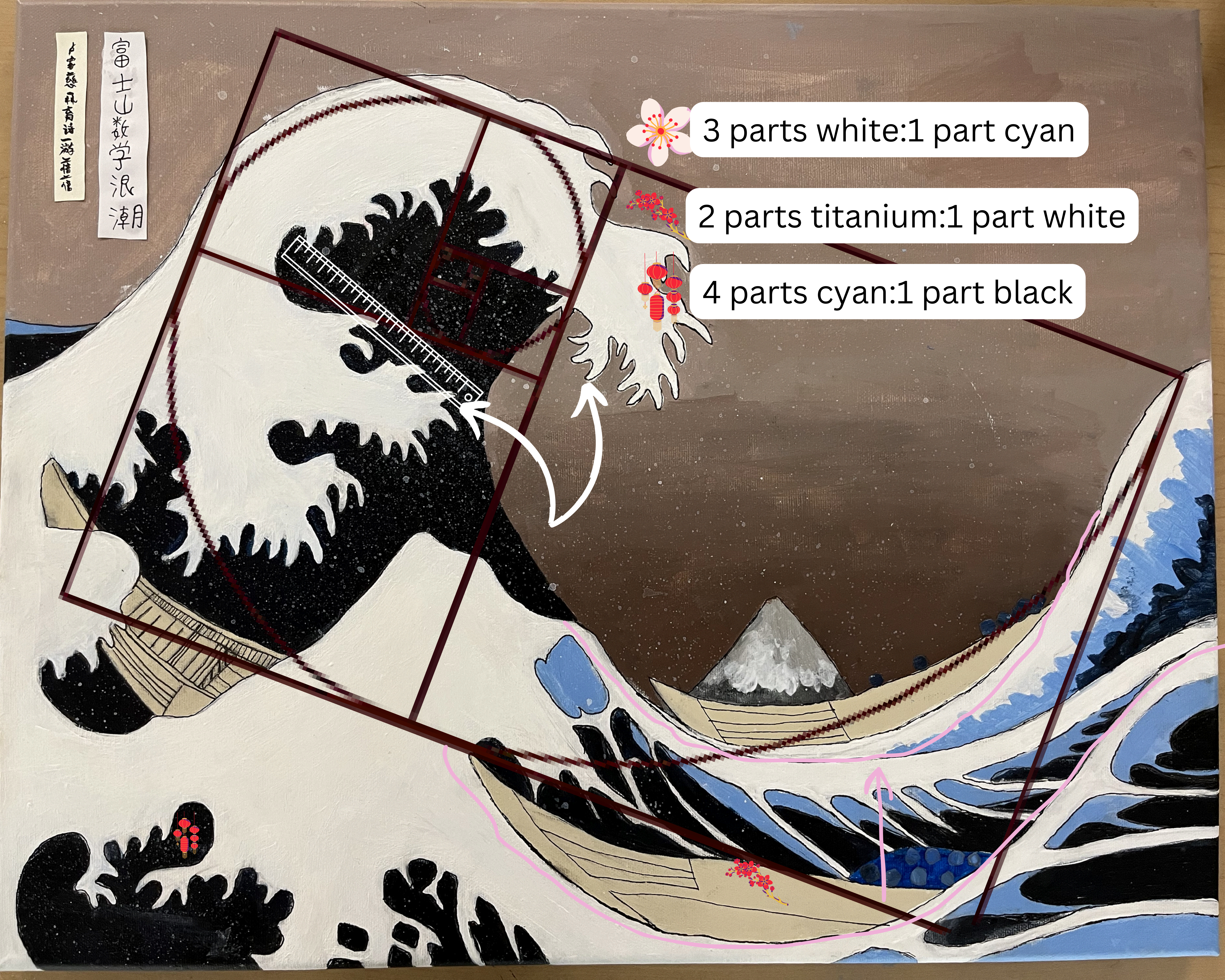
Gold Level MATHCOUNTS Project

May 2024


冨嶽三十六景 神奈川沖浪裏


富士山数学浪潮



富士山数学浪潮
3 parts white:1 part cyan
2 parts titanium:1 part white
4 parts cyan:1 part black

The piece of artwork that we have chosen to recreate is The Great Wave of Kanagawa, originally a wood block print by Hokusai. It was chosen because we think it includes a multitude of math concepts, and would challenge our small group to recreate it. The math concepts include quadratics, the golden ratio, the square root of two, the concept of proportionality, transformation, and ratios. Additionally, all mathematical calculations were done by hand without the assistance of a calculator. The second image is our recreation, The Mount Fuji Wave of Math. We used acrylic paint, pencils and a fineliner to add details to a 16" by 20" canvas. This scale allows the viewer to experience how menacing the wave is as the original is 10.1" by 14.9". We dedicated our spring break to working on this project and are very proud of it, but acknowledge that it can be improved. If not for the limited time, there would be less to improve, but we are proud nonetheless.

The first math concept in our painting is the quadratics that are in the wave claws. The quadratic equation, ax^2+bx+c=y. The graphed form of the quadratic equation is also a form of parabola, a continuous curve starting from a fixed point. Once restrictions are added to the equation, it becomes a finite curve. The quadratic equation is used as a last resort for factoring equations and expressions. Like linear and exponential functions, there is also a quadratic function. When a quadratic equation is graphed on a graphing calculator, the intercepts are the possible values of x for each value of y. In our piece, every wave 'claw' is a quadratic equation graphed on the coordinate plane; they have just been rotated to form a wave-like shape.

(Shown by the arrows)

The second math concept demonstrates the golden ratio. The golden ratio is a ratio between two numbers that is about 1.618 and is used in photography to accentuate figures. It is commonly associated with the fibonacci sequence, which is when you add the previous two numbers together to get the next number. The fibonacci sequence starts with zero and one and then continues in its pattern as such: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89...(the ellipses show that the sequence continues as there is an infinite amount of numbers) The golden ratio is very similar. It starts as a single rectangle, then is cut into two halves, then that half is cut in half, and so on. It can also be shown as one plus the square root of five, all divided by two. This is displayed in the curve of the large wave, which almost perfectly aligns with the spiral of the golden ratio, as shown in our image. The frothiest area is centered at the nucleus of the golden spiral, and the tail follows the curve of the wave.

(Shown by the spiral)

Our team, as the overachievers that we are, decided to include more than the two required math concepts, so for our third, we included the square root of two in the thickness of the blue stripes on the great wave, although it is a little difficult to see. The right-most dark stripe, or ‘rib’, is 1 mm thick. The second is 4 mm, the third one is 1 mm, and so on, following the sequence 1.41421356237 from right to left, which is the square root of two. A square root is a number where, when multiplied by itself, it equals another number. For example, since 22 is 4, 2 is the square root of 4 because 22 is equivalent to 22. In this case, 1.41421356237... times itself is equivalent to two (the ellipses show that this is a non-terminating decimal, meaning it goes on forever). Another name for the square root of two is Pythagoras's constant, and this is because in a square with side lengths of one unit, the line from one corner to the opposite one is the square root of two. Pythagoras’s constant is very important in the world of math because not only was it most likely the first irrational number to be discovered, causing it to be quite a breakthrough. It is also used in a variety of different fields to calculate everyday things.

(Shown by the ruler)

We didn't stop at three, we went on to four! Our fourth concept is the concept of proportionality which is shown in the heads of the rowers in the boats. This is displayed as in the radii of the heads on the viewer side of the closest boat goes 0.45, 0.405, 0.3645, and 0.32805 (scale of 0.9, which means that it was multiplied by 0.9 each time to get the correct scale) centimeters. The radii of the heads on the farther side of that same boat are 0.4, 0.32, 0.256, and 0.2048 (scale of 0.8) centimeters. This is also displayed when looking at the boat closest to Mount. Fuji, which follow the order 0.425, 0.34025, 0.272225, and 0.21778025 (scale of 0.85) centimeters. At the very back of that same boat, we included four heads, each with a radius of 0.32805 centimeters, but while the back two are semicircles, the two closer to Mount. Fuji are cut very slightly. These numbers display how our entire project is scaled smaller the further back you go so that the viewer experiences a sense of perspective and depth. This also helps to make the piece more accurate and appear to be realistic and well thought out by allowing each part of the piece to be proportional to the parts at the same depth of the ones next to it.

(The little round circles)

After four, of course, it is necessary to reach five because we hate the number four. For our fifth reason, we are showing the transformation. This is displayed in our piece as two of the waves on the right-hand side have identical curves. They have been translated to different places and rotated to different angles. This is a form of transformation because a transformation is when a shape or object is altered by either moving it around without changing the shape itself (translation), when a shape is reflected across a line on the coordinate plane (reflection), or when a shape is rotated around a point on the coordinate plane (rotation). A rotation is when a shape is moved around a point in a circular motion, e.g. if something was moving along the circumference of a circle, of which the center point is the point it is being rotated around. The coordinate plane can help with this. So our two waves are transformed by being translated about an inch up and rotated about thirty-five degrees. This displays the continuity of the waves and the similarities between them. This also tricks peoples' brains into thinking that they go together or are meant to go together.

(Shown in the pink lines)

Five of course, is an odd number, and it is therefore insufficient. We couldn’t bear to leave it there, so we included a sixth math concept. This concept is of color ratios. We used color ratios to display how we used shading our piece and this also made our recreation less monotonous and allowed for it to be more interesting and concise for the viewer. For parts of our piece, we used ratios of titanium white:primary cyan, primary cyan:black, and titanium white:unbleached titanium. These ratios allow us to include many different shades and colors, which really seems to enhance and add complexity to our recreation. A ratio is a comparison between two different values, such as apples and oranges. If you had 3 apples and 8 oranges, you could compare them as apples:oranges, or 3:8. You could also compare them as oranges:apples, or 8:3. For the darker parts of the wave, we used a primary cyan:black ratio of 4:1, for the slightly lighter parts between the white and the dark blue we used a titanium white:primary cyan ratio of 3:1, and for the boats’ colors we used a titanium white:unbleached titanium ratio of 1:2.

(The images that have writing attached)

Even more importantly, we conducted extensive math together as a part of the project. All the mathematical calculations were done without a calculator. Our piece was done with lots of thought, and we really put a lot of effort into the writing. Our writing encompasses and explains many different math concepts, such as quadratics, the square root of two, the golden ratio, and the concept of proportionality, that were all displayed in our work of art, The Mount Fuji Wave of Math. We strive to continue to continue to do math in the coming years and to keep giving it our all.