



News

Math + The Arts is more than the Sum of its Parts

—HOLLY HUBBARD, THOM KLEPACH, CHRISTINE LITTLE, AMY MURPHY, SCOTT TAYLOR, AND PAUL VILLAVICENCIO

“Math is everywhere,” mathematicians exclaim to the world at large. Perhaps most people believe us, but unless they work in quantitative careers, how many actually see the world mathematically?

In Waterville, Maine, as in lots of communities, many students make their way through elementary school trying to please their teachers but not deeply internalizing the meaning of math or understanding why it matters. Sum Camp is our collaborative attempt to impact our local community by infusing music, art, theatre, and playground games with mathematics in a way that reinforces K–5 state mathematics standards. We take a nontraditional approach to traditional mathematics.

Robert¹ attended the camp in 2019. During the camp, he had a lot of trouble with emotional outbursts, perhaps a symptom of his difficult family situation. He fell in love with the theatre and game components of camp, though, and by the end, he had improved tremendously in his ability to analyze and correct his mathematical mistakes. Robert is now entering high school. His school bus driver told us that he credits Sum Camp with helping him navigate middle school.

Sum Camp is designed for children who are behind grade-level in math. Many of the children in our camp come from difficult backgrounds; we believe that the experience of math through the arts can help them circumvent some of the negative effects of trauma on mathematics learning and social functioning.

The camp concludes with an art show and performance for caregivers. Our hearts are warmed by the joyful mathematical and social confidence the campers exude from the stage and in their explanations to their caregivers of the math in their artwork. The caregivers, school administrators, and community members in attendance rave about this approach to mathematics.

This year, with a grant from the John and Mary Neff Foundation, we were able to “multiply the math” by augmenting camp with discussions of overarching mathematical themes and practice with specific mathematical activities bridging camp mathematics to school mathematics. Experiencing mathematics as embedded in their world transforms campers’ perception of math. As they enter the middle school years,

¹ The student’s name has been changed to protect his privacy.



they do so with stronger mathematical skills and deep motivation for achieving the next level in understanding.

We’d like to share a few examples of activities campers will engage in at Sum Camp.

Music

Each day starts with music and movement. Children learn about pitch, rhythm, tempo, and dynamics and interpret them mathematically. Several activities build an understanding of simple ratios and fractions, such as creating a rhythm fraction tree with whole notes, half notes, quarter notes, etc. Campers then develop their own rhythmic motifs and express them in both musical and mathematical notation. For instance, writing both a quarter note and $\frac{1}{4}$.

Another body-based activity explores tempo by choosing a metronome marking, identifying the tempo as a measurement along a number line of beats per minute, and then playing the tempo on a frame drum while campers move their bodies according to the chosen speed. Students eventually create their own melodies that we incorporate into the final performance.

Theatre

The theatre portion of the camp emphasizes persistence, growth mindset, and teamwork. Activities build the self-confidence required to productively handle failure. Kids work on stage presence and help write a mathematically-themed play. To develop the ability to project a speaking voice, children are paired up. They take turns speaking at various volumes and measure the distance at which they can be heard. We learned,



however, that it is important that students have their backs to each other to keep them from just seeing their partner's lips move!

Last year, the theatre teacher and the children created "Gnome math for me!"; a play about gnomes who work together to solve the math problems necessary for growing healthy gardens. This summer, the play will be "Math Magic." In it, mages are accepted to a camp where they learn the magic behind math. They create potions for each arithmetic operation, resulting in fantastic mayhem.

Art

Art activities are designed to creatively engage learners through self-expression. Campers' art is a launching point for number talks, a pedagogy for helping children develop creativity and fluency with numbers. One favorite activity involves looking for inspiration in the brightly colored, mosaic-looking acrylic paintings of artist Alma Thomas (1891–1978). Each student creates their own unique version using torn scraps of colored paper and then analyzes it from a mathematical point of view. Students observe their works closely, counting and then totaling the number of tiles for each color chosen. They practice estimating, rounding, and comparing numbers and proportions. They explore questions like: *How many blue tiles are there? What proportion of my artwork is blue? How does that compare with other students' work?* Beauty is exhibited in the variety of designs and rich conversation. Students experience firsthand the presence of math in art and in the ordinary things that surround them.

Math Games

Afternoons are spent playing an enormous variety of custom-designed math games. Despite this diversity, there are a number of themes that tie many of the activities together. One of these is the use of various polyhedral dice. We teach campers notation such as "2d10+1d4" which means: "roll a 10-sided die twice and a 4-sided die once." These "magical geometric gems" are the perfect number generators for any activity.

For example, in one game, students cast "spells," each of which consists of a certain dice combination. The person with the greatest total from the roll wins. Spells include the "Per-



nicious Pancakes of Power" (allowing students to shoot giant pancakes) using 2d12; "Pink Eye of Doom" (causing a nasty itchy eye infection) using 2d10+1d4; "Goodness, Gracious, Great Faerie Furballs of Fire!" (shooting a tiny ball of fiery faerie fur) using a 3d8. After the students select two spells from the master list, they get to create a spell of their own. The only stipulation for any of these spells is that the maximum possible total cannot be larger than 24. After the students have their chosen spells, they need to go to "Spell Caster School." A group of two to four spellcasters places a token on the "one" square of a sequentially numbered 8×8 checkerboard. They take turns casting spells from their personal spell books and moving their token forward on the number-line represented by the spaces of the board. As students reach the end of the number-line, they acquire points determined by arithmetic rules, whose difficulty is chosen by the math teacher. These spells are then used subsequently in other games requiring more strategy and more sophisticated arithmetic.

This activity reinforces basic math facts, serial addition and multiplication, the number line, and the idea that there are multiple ways to achieve a result—in this instance, the many different ways to combine numbers to get a total of 24. Students discover strategies to optimize their outcomes by comparing the effectiveness of certain combinations of dice versus others.

Although funding for the camp in its current configuration is coming to an end, we look forward to finding additional ways the Sum Camp philosophy and curriculum can benefit our community.



Holly Hubbard, MEd, creates the art curriculum for Sum Camp; she spent many years teaching at a Montessori School, is an artist and currently teaches K–3 art at Waterville Public Schools. Thom Klepach, PhD, creates the math games for Sum Camp; he teaches in the Science, Technology, and Society department at Colby College. Christine Little, MA, creates the music curriculum for Sum Camp; she teaches music and movement at Snow Pond Center for the Arts. Amy Murphy, MEd, is Sum Camp director; she spent many years as a Montessori teacher and currently directs the Gifted and Talented program at Waterville Public Schools. Scott Taylor, PhD, is Sum Camp producer; he teaches mathematics at Colby College. Paul Villavicencio, MA, creates the theatre curriculum for Sum Camp; he teaches 6th grade English and Language Arts at Waterville Public Schools.