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Teaching Mathematics with Poetry: Some Activities

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Synopsis

During the summer of 2021, I experimented with a new way of getting children excited about mathematics: math poetry. "Math" can be a trigger word for some children and many adults. I wanted to find a way to make learning math fun — without the students knowing they're doing math. In this paper I describe some activities I used with students ranging from grades K-12 to the college level and share several poem examples, from students in grades two through eight.

1. Background

While at Trinity Christian College, as part of my graduation requirements for my mathematics degree, I did research on what seemed to me to be an out-of-the-ordinary topic. Though I eventually discovered a large literature on how math and poetry are connected, the article [1] by Patrick Bahls was what originally led me into this work. I learned about many advanced types of mathematical poetry and was inspired to try out letter symmetry in poetry and modular arithmetic, having the same remainder on each line.

Last summer, my father, a computer science professor, asked me to design a course for the STEAM camps we teach together every year through Moraine Valley Community College. I started brainstorming on how to bring poetry into the math class for young children. I needed poems that didn't contain advanced mathematics and that gave them the opportunity to be creative as they learned. I got my greatest inspiration from Laken Brooks' TEDx talk [2]. Brooks was a literature major, and she was terrified by mathematics. In [2], she talked about how she used poetry to get through that anxiety.

I show students that video before they start making their poetry so they can see how they can use poetry if they feel overwhelmed with their math lessons. Being able to relate what you're learning to your interests is important for anyone, especially for children. I am very passionate about getting children — particularly young women — excited about mathematics. I believe that using poetry and art is a way to do exactly that. Math can be scary to some children — as I've found it's not very exciting for many students until later in one's undergraduate work, or even into graduate school. All children need to see how fun and nonthreatening mathematics is. Poetry gives them a chance to find a love for math in an approachable and creative way.

2. Running the Class

To make this activity fun for children, and to allow for more creativity, I provided graph paper and colored pencils to each student. There were seven types of poems (demonstrated on the next few pages) that I decided to use for students as young as those in the second grade. Before students started writing, I asked them each to write down a list of interests. This helped students when it came time to write their poems. Sometimes the most challenging part of writing poetry is deciding what to write about. Having them do this eliminated that frustration. For some of the higher-level poetry, computers may be necessary, or a very helpful tool at the least.

3. Kindergarten: Wordless Poetry with Colors

Kindergarteners are still developing basic reading and writing skills. My main goal with kindergarteners was to gently introduce the concept of graph theory through map coloring. The numbers in Figure 1 are divided into

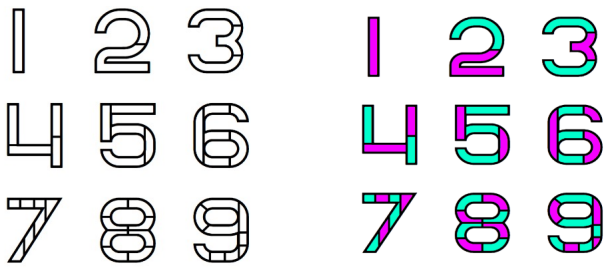


Figure 1: Coloring, counting, graphs! An activity for kindergarteners.

sections that correspond with their value, teaching quantity while teaching map coloring concepts (same colors cannot touch while filling in the map).

A second activity uses counting to introduce patterns found in concepts such as Pascal's Triangle; see Figure 2. Students can number the circles in the blank triangle below in a variety of ways. For example, in the lower left triangle, I numbered the individual rows of circles which I colored to look like a slice of watermelon. It's a simple exercise that introduces the basics of pattern counting. One could also use a filled-in outline of Pascal's Triangle to help students recognize patterns. Coloring all instances of the numeral "1" blue, for example, while searching for like terms. Teachers could have students color odd numbers one color and even another. My favorite application is pointing out the Sierpinski Triangle within Pascal's triangle by having them search for a particular multiple. In my example shown below I colored multiples of 2 blue.

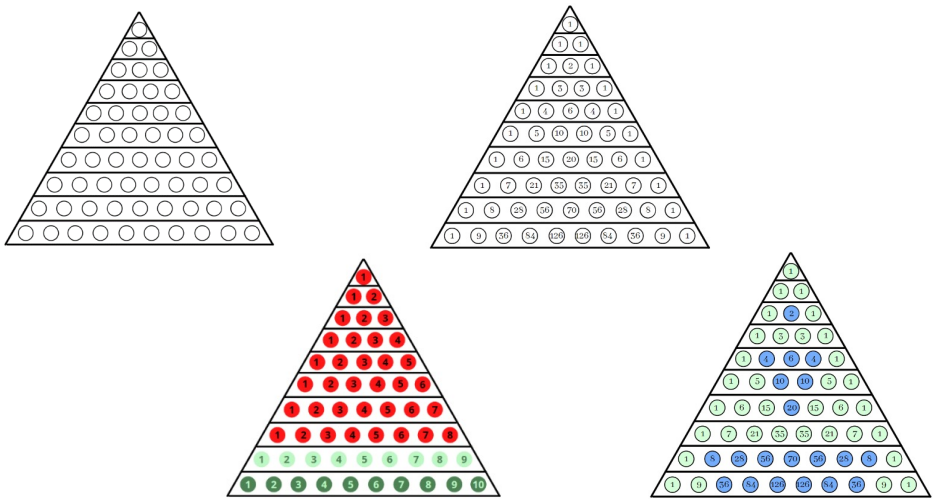


Figure 2: Triangles and colors! Another activity for kindergarteners.

4. First-Second Grade: Words Enter the Game

For grades 1-2, teachers can introduce principles of basic arithmetic using wordplay. By adding or subtracting words from one another as in Figure 3, students exercise mathematical thinking while implementing deductive reasoning and word association. In my experience this poem is particularly fun for students and eases almost all ages into thinking mathematically.

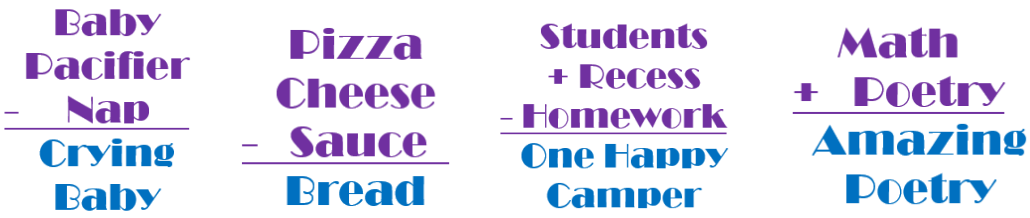


Figure 3: Word arithmetic! An activity for Grades 1-2.

To introduce word problems, I like to use Sestains and visual aids. Students write six lines that include the number of that line in each sentence (as shown in Figure 4). I then have them draw a picture of their story. This helps with visualization of word problems, showing that these seemingly scary and intimidating forms of math problems are nothing more than stories they can come up with themselves.

Figure 4: A sestain and a picture! Another activity for Grades 1-2.

5. Third-Fifth Grade: More Structure!

Haikus are a perfect tool to introduce prime numbers; see Figure 5. The confinements of the poem are that there can only be **three** lines made up from a **five-seven-five** syllable structure, totaling **17** syllables. Haiku is a well-known poetic form (see, for example, [3]) and it is not difficult for most students to understand. The only thing to remember is that younger students may not have enough experience with syllables to craft poems just yet, but showing them how to clap syllables out gets them on their way!

I love prime numbers,
Two, seven, and twenty-three,
Just some of my favs!

Figure 5: A haiku for primes! An activity for Grades 3-5.

For area or shape filling concepts, I use the abstract poem (Figure 6 left). For this type of poem, students write inside or outside of a shape that they draw. This can be one word or number repeated or an actual poem. On the forming shapes end of geometry, I use concrete poems (Figure 6 right). The line length forms the shape that the poem is about. Students have a lot of fun with both the abstract and concrete poems.

Figure 6: Abstract and concrete. Another activity for Grades 3-5.

6. Sixth-Eighth Grade: Playing with Sequences

The poems for this age group are focused on sequences. The first poem is the Trianglet (Figure 7). The syllable pattern is 1-2-3-4-5-5-4-3-2-1. This is a 10-line poem with the first and last word the same. As can be seen, this poem takes on a diamond shape due to the sequence when centered, but a triangle shape when left or right aligned. This starts visually showing students patterns that form from sequences outside of just numerical ones.

Figure 7: The Trianglent. An activity for Grades 6-8.

The second poem is the Golden Fib poem (Figure 8). This is a fib, a poem that follows the Fibonacci sequence in terms of its syllable or word count [4]. The Fibonacci sequence is built by adding the two previous digits together, starting with 1 and 1 to get 1,1,2,3,5,8,13,21,34 and so on... It's a fun challenge to make these poems about places where you find the golden spiral or Fibonacci sequence in nature like a snail, pinecone, or a flower.

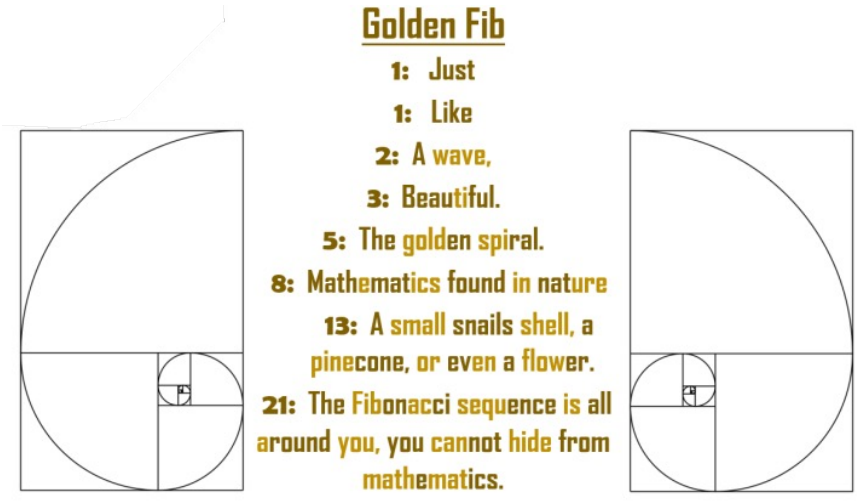


Figure 8: A Golden Fib! Another activity for Grades 6-8.

7. Ninth-Twelfth Grade: Sets and Symmetries

I use Lipograms for sets containing elements. I explain this as removing a certain letter from the alphabet cereal and only using the ones remaining (Figure 9 left). In the poem on the right, I only used the vowels "a" and "e." This can be used to teach elements in a set, union of sets, intersections, and so on. This concept can also be applied to Venn diagrams by putting words or themes in different sections.

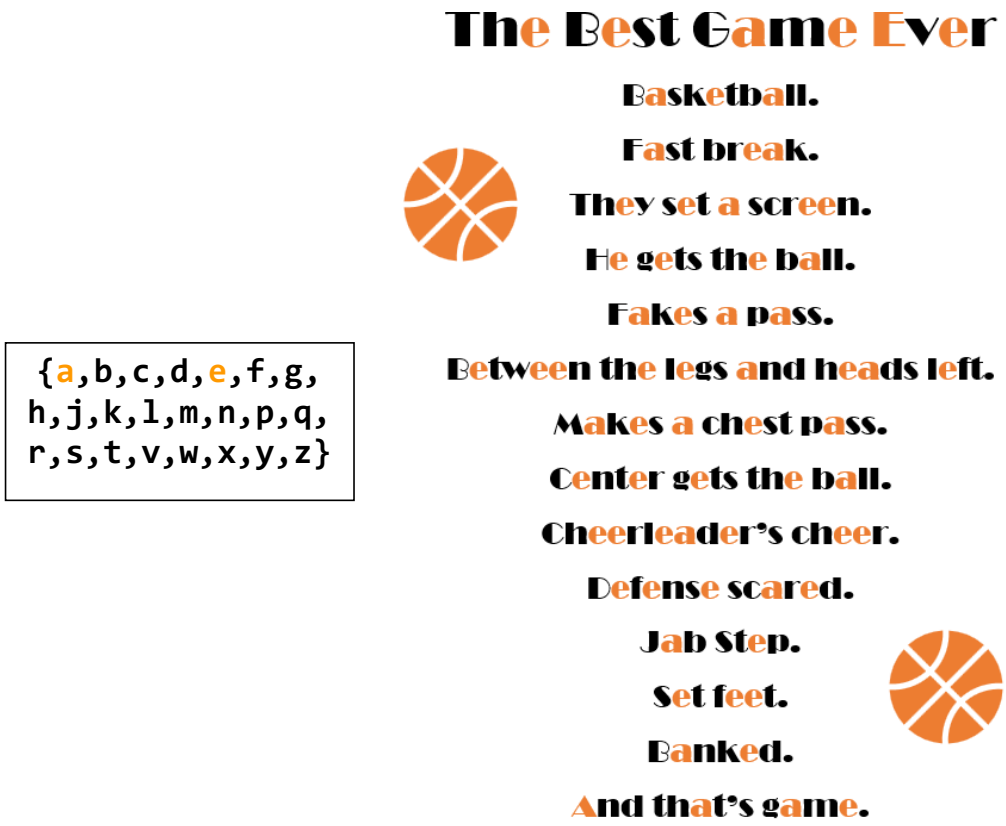


Figure 9: Lipograms! An activity for Grades 9-12.

I then address symmetry. I realize symmetry is introduced earlier in school, but grades 9-12 are when students really dive into geometry. In the poems in Figure 10, students use horizontally or vertically symmetric letters and shapes. One could either do the entire poem one way or alternate lines, letters, and words.

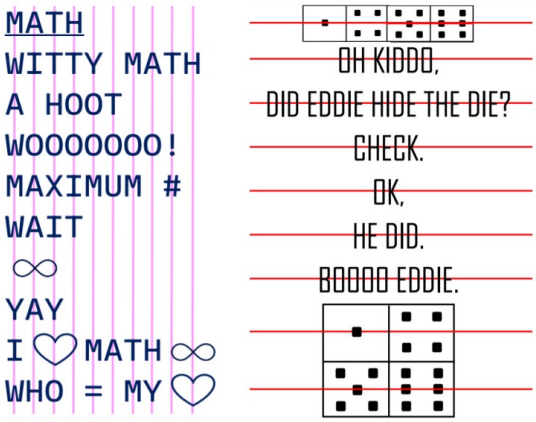


Figure 10: Poetry using symmetric letters. Another activity for Grades 9-12.

For this activity, it is best to provide a sheet with words that can be formed with the letters with symmetries (see Figures 11-12). Teachers can start the activity by having students identify letters with symmetries first. This is also a great activity when students are first introduced to the topic of symmetry in middle school — it does not have to be limited to high school students.

Horizontal Symmetry: B C D E H I K O X

▷ ◆ # ◯ ∞ □ + = ◁

Noun

EX	ID	BOX	COB	COD	DIB	BIO
DIE	OX	ED	CHI	BED	DEB	ECO
DEED	OK	HEX	KID	BOD	DOC	HIDE
CODE	COED	DICE	HOOK	BOOK	COOK	ICEE
HOOD	CHEE	OXIDE	KIDDO	CHEEK	ICEBOX	CHECK
COOKIE	HOODIE	DEBBIE	KIDDIE			

Verb

BE	DO	HEX	BOX	DID	HID
BID	BIDE	BODE	HIKE	CODE	EXCEED
HEED	COOK	BOXED	CHOKE	HIKED	CHECKED
EBOOK	BOOED	CHECK	CHOKED	KIDDED	EXCEEDED
HOOKED	BOOKED	COOKED	BOOTED	DECKED	CODEBOOK

Adjective

OK	ICED	BOXED	COOKED	BEDDED	CODED

Roman Numerals: I (1) - X (10) - C (100) - D (500) - M (1,000)

Onomatopoeia

EHH	HOHOHO	OHHH

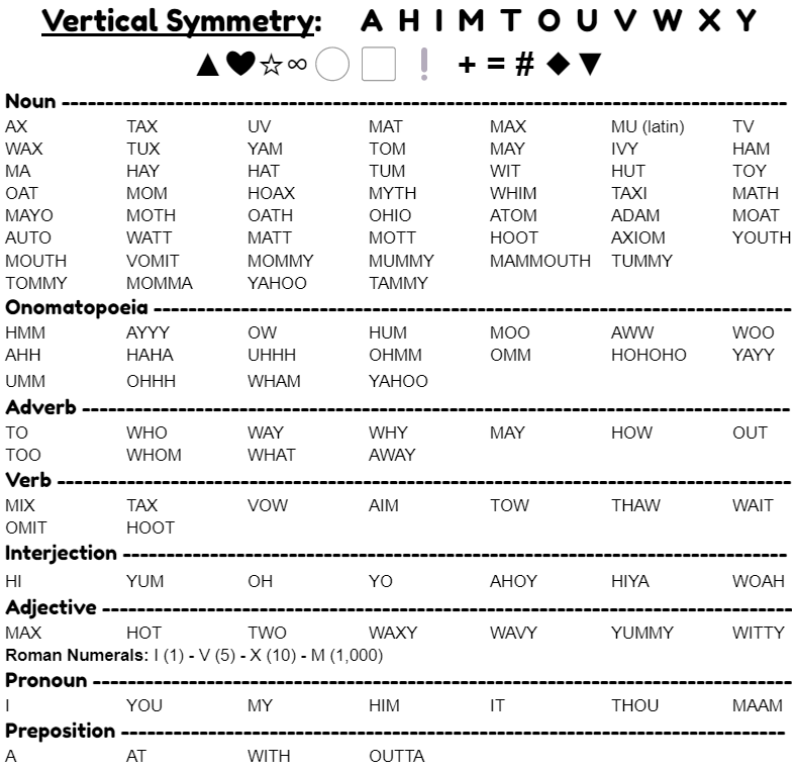
Interjection

OH	HI

Pronoun

I	HE

Figure 11: A list of letters and words with horizontal symmetry.



Vertical Symmetry: A H I M T O U V W X Y

▲❤☆∞◯□ ! + = # ◆▼

Noun

AX	TAX	UV	MAT	MAX	MU (latin)	TV
WAX	TUX	YAM	TOM	MAY	IVY	HAM
MA	HAY	HAT	TUM	WIT	HUT	TOY
OAT	MOM	HOAX	MYTH	WHIM	TAXI	MATH
MAYO	MOTH	OATH	OHIO	ATOM	ADAM	MOAT
AUTO	WATT	MATT	MOTT	HOOT	AXIOM	YOUTH
MOUTH	VOMIT	MOMMY	MUMMY	MAMMOUTH	TUMMY	
TOMMY	MOMMA	YAHOO	TAMMY			

Onomatopoeia

HMM	AYYY	OW	HUM	MOO	AWW	WOO
AHH	HAHA	UHHH	OHMM	OMM	HOHOHO	YAYY
UMM	OHHH	WHAM	YAHOO			

Adverb

TO	WHO	WAY	WHY	MAY	HOW	OUT
TOO	WHOM	WHAT	AWAY			

Verb

MIX	TAX	VOW	AIM	TOW	THAW	WAIT
OMIT	HOOT					

Interjection

HI	YUM	OH	YO	AHOY	HIYA	WOAH

Adjective

MAX	HOT	TWO	WAXY	WAVY	YUMMY	WITTY

Roman Numerals: I (1) - V (5) - X (10) - M (1,000)

Pronoun

I	YOU	MY	HIM	IT	THOU	MAAM

Preposition

A	AT	WITH	OUTTA

Figure 12: A list of letters and words with vertical symmetry.

8. College: Math Poetry Still Works!

The first college-level topic I experimented with was homomorphism. For the poem seen in Figure 13, the rule is that whenever the letter is a vowel (a, e, i, o, u, or y), we add 1; if the letter is a consonant, we subtract 1. The goal for this poem is to have the end total be 0. This is rather challenging — there are a lot of common words that have more consonants than vowels. The first time I attempted this, I struggled to keep the poem out of the negative.

The second college-level poem (Figure 14) has to do with modular arithmetic. We use base 26 with A equaling 1, B equaling 2, and so on. Z is technically 0, due to 26 being 0 mod 26. For this poem I wanted the sum as a whole to be 0 mod 26. We can change what the sum of the poem ends up equaling, have each line yield a certain remainder, or for something even more challenging, have each word yield the same remainder mod 26.

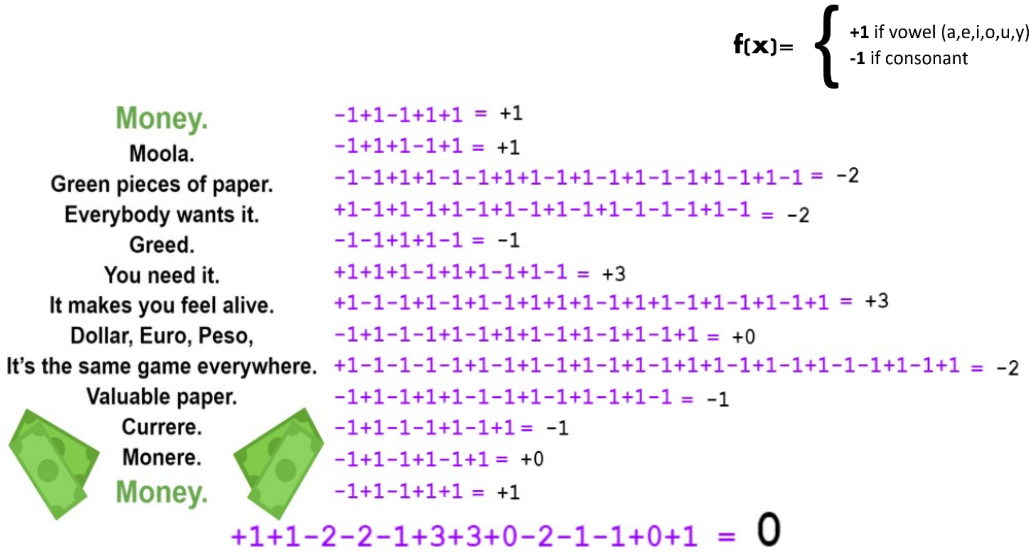
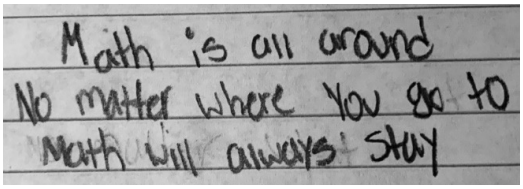


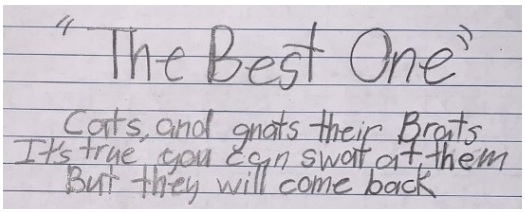
Figure 13: Homomorphic poetry! A college-level activity.

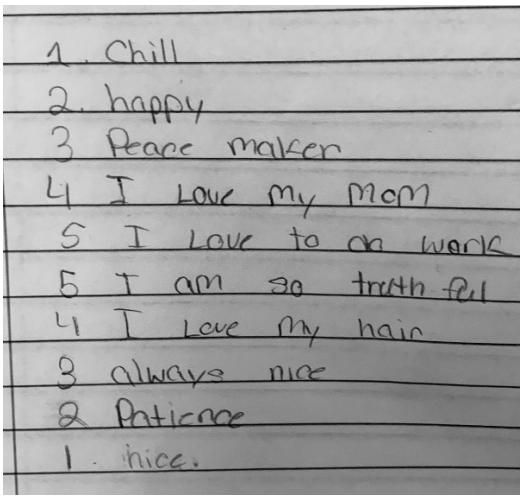
Figure 14: Modular arithmetic! Another activity for the college level.

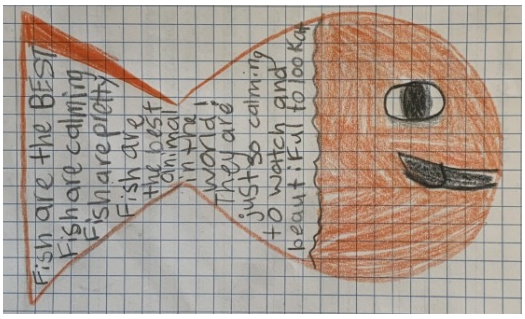
9. Student Poems

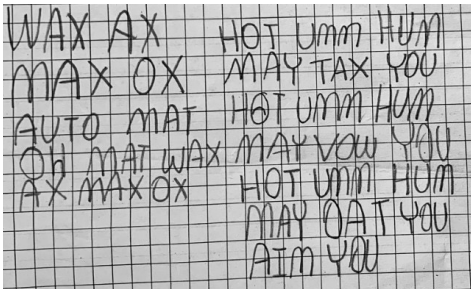
In this section, I share a select number of poems from my students.

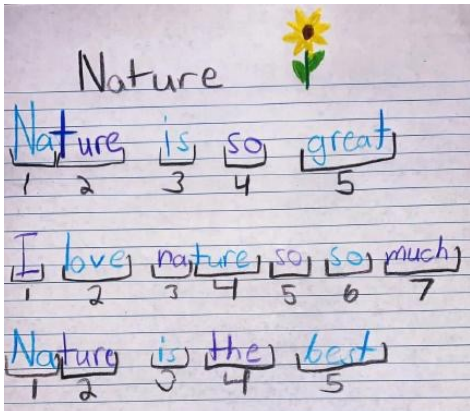


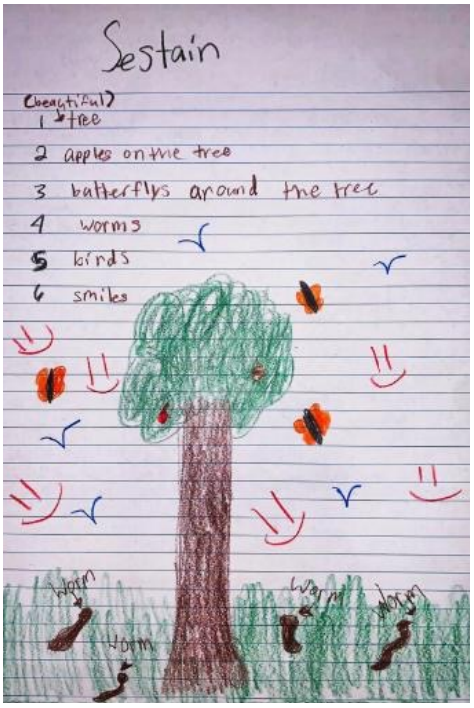


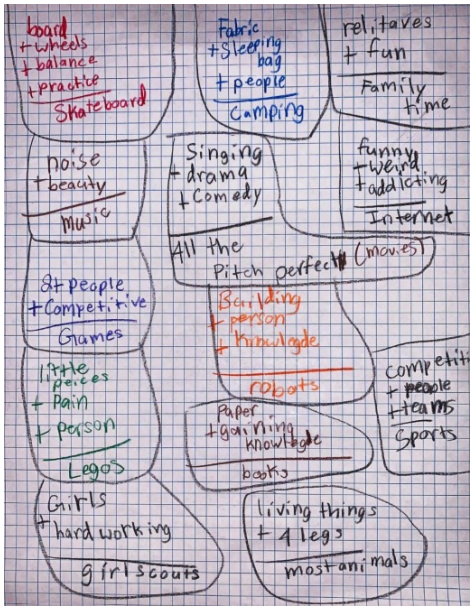


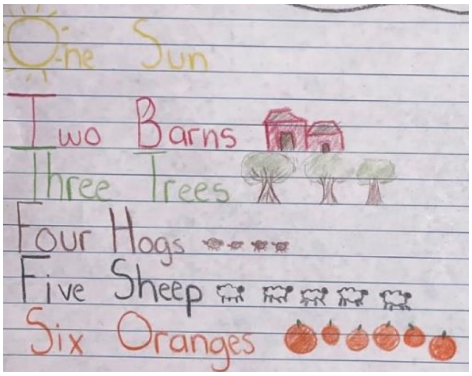


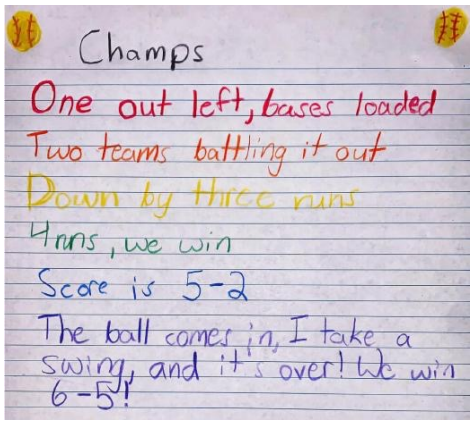


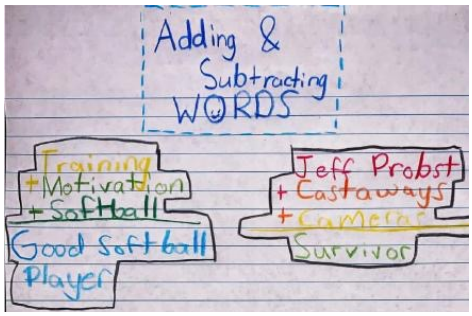



Sestain
(beautiful)
1 tree
2 apples on the tree
3 butterflys around the tree
4 worms
5 birds
6 smiles
worm
worm
worm
worm


board
+wheels
+balance
+practice
Skateboard
Fabric
+Sleeping bag
+people
Camping
relitaves
+ fun
Family time
noise
+beauty
Music
Singing
+drama
+Comedy
funny
+weird
+addicting
Internet
All the Pitch perfect (movies)
2+people
+Competitive
Games
Building
+person
+knowledge
robots
little pieces
+ Pain
+ person
Legos
Paper
+gaining knowledge
books
competit
+people
+teams
Sports
Girls
+hard working
girlscouts
living things
+ 4 legs
most animals


One Sun
Two Barns
Three Trees
Four Hogs
Five Sheep
Six Oranges


Champs
One out left, bases loaded
Two teams battling it out
Down by three runs
4 runs, we win
Score is 5-2
The ball comes in, I take a swing, and it's over! We win 6-5!


Adding & Subtracting WORDS
Training
+Motivation
+Softball
Good Softball Player
Jeff Probst
+Castaways
+Cameras
Survivor

10. Takeaways

As I expected, students were hesitant at first when I announced mathematical poetry as the activity for the day. Once they started the activity, however, they were very engaged and got creative with their poetry. The colored pencils led to these poems being even more special and unique. The children were also more excited about the activity when given art supplies. Besides some spelling errors, the students made amazing poetry. I was worried about some of the younger students being able to count syllables. Some of them had never heard of syllables before but caught on very quickly. I was able to teach them many grammar and math skills, besides syllables, that they had never experienced before. I used the haiku (Figure 5) as an opportunity to teach them about prime numbers. I was also able to teach the students about the Fibonacci sequence with the Golden Fib poem (Figure 8). I showed them how the sequence works, the golden spiral, and about examples of mathematics in nature. It was very rewarding to see children engaged in and enthusiastic about mathematics.

I asked kids to rank how much they liked math, poetry, and art individually and then how they felt about the math poetry activities. To my surprise there were students that ranked math high and the other two low, poetry high and the others low, and art high with the others low. But no matter what the students had a higher interest in, the students loved the activities.

There was no one type of poem that was unanimously liked. Adding and subtracting words (Figure 3) along with abstract and concrete (Figure 6) were some of the more popular poems, but students also said haikus (Figure 5) and letter symmetry (Figure 10) were their favorites.

I also asked if math poetry helped students grasp any math topics better. The students I was teaching had just recently learned about symmetry in school. Many said they struggled with that concept and that the symmetry poems helped them get a stronger understanding. Many students also said adding and subtracting words helped them get a better understanding of arithmetic concepts.

I believe that using poetry to teach mathematics to young children is a great way to get them excited about the subject. They count, use arithmetic, practice shape filling, and learn about symmetry. This is a great classroom activity and, from my experience, works well with students as young as second grade. Children of any age would benefit from such activities.

References

[1] Patrick Bahls, "The Mathematical Muse: Using Math to Construct Poetry," *Math Horizons*, Volume **17** Issue 3 (February 2010), pages 14-17.

[2] Laken Brooks, "Poetry: A simple solution to math anxiety", TEDxEHC (TEDx Talk at Emory & Henry College), Apr 5, 2017. Available at https://youtu.be/nGkfRN2i6vY, last accessed on July 27, 2023.

[3] "Math in Seventeen Syllables: A Folder of Mathematical Haiku," *Journal of Humanistic Mathematics*, Volume **8** Issue 1 (January 2018), pages 441-472. doi:10.5642/jhummath.201801.22

[4] "Poetry in the Glade: Bridges 2021 Fib Collection," *Journal of Humanistic Mathematics*, Volume **12** Issue 1 (January 2022), pages 467-500. doi:10.5642/jhummath.202201.35