Mathematics and Poetry

The Right Connection

David J. Whitin
and Michelle Piwko

Reading, writing, and mathematics are best learned by children in meaningful, integrated experiences. A rich and engaging curriculum encourages children to collaborate with peers and to use various modes of representation to express their understandings. Such an approach

- strengthens concepts and skills in more than one subject area (NAEYC & NCTM 2002);
- demonstrates the wide applicability of mathematics in numerous contexts (Whitin & Whitin 2004):
- provides meaningful, authentic learning (Kilpatrick, Swafford, & Findell 2001; Clements, Sarama, & DiBiase 2003); and
- saves time in an already crowded curriculum (NAEYC & NCTM 2002).

NAEYC advocates integrated learning in its joint position statements with the International Reading Association (IRA & NAEYC 1998) and the National Council of Teachers of Mathematics (NAEYC & NCTM 2002).

To capitalize on these benefits, teacher Michelle Piwko, one of the authors of this article, planned a combined geometry and language arts project for second- and third-graders.

Starting the project

In response to the school district's mandate to teach geometry because children in grades 2–8 scored poorly in this area, Michelle decided to integrate reading and writing into her geometry lessons. She also planned ways to involve busy families in their child's homework.

Geometry learning

As a part of the school's grade-level expectations, second- and third-graders need to know the names of common three-dimensional shapes, such as rectangular solid, sphere, cylinder, and cube, and be able to identify a face (a flat side), vertex (a point where three or more edges meet), and edge (a straight segment formed by two faces) of a geometric solid. To address these objectives, Michelle planned several hands-on experiences with three-dimensional shapes. After handling and exploring the solids, the children classified the shapes into groups, noting similarities and differences. They also traced the faces of the solids and used the resulting discoveries to further classify them.

Literacy learning

Michelle extended the hands-on experiences by inviting the children to express their mathematical knowledge through writing. Composing their own texts would give children a meaningful context for reflecting on and consolidating their knowledge about mathematics. Offering activities that let children revisit concepts they previously explored is an important teaching strategy (NCTM 2000). At the same time the writing activity would address several of the state's grade-level expectations for second- and third-graders in language arts, such as analyzing an author's craft and revising one's writing.

Michelle led the class in listing all the geometric terms they could think of. She then asked the children to each select a geometry term for the writing project. They would brainstorm descriptive phrases about their terms and ask

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family members for their ideas. Using the literary structure of the text in a particular children's book as a model, the children would each compose a written piece about their chosen geometric term, incorporating the descriptive elements, and then revise and illustrate their writing for publication in a class book.

Reading *The Important Book*

Michelle selected *The Important Book*, a children's classic by Margaret Wise Brown, to inspire the children's writing. In *The Important Book*, Brown describes a variety of objects—snow, shoes, grass, sky, wind, an apple, and more—in simple terms, one object per page. The text is arranged in short lines, like verse (see the passage below).

When Michelle read the book aloud, the children were immediately attracted to its patterned language. They noticed the repetition of lines and began chiming in as Michelle read the last line of each page. The class discussion that followed highlighted techniques authors can use to construct their writing and make it appealing. One child wondered if the book could be made into a song, and another said the pages were "sort of like poems." Another child remarked how the placement of words was different from the longer lines in storybooks. Their observations underscore one of the important goals that the International Reading Association (IRA) and NAEYC advocate for children: "to recognize and discuss elements of different text structures" (1998, 46).

Passage from *The Important Book*

The important thing about a spoon is that
you eat with it.
It's like a little shovel,
You hold it in your hand,
You can put it in your mouth,
It isn't flat,
It's hollow,
And it spoons things up.
But the most important thing about
a spoon is that you eat with it.

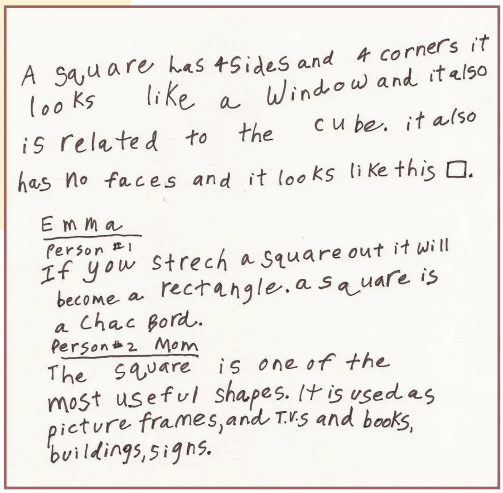
From Margaret Wise Brown, *The Important Book* (New York: HarperCollins, 1949/1977).

As the conversation continued, a child commented, "The book is telling you that the properties of [an object] are very important." The children were familiar with the word *properties* in different contexts: they had learned about the three properties of solids, liquids, and gases and had identified properties of geometric solids. This comment seemed to confirm the project as an intellectually stimulating activity that "expands children's knowledge of the world and vocabulary" (IRA & NAEYC 1998, 10).

The talk around *The Important Book* helped the children to analyze an author's purpose, her use of language, the pattern of illustrations, and the choices she made in determining what is "most important." These insights about the craft of writing, and the examination of the structure of Brown's text, provided helpful understandings as Michelle invited the children to compose their own poems.

Creating the poems

When each child had chosen a geometry word, Michelle instructed them to record its mathematical attributes and then expand their lists to include examples of the shape/term in the real world. In this way the children could demonstrate their knowledge of the mathematical properties of a shape as well as draw upon prior experiences to make personal connections with the shape. For instance, one child noted that a cone "has one face on the bottom and has zero corners." His real-world examples included a birthday hat, a castle top, a snow cone, and a traffic cone. Another child wrote that "an octagon has eight sides and eight corners," and his personal associations included "a stop sign, tabletop, watch face, and a pattern on a quilt." He also added, "Up north there was a house that looked like an octagon."


A square has 4 sides and 4 corners it looks like a window and it also is related to the cube. it also has no faces and it looks like this □.

Emma
person #1
If yow strech a square out it will become a rectangle. a square is a chac bord.
person #2 Mom
The square is one of the most useful shapes. It is used as picture frames, and T.V.s and books, buildings, signs.

Involving families

After developing their lists of attributes and examples, the children interviewed a person in their household for additional words and phrases. Michelle wanted to involve

One child wondered if the book could be made into a song, and another said the pages were "sort of like poems."

families in the project so they could see the importance of integrating language and mathematics. The project was an opportunity for adults to view children as the experts.

The children reported on their families' observations. When one child shared the word *cube* with his mother, she responded that "cubes have three dimensions and they remind me of a Rubik's Cube." The mother of a child whose word was *square* said, "The square is one of the most useful shapes. It is used as picture frames, televisions, books, buildings, and signs." A child whose word was *cone* recorded this observation from his mother: "I learned that a cone is sort of like a triangle [contrasting two- and three-dimensional shapes]." In this way children and their families became partners in learning and coconstructors of this mathematics text.

Writing

The next day the children used their word lists to begin creating their poems. Before they began writing, Michelle and the children briefly discussed some of the elements of poems. Because the children wanted to follow the style of Margaret Wise Brown, they reasoned that their poems should not be written as "one long line." They wanted to use short phrases, like the author did, and they wanted their first lines to be repeated in the last lines. This analysis of a poem's form enabled the children to clone the author's style and try out her organizational structure themselves (Short, Harste, & Burke 1996). With these guidelines in mind, the children began their writing.

Another Choice for Authors

The choice of spacing between lines (single, 1.5 lines, double, and more) caused quite a stir! There were so many options that the children were not sure which one was most appropriate. So Michelle had the children go on a "space hunt" to find examples in the books in their classroom of how authors use spacing.

When the children met in the lab a day later, they shared what they had found. They noticed that in *The Important Book* and other poetry books the spacing was often double, while the spacing in their chapter books was single. The children reasoned that the double (and even triple) spacing made the writing "look more like a poem." They argued that poems have fewer words and that more spacing helps to emphasize the "importance" of each word. This discussion highlighted more of the choices authors make and increased the children's appreciation for the unique potential of poetry.

They wanted to use short phrases, like the author did, and they wanted their first lines to be repeated in the last lines.

Revising

As the children finished their first drafts, they each met with Michelle over the course of several days to discuss their work during writers' workshop time. Michelle used these conferences to address children's individual needs. After each child read his or her piece aloud, she posed such questions as, "What parts are you most pleased with and why?" "What parts do you want to make better?" Some children needed help in clustering common ideas together. Others needed help fixing grammar or punctuation errors. For instance, one child learned about the homophones *they're* and *their;* another learned about rules for making plurals; and still another learned about the standard use for upper- and lowercase letters.

Typesetting

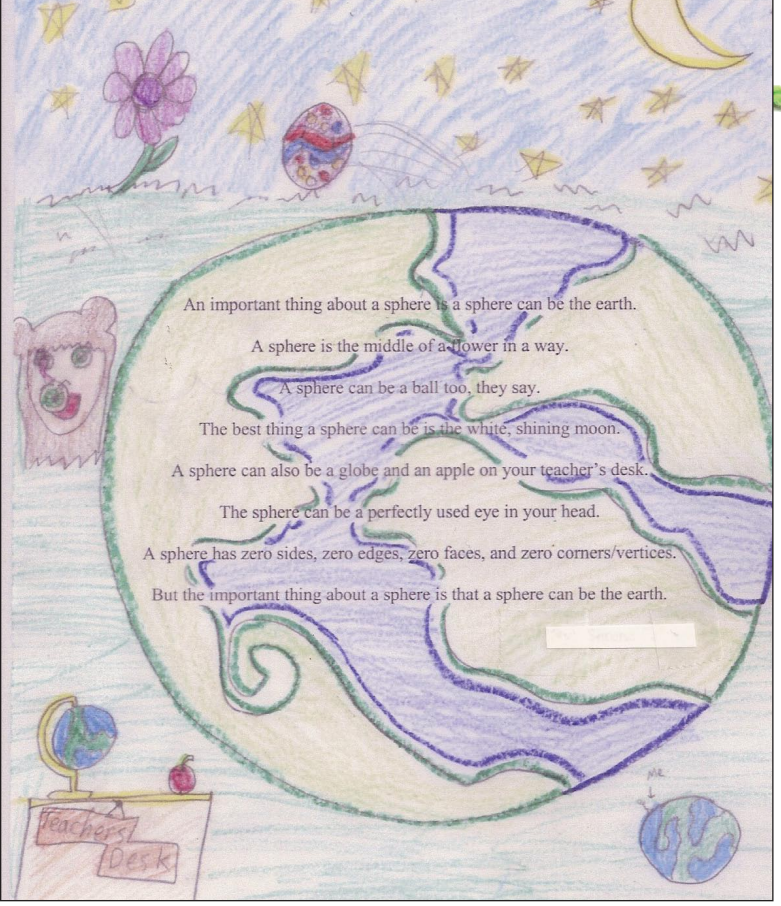
Once all the children had completed their final drafts, Michelle led them to the computer lab to type their poems. The children were proud of their poems and wanted their finished products to look typeset, like the text in *The Important Book*. When the children began typing, it was clear that they lacked basic keyboarding skills; however, they were very eager to learn to use the word processing software.

Michelle took them to a corner of the computer lab, where she introduced some basic skills on a computer with a larger screen. She demonstrated how to open a Microsoft Word document; capitalize a letter; understand what the green or red squiggly underlines mean; and add space between the lines (see "Another Choice for Authors"). The children returned to the computer lab several times to complete their typing.

Examples of children's work

Sarah

Many of the children's poems reflect mathematical attributes as well as real-world applications of the shape. For instance, Sarah's poem is about a sphere. She clustered the applications together at the start of her poem and the mathematical attributes at the end. She chose the sphere's resemblance to the Earth as its most important attribute and made the Earth her illustration. Sarah, like several

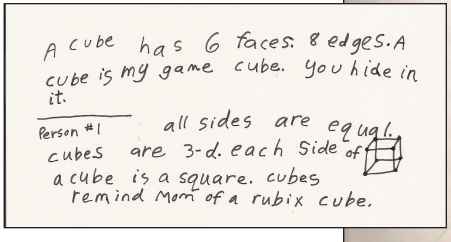


other children, considered the absence of certain mathematical attributes to be a unique attribute itself. She wrote, "A sphere has zero sides, zero edges, zero faces, and zero corners/vertices."

Children gain a deeper understanding of mathematical terms when they can explain not only what the shape is but also what the shape is not. Nonattributes are in fact important distinguishing characteristics that enrich children's classification skills (Whitin & Cox 2003).

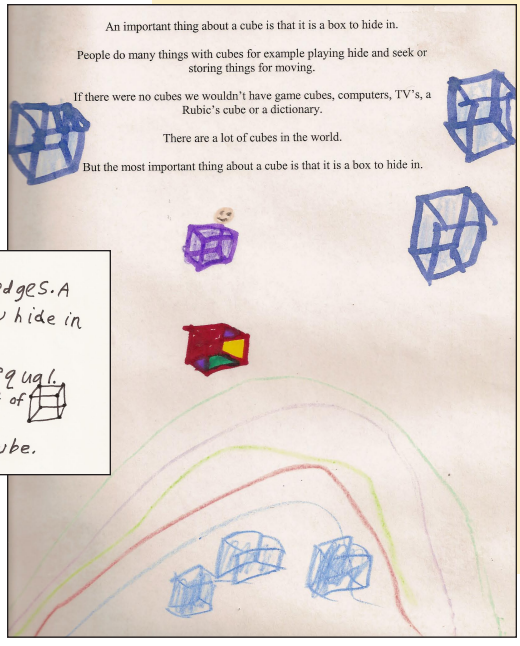
Aaron

Aaron's poem about a cube included only real-life applications. However, in his initial brainstorming he recorded several mathematical attributes: "A cube has 6 faces. 8 edges. A cube is my game cube. You hide in it." His talk with his mother included even more mathematics observations: "All sides are equal. Cubes are 3-d. Each side of a cube is a square. Cubes remind Mom of a rubix cube."


A cube has 6 faces. 8 edges. A cube is my game cube. You hide in it.

Person #1 all sides are equal. cubes are 3-d. each side of a cube is a square. cubes remind Mom of a rubix cube.

Aaron began his poem with his connection to hiding and then continued with other real-life associations: "An important thing about a cube



Teaching Strategies

Here are some strategies that helped make the geometry/poem project successful:

1. Look for ways to integrate literature and mathematics. The children adapted a book's literary structure to create poems in which they used their mathematics vocabulary in a meaningful way.

2. Offer children several different ways to experience a concept. The children handled and examined three-dimensional models of geometric solids; traced the faces of the solids; went on a shape walk to identify polygons in their environment; and wrote poems to express their mathematics understandings. When teachers offer children varied ways to express knowledge, they increase the likelihood that more children will be successful (Eisner 1998).

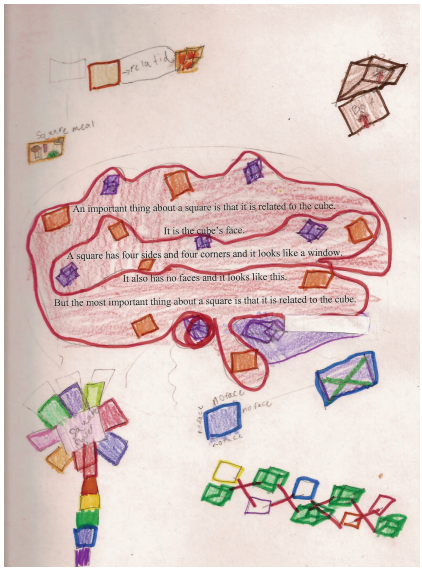
3. Extend children's observations. Effective teachers pose open-ended questions like, "How might we test out your idea?" "How could you show your idea in another way?" "How could you use your idea about patterning as you write your poem?" Such questions build on what children have already learned and challenge their thinking. The more children notice and wonder about, the more opportunities teachers have to extend their learning.

4. Support children in analyzing an author's writing. Teachers can share books or poems that have an easily identifiable language structure. These children heard the repetition when the teacher read aloud *The Important Book*, and they noticed the shorter lines of text—two devices they could use in their own writing. One child remarked, "I know you are going to ask us why the author wrote this book. Well, she wrote the book to tell us that everything has an importance." Good questions posed over time help children to frame their analyses.

is that it is a box to hide in. / People do many things with cubes for example playing hide and seek or storing things for moving. / If there were no cubes we wouldn't have game cubes, computers, TV's, a Rubic's cube or a dictionary. / There are a lot of cubes in the world. / But the most important thing about a cube is that it is a box to hide in." The final poem does not reflect all of the attributes Aaron developed and considered, but as the author, he decided which ones to emphasize.

Inez

Inez was interested in the mathematical attributes of her geometric shape, the square. Her initial brainstorming included many mathematical associations, but the ideas she recorded from her sister and mother reflected real-life applications—chalkboards, picture frames, TVs, books, buildings, and signs. In her completed poem Inez emphasized the relationship between two-dimensional (square) and three-dimensional (cube) shapes. She was intrigued that a square has four sides and four vertices but no faces; a square only has a face when it is part of a three-dimensional figure.



Inez's illustrations further accentuated this relationship. In the upper right she drew a cube with the bottom face falling open to show the cube/square relationship. Below her poem Inez drew a series of cubes and squares connected by diagonal lines. She drew a square and wrote along each of its four sides, "No face." Her artwork complements her writing, making her page a well-orchestrated piece.

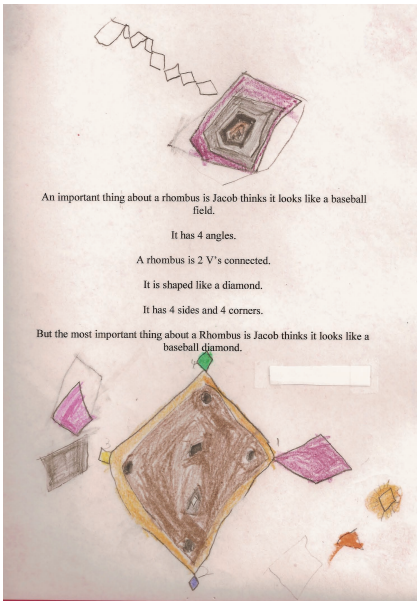
Lynn

Lynn selected the semicircle. She was particularly intrigued by a semicircle's relationship to a circle. It interested her that a circle has no edges but a semicircle has one edge, a unique characteristic. Thus, she included these attributes in her poem along with contributions from her family (contributors' names added):

An important thing about a semicircle is that it is half a circle. [*Lynn*]
It has one edge. [*Lynn*]
It looks like a swing on the playground. [*Lynn*]
The moon can be a semicircle [*Mother*], and a semicircle shows on your face when you smile. [*Sister*]
A semicircle has the shape of a half of a pizza. [*Mother*]
Two semicircles make a circle. [*Mother*]
But the most important thing about a semicircle is that it is half a circle. [*Lynn*]

Justin

Justin often complained when he had to do any writing. He usually had trouble completing writing assignments; however, this time he worked hard to finish his piece. Michelle thought that working with his family was the impetus. Justin had brainstormed a few ideas about a rhombus, but he was still not sure how to begin. But when he solicited ideas from his brother Jacob, he knew he had the perfect "most important" attribute to feature in his poem. His final product reflected the benefits of home-school collaboration. His poem highlighted not only his brother's name but also his brother's association: "An important thing about a rhombus is Jacob thinks it looks like a baseball field. / It has 4 edges. / A rhombus is 2 V's connected. / It is shaped like a diamond. It has 4 sides and 4 corners. / But the most important thing about a rhombus is Jacob thinks it looks like a baseball diamond."



Tony

The open-ended nature of this activity supported children like Tony, who are English-language learners. Tony generated a variety of attributes to describe a circle but needed some support in organizing his ideas. As he reviewed his list of phrases for his final poem, Michelle asked him to cluster the ideas that went together. For example, he found

(cont'd on p. 7)

"An important thing about a rhombus is Jacob thinks it looks like a baseball field."

This rubric for the geometry and writing project incorporates some of the first-grade level expectations for math and writing. It is useful in tracking children's progress and as a guide for assessment.

The project evaluation has four categories: Prewriting, Conferencing, Final Copy, and Illustration. Prewriting includes the child's initial brainstorming and the ideas garnered from family members. Conferencing and Final Copy stages focus on seven different areas: mathematics, grammar, spelling, and several organizational skills. Mathematics, listed under both Conferencing and Final Copy, refers to accurately using mathematical terminology and accurately identifying shapes in the real world respectively.

The form is a record of which areas of a child's project were accurate and which were discussed with the child and recommended for revision. During the Final Copy stage, the teacher checks whether the child incorporated the recommended changes.

The seven items under Final Copy, plus the three criteria for illustrations, constitute 10 points. Teachers can use these points as the basis for a final evaluation.

Geometry Poem Project Evaluation Form

Name _____

Geometry topic _____

Please turn in all pieces of the project with the final copy.

Prewriting	*Complete*	*Partial*	*Did not do*
Recording sheet of initial ideas	_____	_____	_____
Rough draft	_____	_____	_____

Conferencing	*Accurate*	*Discussed*
Mathematics	_____	_____
Form of poem (opens/closes with repeated line)	_____	_____
Flow of poem (organization of ideas)	_____	_____
Vocabulary	_____	_____
Grammar	_____	_____
Spelling	_____	_____
2nd conference: computer form	_____	_____

Final Copy	*Accurate*	*Discussed/ Changed*	*Discussed/ Not changed*
Mathematics	_____	_____	_____
Form of poem (opens/closes with repeated line)	_____	_____	_____
Flow of poem (organization of ideas)	_____	_____	_____
Vocabulary	_____	_____	_____
Grammar	_____	_____	_____
Spelling	_____	_____	_____
Computer form	_____	_____	_____

Illustration	*Yes*	*No*
Matches poem	_____	_____
Neat	_____	_____
Colorful	_____	_____

Final Assessment

Outstanding (10–9 pts.) (exceeded or met expectations)

Satisfactory (8–7 pts.) (met most expectations)

Progressing (6–5 pts.)

Needs improvement (4–0 pts.)

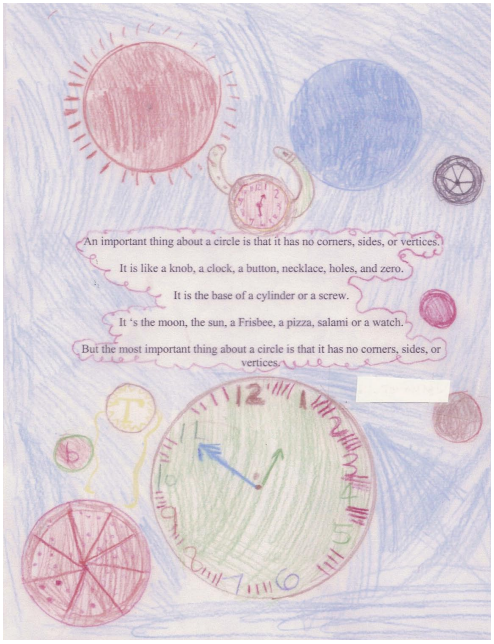
Comments _____

_____

_____

two ideas that showed a circle as the base of a three-dimensional solid, and he combined them in one sentence: "It is the base of a cylinder or a screw." He put the moon and the sun together, as well as a pizza and a salami. This experience in reorganizing and combining made his finished product more coherent and united.

Michelle gave Tony a minilesson in the use of commas to separate items in a list. Tony absorbed the information readily because he needed to use it to write the list in his poem.



Conclusion

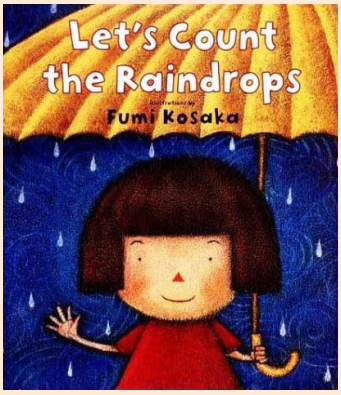
Language and mathematics are best learned as children engage in meaningful, connected experiences. The children in Michelle's class fulfilled grade-level expectations in both mathematics and language arts while writing a poem about a geometric term. They examined an author's style and writing choices. They brainstormed ideas and learned to organize them to create a unified piece. The children learned punctuation and grammar skills while revising their writing. They expressed their mathematics knowledge by identifying attributes of a geometric shape, citing examples of geometric shapes found in the real world, and writing and illustrating poems about geometric concepts. This kind of integrated curriculum and learning is essential for long-lasting understanding.

(cont'd on p. 8)

Resources for Poetry with a Mathematics Dimension

Individual Poems

Benjamin, Alan, "Let's Count the Raindrops" (viewing raindrops as large numbers), in *Let's Count the Raindrops,* illus. Fumi Kosaka (New York: Viking, 2001).



Blair, Lee, "Using Subtraction" (spoof on the term "take away"), in *Arithmetic in verse and rhyme,* eds. Allan Jacobs & Leland Jacobs (Champagne, IL: Garrard Publishing, 1971).

Ciardi, John, "Little Bits" (dividing a pie into little bits and eating them all!), in *You Read to Me, I'll Read to You* (New York: HarperTrophy, 1987).

Fleischmann, Paul, "Mayflies" (a mayfly's lifespan gives an interesting perspective on time), in *Joyful Noise: Poems for Two Voices* (New York: HarperCollins, 1988).

Giovanni, Nikki, "Two Friends" (counting pierced ears, pigtails, and more), in *Spin a Soft Black Song* (New York: Farrar Strauss, Giroux, 1987).

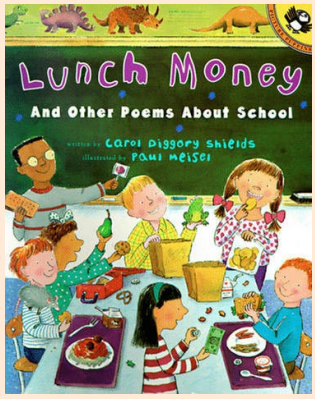
Hillert, Margaret, "About Feet" (creatures with different numbers of feet), in *Potato Chips and a Slice of Moon,* ed. Lee Bennett Hopkins (1988).

Hoberman, Mary Ann, "The Dime," in *You Read to Me, I'll Read to You* (Boston: Little Brown, 2001).

Hymes, Lucia, and James Hymes. "Beans, Beans, Beans." (classifying all kinds of beans), in *Hooray for Chocolate* (Reading, MA: Addison-Wesley, 1960).

Milne, A.A., "Halfway Down" (one half is described as halfway down the stairs), in *When We Were Very Young* (New York: Dell, 1979).

Shields, Carol, "Eight-Oh-Three" (hurrying to catch the school bus), in *Lunch Money and Other Poems about School* (New York: Dutton, 1999):

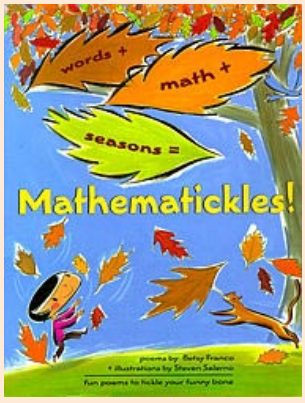


Anthologies, Specialized Collections, and Picture Book Poems

Baranski, Joan, *Round Is a Pancake* (New York: Dutton, 2001).

Brown, Margaret Wise, *The Important Book.* (New York: HarperCollins, 1949/1977).

Brown, Margaret Wise, *Four Fur Feet* (New York: Hyperion, 1996).



Esbensen, Barbara, *Echoes for the Eye: Poems to Celebrate Patterns in Nature* (NewYork: HarperCollins, 1996).

Franco, Betsy, *Mathematickles* (New York: Simon and Schuster, 2003).

Heide, Florence, Judith Gilliland, and Roxanne Pierce, *It's about Time* (New York: Clarion, 1999).

Hoberman, Mary Ann, *The Llama Who Had No Pajama* (New York: Harcourt, 2008).

Hopkins, Lee Bennet, *It's about Time* (New York: Simon & Schuster, 1993).

Hopkins, Lee Bennet, *School Supplies* (New York: Simon & Schuster, 1996)

Hopkins, Lee Bennett, *Marvelous Math* (New York: Simon & Schuster, 1997).

O'Neil, Mary, *Take a Number* (New York: Doubleday, 1968)

Perlutsky, Jack, *A Pizza the Size of the Sun* (New York: Scholastic, 1996).

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Whitin, D.J., & P. Whitin. 2004. *New visions for linking literature and mathematics.* Urbana, IL: National Council of Teachers of English; Reston, VA: National Council of Teachers of Mathematics.