

# Reading in the Math Class

## Selecting and Using Picture Books for Math Investigations

Debra H. Thatcher

Teachers and curriculum designers recognize the power of children's literature. In the past few years children's literature has become an increasingly important component of mathematics curricula in early childhood programs. Good books provide a meaningful context for learning mathematics concepts. Stories spark children's curiosity about their world, serving as springboards for mathematics investigations.

Children's literature needs to be thoughtfully used in the early elementary classroom. Teachers of young children must be able to decide when it is appropriate to use trade books, and they must select books of high quality. This article identifies criteria for selecting children's books for math class, makes suggestions for effective use of literature in the teaching of mathematics to young children, and provides a cautionary note to consider when using literature.

### Selecting children's books for math class

When selecting a children's book to use in a math lesson, teachers need to ask themselves several questions.

#### 1. Would I read this book to the children even if I weren't choosing it for a math lesson?

This is an important question. Books should be used in the classroom because they are enjoyable, not because they teach a lesson. According to Nodelman, adults and children alike, whether reading for entertainment or information, "take pleasure in how and what our reading makes us think and feel" (1996, 20). Children should savor the words, get lost in the illustrations, and marvel at the

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photographs. For a book to promote interest in reading as well as be appropriate for math class, it must be memorable, use natural language, have captivating images, and stand up to multiple readings.

A book that meets this first criterion is *The Doorbell Rang* (Hutchins 1986). The story begins with Ma giving Sam and Victoria a dozen freshly baked cookies to share. But before the two children begin to eat, the doorbell rings several times and more children arrive to share the cookies. *The Doorbell Rang* is filled with natural language and rich illustrations. The mathematical concepts of *more*, *same*, and *fewer* are implicitly embedded in the story. The illustrations, though relatively simple, beg to be pored over. As Nodelman points out,

When we look at the pictures in picture books, we're meant not just to do that but also to think about how they relate to the accompanying words and also to the pictures preceding and following them. In other words, we must consider not only their beauty but also how they contribute to our unfolding knowledge of the story. (1996, 219)

Victoria's and Sam's disappointment over sharing cookies, their anxiety when the doorbell rings, the behavior of the family cat, and Mom's mopping up of muddy shoe tracks are some of the details that appear in the illustrations, making the story much richer than just the words. This is a story with a familiar theme of sharing that demands repeated readings.

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Another captivating book about *more* and *less* is Tana Hoban's *More, Fewer, Less* (1998). Hoban captures everyday scenes in bold and colorful photographs. There is no hint of a textbook approach to presenting comparison concepts as children consider the lovely photographs of foods, dishes, clothing, animals, and more. Nowhere is the reader told the right answers (not even in the back of the book), and the possibilities for interpretation are many. This wordless book invites children to look at objects they encounter every day in a new way.

### **2. Does the book stimulate curiosity and a sense of wonder? Are children inspired to do their own investigations?**

Books used in math lessons need to present the potential for learning something new based on personal investigation (Whitin & Wilde 1992). For example, a reading of *Jim and the Beanstalk* (Briggs 1970) may cause children to question the relative size of a giant. Just how big would eyeglasses be for a giant? The teacher can use the illustrations to stimulate children to create drawings of giant-size glasses, watches, shoes, and so on. In *Who Sank the Boat?* (Allen 1982), young readers are surprised to see that it is the mouse that upsets the boat. Eager children will create simulations to prove or disprove that such a tiny creature could have such a major impact. *Breathtaking Noses* (Machotka 1992) presents wonderful photographs of animal noses. Readers will find themselves wondering why noses have the shapes they do, and they will soon find themselves making inquiries about other shapes in their world.

In the reading of these books, concepts that a teacher may be required to teach, such as proportion, measurement, weight, capacity, and shapes, become topics that children want to investigate on their own. Open-ended investigations in an inquiry curriculum fueled by children's interests must have primacy in today's education of young children (Edwards, Gandini, & Forman 1993; Bredekamp & Copple 1997; Helm & Katz 2001).

### **3. Is the book meaningful to the children? Can they make personal connections?**

The teeter-totter or seesaw is a piece of playground equipment that most young children have experienced. In *Just a Little Bit* (Tompert 1993), an elephant and a mouse

must solve a problem when their mismatched weights prevent them from using the seesaw. The use of this book for teaching balance "helps to break down the artificial dichotomy that sometimes exists between *learning* mathematics and *living* mathematics" (Whitin & Wilde 1992, 4).

In *And I Mean It, Stanley* (Bonsall 1974), a young boy builds a fanciful sculpture using found objects such as boxes, blocks, and toys, and discarded items such as shoes and hangers. This is an experience many children have had themselves, so they can relate to the story's mathematical concepts.

In addition, *And I Mean It, Stanley* and *Just a Little Bit* have layers of meaning, a criterion identified by Austin (1998) as necessary in outstanding books. Both books deal with emotions, a need to be accepted, and friendship. Inclusion of such books in the study of math provides the opportunity to address the needs of the whole child by recognizing the role of interpersonal relationships in learning (Bredekamp & Copple 1997).

### **4. Are the math connections natural?**

When math connections are embedded in a story, the reader not only enjoys the book but also is intrigued by the math concepts. For example, in the wordless *Window* (Baker 1991), children witness a child grow from infancy to adulthood and watch how his neighborhood changes from a peaceful countryside to a bustling urban setting. The concepts of time, life cycle, and the environmental impact of land development are central to the story without being preachy.

*Emma's Christmas* (Trivas 1988) is a delightful retelling of the song "The Twelve Days of Christmas." On each day a young prince gives his love the gifts of the day as well as a repeat of the items given on previous days. As a result, on the last day his love has 12 partridges in pear trees, 24 turtledoves, and so on. The big numbers in this book add to its humor and invite the reader to imagine what it would be like to feed and care for so many animals and people.

The unique format of *The Farm* (Aubinais 1996) is intriguing for children and adults alike. This cumulative story introduces farm animals, from small to large, on pages that fold out. The surprise quality of the format provides a wonderfully natural presentation of size comparisons. There is no better way to introduce non-standard and standard measurement than through *How Big Is a Foot?* (Myller 1990). The humorous errors made in constructing a bed by measuring with various sizes of feet leave readers with a real problem to solve.

In all of these books, mathematical ways of thinking are emphasized; they are not facts presented in an authoritarian tone. As such, children have opportunities to question and pursue solutions. This places them at the center of their learning and fosters a sense of wonder that fuels the desire to learn (Katz & Chard 2000).

### 5. Is the information accurate?

Many books unwittingly perpetuate misconceptions due to inaccuracy of information. *What Neat Feet!* (Machotka 1991) is a masterful collection of photographs that invites the reader to consider why animals' feet have such different shapes, but the author inaccurately labels a sea lion as a seal. This is an error that has permeated media for decades (from *Sammy the Seal*, written by Hoff in 1959; to *Edward the Emu*, a 1988 book by Knowles; and *Sea Squares*, a 1991 book by Hulme, seals have been inaccurately pictured as the zoo animals that sit up and balance balls on their noses). Such inaccuracies, however, are not reason enough to discredit otherwise acceptable books. If a book promotes curiosity and motivation, the teacher can use the inaccuracies to engage children in investigations that dispel myths or misinformation.

### Posing questions to initiate literature-based investigations

There are many available resources of varying quality on the use of children's literature in the classroom. But rather than relying on these, teachers and children can draw upon their own interests and experiences and design projects to answer questions they generate themselves. The use of personally generated questions versus those posed by someone else in a book is more closely aligned to the ways in which mathematicians think (Parker 1993) and is more satisfying for learners (Helm & Katz 2001). Here are three guidelines to help teachers stimulate children's questions.

#### 1. Select a good book and pose natural mathematical questions.

Consider how mathematical ways of thinking enhance children's understanding of the content of the book being read. Questions should grow naturally from the story; avoid contrived questions such as the typical math "word" problems. Here are some examples of questions that teachers and children have posed:

- *Goldilocks and the Three Bears* (Brett 1987): Why would the temperature of a large bowl of porridge be hot, a medium bowl cold, and a small bowl "just right" (Weaver 1999)?
- *The Three Little Pigs* (Galdone 1970): Could a wolf really blow hard enough to knock over the pigs' houses?
- *Shapes, Shapes, Shapes* (Hoban 1986): Why are some things always circular? Why do bridges have triangles?

- *Biggest, Strongest, Fastest* (Jenkins 1995): Can I run as fast as a \_\_\_\_\_?
- *How Much Is a Million?* (Schwartz 1993): Would it really take 95 years to count to a billion?

### 2. Use both fiction and nonfiction books.

Mathematical questions raised in a fiction book can lead to the reading of nonfiction books. For example, reading *Tacky the Penguin* (Lester 1988) for mathematical connections may elicit such questions as

- How high was Tacky when he dived into the water?
- How cold is it where Tacky lives?
- How much does Tacky eat?
- What size shirt does Tacky wear?

The reading of *Tacky the Penguin* also may cause some children to wonder and read about real penguins. Further

investigations can be based on such questions as

- How fast can real penguins move on land? In the water?
- How much cold can a real penguin tolerate?
- How big are real penguins?
- Why are penguins' bodies, beaks, and wings shaped the way they are?
- How long can penguins stay underwater?

### Choosing Books for Math Class

1. Would I read this book to the children even if I weren't choosing it for a math lesson?
2. Does the book stimulate curiosity and a sense of wonder? Are children inspired to do their own investigations?
3. Is the book meaningful to the children? Can they make personal connections?
4. Are the math connections natural?
5. Is the information accurate?

When children pose questions based on their reading of both fiction and expository texts, they never suggest the traditional math textbook word problem such as, "If Tacky ate 2 sandwiches for breakfast, 1 for lunch, and 3 for dinner, how many sandwiches did he eat all together?" Such a question serves only to force children to simply *practice* skills, whereas children naturally desire to *apply* their skills to answer real questions of interest.

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**The children's results may be presented in drawings, stories, charts or graphs, drama, or manipulation of objects, all with an accompanying explanation of the math involved.**

In general, it is preferable that children investigate math topics that allow them to have direct, hands-on experiences (Helm & Katz 2001). We know from young children's fascination with dinosaurs and spaceships, for example, that their interests go beyond direct experiences and into the realm of possibilities and dreams. The pleasures of literature include "the ways in which [pictures and text] allow us to visualize people and places we've never actually seen or think about ideas we haven't considered before" (Nodelman 1996, 20). The challenge for the teacher is to make topics as concrete as possible. For example, when investigating how much a penguin weighs, children can pile books onto a scale until they reach the indicated weight. They also can represent their findings in a concrete way, using photographs or drawings. Comparisons to familiar items in their lives make the information meaningful.

### **3. Ask iwhat iff questions.**

Another technique for posing mathematical questions based on the reading of children's books is to ask, "What if \_\_\_\_?" This is a very powerful method of involving children in the pursuit of personal areas of interest, a technique modeled on the problem-posing strategy identified by Brown and Walter (1990). Children and teachers identify attributes of a story, ask what-if questions, and investigate those questions that are of highest interest. For example, in *The Doorbell Rang*, 12 children share 12 chocolate-chip cookies. If the number of children is changed or if there is more than one kind of cookie, children may investigate how the story would turn out differently. The children's results may be presented in drawings, stories, charts or graphs, drama, or manipulation of objects, all with an accompanying explanation of the math involved.

By participating in this process and posing their own questions and searching for solutions, children are empowered. "Engaging in this kind of problem generation helps learners to break the right-answer syndrome and demonstrates the infinite array of possible modifications" (Whitin & Wilde 1992, 16). Children gain great satisfaction and confidence when they tackle these often difficult and ill-defined problems (Katz & Chard 2000). Rather than simply applying the formula or algorithm taught in the

day's math class, they thoughtfully apply skills to solve problems they find important (NCTM 2000). They see themselves as mathematicians. Understanding is deepened and new ideas are created (Brown & Walter 1990). Teachers, along with the children, become creators of curriculum rather than abdicating decisionmaking to textbook publishers.

## **General suggestions**

When using children's books in math class, teachers should keep the following in mind.

- **Read books first for pleasure.** Avoid immediately following the initial reading with activities. When children are continually asked to do an activity after reading a book, their desire to read and be read to can diminish, and they eventually may dread the introduction of any new book.
- **Choose activities that are open-ended,** encourage multiple responses, and allow children to use and do math for authentic purposes. Any activity that follows the reading of a book should grow naturally from the book to questions or insight.
- **Look for both fictional and informational texts** in which the asking of mathematical questions enhances children's understanding, provides new perspectives, or instills a skeptical attitude.
- **Model a sense of wonder.** Demonstrate how to ask questions, search for solutions, and represent findings. Use charts, graphs, timelines, cross-sections, diagrams, illustrations, drama, music, poems, stories, and written explanations to show results of investigations.
- **Beware of the use of KWL charts** (What do you Know? What do you Want to know or Wonder about? What have you Learned?). When children have little experience with a concept or topic, there is little they want to know. For them to know something or to have questions about a topic, they need experiences to draw upon (Helm & Katz 2001). Teachers often must introduce a new topic by providing new experiences. Only then can children ask meaningful questions that lead to interesting and productive investigations.

## **Three Ways to Stimulate Children's Questions**

1. Select a good book and pose natural mathematical questions.
2. Use both fiction and nonfiction books.
3. Ask iwhat iff questions.

### A cautionary note

Attention given to children's books by textbook publishers has resulted in a proliferation of trade books designed to be used across the curriculum. Unfortunately, publishers sometimes sacrifice the elements of good literature for elements they perceive to be highly marketable. As a result, many books are poorly written and illustrated, and others are merely workbooks in disguise. Such books, according to Austin, "distort the purpose of children's literature, are an insult to children's intelligence, and are potentially damaging to a child's motivation and interest in reading" (1998, 119).

Books that force math content, such as *Just Enough Carrots* (Murphy 1997), *Mission Addition* (Leedy 1997), and *The M&M's Brand Chocolate Candies Counting Book*, are little more than collections of facts. In the first story of *Mission Addition*, the children in Miss Prime's classroom try to solve the mystery of missing chocolate-chip cookies. They collect evidence and present it as sums; for example, one child's discovery of blond hairs is accompanied by a poster showing blond hairs and the sum  $3 + 5 = 8$ . The investigative nature of the story is sacrificed so that sums can be shown. To top it off, the story ends with a mathematics lesson: "The numbers you add together are called addends. The answer is the sum." And to cement the workbook image, the story ends with a classic: "If you change the order of the addends, does it change the sum? See page 32 for the answer." Young readers are being taught that the answers are in the back of the book, a misrepresentation of real mathematical thinking. The story line is completely lost in the forced inclusion of math facts. It is very clear to the reader that this book is not to be enjoyed. Rather, the book requires work, work that is disguised with cute pictures.

*The M&M's Brand Chocolate Candies Counting Book* capitalizes on the popularity of M&Ms as it leads the reader through activities of sorting by color, making sets, creating shapes, and subtracting. The unremarkable text uses a contrived rhyming scheme that insults even the youngest of children:

Shape the twelve candies, please, into a square.  
A square has four sides. Please count them with care.  
Change the square to a circle, the big round kind.  
A circle's beginning is so hard to find.  
Let's make a triangle before we stop.  
Give it three sides and a point on the top. (pp. 21–23)

The illustrations are reminiscent of a workbook. The use of candy underscores the belief of many teachers that math is palatable only if disguised. There is no encouragement to explore ideas; the reader is told exactly what to do. At this very early stage, children get the message that there is one right way to complete a task. Furthermore,

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misconceptions are perpetuated when triangles are required to have "a point on the top" (the faulty belief that triangles must be equilateral and oriented with a point on the top persists throughout the primary grades).

In *Just Enough Carrots*, one of many instructional storybooks in the MathStart series by Stuart Murphy (1997), a bunny whines about the amount of carrots his mother has placed in her shopping cart. In a didactic manner, the mother bunny points out, "Yes, Horse has more carrots, but Bird has the same amount, and Elephant has even fewer." This unappealing text is then interrupted by a chart showing more, the same, and fewer carrots. This pattern of instructional text followed by workbook-like displays is repeated as the bunnies compare additional food items with the purchases of other shoppers. *Just Enough Carrots* is overly simplistic and contrived. Conversation is unnatural and forced. Illustrations are overly simplistic, forcing the viewer to focus primarily on mathematical concepts rather than on the story itself. In no way does the book convey the possible joy of shopping with a parent and the potential of rich, natural learning experiences for a child in the grocery store. One reading of this book and children have had enough.

Teachers must wisely choose the books read in class. Not all books are equally worthy. The wise teacher avoids books that are nothing more than workbooks in disguise, books used primarily to instruct. Such books use contrived situations that fail to spark young children's interest. The mathematics content is stilted and unnatural, lacking playfulness and a sense of wonder. Teachers must ask themselves why they would waste valuable classroom time with such books, time that could be used for reading excellent children's stories and participating in meaningful learning engagements.

### Conclusion

Thoughtful inclusion of high-quality children's books in the math curriculum significantly enhances children's interest and leads to meaningful investigations. Selecting books that are well written and illustrated and designing activities that are not contrived but naturally flow from the text are crucial. Inspired by good literature, children and teachers alike can experience the joy of mathematical thinking and exploring.

## ***A Sampler of Math Books for Young Children***

- Allen, P. 1982. *Who sank the boat?* New York: Putman & Grosset. (balance, capacity)
- Appelt, K. 1999. *Bats on parade.* New York: Morrow. (square numbers)
- Aubinai, M. 1996. *The farm.* Illustrations by J.F. Martin. New York: Abbeville. (size relationships)
- Baker, J. 1991. *Window.* New York: Greenwillow. (environmental awareness, change, growing up, timelines)
- Barry, D. 1994. *The rajah's rice.* New York: Freeman. (large numbers, powers of two)
- Bonsall, C. 1974. *And I mean it, Stanley.* New York: Harper & Row. (balance)
- Brett, J. 1987. *Goldilocks and the three bears.* New York: Dodd, Mead. (temperature, size)
- Briggs, R. 1970. *Jim and the beanstalk.* New York: Coward-McCann. (size comparisons, measurement)
- Brooks, A. 1996. *Frogs jump: A counting book.* New York: Scholastic. (counting)
- Burns, M. 1994. *The greedy triangle.* New York: Scholastic. (environmental shapes)
- Clement, R. 1991. *Counting on Frank.* Milwaukee: Gareth Stevens. (sense of wonder, estimation)
- Dee, R. 1988. *Two ways to count to ten.* New York: Henry Holt. (contests, finding alternatives, counting)
- Galdone, P. 1970. *The three little pigs.* New York: Clarion. (wind force)
- Hoban, T. 1986. *Shapes, shapes, shapes.* New York: Greenwillow. (geometric shapes)
- Hoban, T. 1998. *More, fewer, less.* New York: Greenwillow. (everyday experiences, comparisons)
- Hoose, P., & H. Hoose. 1998. *Hey, little ant.* Berkeley, CA: Tricycle. (ant behavior, size relationships)
- Hutchins, P. 1986. *The doorbell rang.* New York: Greenwillow. (division, sharing)
- Jenkins, S. 1995. *Biggest, strongest, fastest.* New York: Ticknor & Fields. (measurement, animal characteristics)
- Jonas, A. 1983. *Round trip.* New York: Greenwillow. (family trips, measurement, symmetry)
- Lester, H. 1988. *Tacky the penguin.* Boston: Houghton Mifflin. (penguin behavior and habitat)
- Machotka, H. 1991. *What neat feet!* New York: Morrow Junior. (animals, function of shapes)
- Machotka, H. 1992. *Breath-taking noses.* New York: Morrow Junior. (animals, function of shapes)
- McMillan, B. 1986. *Counting wildflowers.* New York: William Morrow. (numbers in the world around us)
- Merriam, E. 1995. *The hole story.* New York: Simon & Schuster. (what, where, and why of holes, geometric shapes)
- Most, B. 1984. *Whatever happened to the dinosaurs?* New York: Harcourt Brace Jovanovich. (hypotheses on dinosaur disappearance)
- Myller, R. 1990. *How big is a foot?* New York: Dell. (measurement, communication)
- Paul, A. 1991. *Eight hands round.* New York: HarperCollins. (traditions, quilting, geometric shapes)
- Rice, D. 1997. *Lifetimes.* Nevada City, CA: Dawn. (plant characteristics, animal behavior, measurement)
- Rylant, C. 1993. *The relatives came.* New York: Aladdin. (family vacations, visitors, measurement)
- Schwartz, D. 1999. *If you hopped like a frog.* New York: Scholastic. (measurement)
- Schwartz, D. 1993. *How much is a million?* New York: Mulberry. (large numbers, computations)
- Scieszka, J. 1995. *Math curse.* New York: Viking. (asking mathematical questions)
- Shields, C. 1997. *Saturday night at the dinosaur stomp.* Cambridge, MA: Candle-wick. (dinosaur size and behavior)
- Spier, P. 1980. *People.* Garden City, NY: Doubleday. (multicultural connections, classifying human activities)
- Toft, K., & A. Sheather. 1998. *One less fish.* Watertown, MA: Charlesbridge. (counting, coral reef life, environment)
- Tompert, A. 1993. *Just a little bit.* Boston: Houghton Mifflin. (balance, fulcrum, animal weights)
- Trivas, I. 1988. *Emma's Christmas.* New York: Orchard. (counting and adding large numbers)
- Van Allsburg, C. 1988. *Two bad ants.* Boston: Houghton Mifflin. (insects, perspective, comparisons, measurement)
- Viorst, J. 1978. *Alexander, who used to be rich last Sunday.* New York: Atheneum. (money)
- Wood, A. 1985. *King Bidgood's in the bathtub.* New York: Harcourt Brace Jovanovich. (time, liquid measurement, volume, capacity)

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