Capitalize on natural opportunities to engage young children with math in their world, contribute to their kindergarten readiness, and develop five-year-old mathematicians.
According to Riley’s first report card, she meets expectations in all areas of mathematics required for kindergartners in her school system. Among other skills, Riley can copy and extend a-b and a-b-c patterns, build sets to 10, sort by attributes, and name numerals from 0–12. At age five, Riley meets all these expectations; what her teacher does not know is that Riley met these expectations two years ago.

In their overview for the prekindergarten–grade 2 Standards, the National Council for Teachers of Mathematics (NCTM) documents the value of early mathematical environments. During these early years, young children are building beliefs about what mathematics is and learning about themselves as early mathematicians (NCTM 2000). What young children learn about math will form the foundation for how they learn and think about mathematics throughout their academic careers. Adults facilitate early mathematics development by creating environments that foster reasoning, thinking, and exploring.

Riley is the product of this kind of mathematically rich home environment. She is a bright young girl who loves math and realizes its usefulness in the world around her. If you ask her, she will tell you that math is important “so you know about money and ... to stop spending, so you have enough left for milk money.” She knows that the smallest number is “zero ... because there is nothing” and that the biggest number is really hard to find: “I keep counting, but I can’t find it yet. Maybe later.”

Over the years, Riley’s mom and I have had many conversations about mathematics concept development. She has shared numerous stories with me regarding Riley’s developing mathematical insights. Although Riley clearly demonstrates development beyond her chronological age, she did not get here on her own. The anecdotes that follow show not only the ways that math appeared naturally in Riley’s environment but also how her parents mediated learning to make math purposeful and meaningful to their young daughter. Every young student will probably not achieve the level of advanced mathematical understanding that Riley demonstrates at an early age, but her stories show how mathematics is always in the environment and that adults, with a little creativity, have the power to make this math accessible to young children. Reading these anecdotes might assist teachers in recognizing the natural mathematics opportunities occurring daily in their classrooms and in encouraging adults to consider the stories that could emerge from the youngsters in their care.

**Paper and metal “moneys”**

In the prekindergarten–grade 2 Standards, NCTM recommends that young children be encouraged to reason and solve problems (2000). The story below describes how four-year-old Riley started receiving an allowance and indicates that solving problems and figuring things out is highly encouraged within this child’s home environment. Riley’s mom tells the story:
Monday, Riley woke up with a huge problem. We [had been] at a store on Sunday and she saw a specific stuffed toy dog. We told her that $4 was too much for such a small toy and [that we] would not get it for her. Monday she woke up with a plan. First she tried crying about it; that didn't work. About an hour later, she came to me saying that she thought she had a solution to the problem. She said, “If I do work around the house, maybe I can earn four paper moneys to be able to get the doggie…”

We talked about this in detail and came up with a list of chores. We made a chore chart, and she gets a check mark for each chore completed. At the end of the week, if all the chores are done, she gets $4 (four “paper moneys” to her). She can spend this how she wishes. If only half the chores are done, she gets half the allowance, $2 (two paper moneys). If under half are done, she gets nothing. She has a good idea of what that is and doesn’t want that to happen.

At the age of four years, Riley understood that paper money is worth more than metal money. She could label pennies, nickels, dimes, and quarters. She did not know exactly how much a quarter was worth, but she knew that her mom broke her Pop-Tart into quarters in the morning, so she knew that somehow four equal-size parts of something were involved. A few months after Riley started receiving her allowance, her mom realized that her daughter was beginning to understand the concept of saving money:

Last night we went out to a toy store for a few minutes. Riley was asking a lot of questions: How much is this? How many paper moneys? Usually when I tell her [something] is five dollars, she says, “Oh, that’s one more than I will get.” If it is ten paper moneys, she just passes and says, “Too much.” So she knows what is more than and equal to the four paper moneys.

A few months later, Riley not only understood the concept of earning an allowance but was also able to save her money so that she could buy something she wanted that costs more than four dollars. A trip to an electronics store gave Riley the opportunity to understand what it means to split the cost of a purchase with her mom and dad. The story below indicates her parents’ willingness to provide their daughter with a learning opportunity in any environment and to expose her to the concept of representation and the modeling of mathematical ideas (NCTM 2000): Riley had managed to save her allowance for the last four weeks. She—

really understands this now…. She saved … $16 and understands how she got … to that huge amount of money. So, she wanted a new computer game … $36. She was halfway
there, so we let her get it by matching her dollar for dollar. [We] told her that she had to pay half and that we would pay the other half. We were in [an electronics store] and used thirty-six pennies laid out on the floor to represent dollar bills of her money and our money. We think she understands some of these ideas; it’s a start.

Natural opportunities for working with money can find their way into the classroom as well. Fund-raising for an upcoming field trip, raising money to contribute to a worthy cause, and contributions (using play money) to a behavior-management system can all be ways to make money meaningful to young students.

**Math everywhere**

A common game for Riley’s family is the Math is Everywhere game. Someone names an ordinary life event or object (e.g., plants, marshmallows). Then they find the math in it. Teachers could bring a similar game into the classroom, thereby purposefully filling in a few spare minutes before lunch or while waiting for the bus in the afternoon. Riley has become quite skilled at finding math in her world. With a little practice, other young students could, too.

NCTM recommends that youngsters begin to understand and make use of commonly used fractions as part of their developing sense of number and operations. In the following story, not only did three-and-a-half-year-old Riley demonstrate her developing understanding of fractions but also used language to effectively communicate mathematical ideas. Her mother’s notes at the time explain:

Riley is *really* getting the math ideas down pat. And I’m not *forcing* them on her either. She is going at her own pace when she wants to “play” with math ideas. The … gas station at the intersection…. Well, the sign is missing part…. It’s that huge sign sooo far up in the air, what seventy-five feet or so? Anyway, we were going up the road, and she says, “Look, a half a … sign.” When we finally found what she was looking at, she said, “Well, maybe it was a little more than half; maybe it was three-quarters.”

Similarly, by using mathematics vocabulary related to fractions in the classroom to intentionally focus attention on mathematics (e.g., a school day being half over, an assignment being three-quarters finished, one-quarter of the tables in the cafeteria being empty), teachers can encourage young students to notice the fractions in the world around them.

When Riley was four years old, simple walks to the parking lot of the school next door gave her mom and Riley a fun mathematical problem to solve. Each morning, they would ask, Have all the buses arrived yet? They knew that there should be seventeen buses altogether, so they would count to see if all had arrived. If there
were fewer than seventeen, they would talk about what might have happened to make the buses late.

Numbers also played a role in entertaining little Riley on car rides. While driving around town, they would count and compare the number they could reach before arriving at a specific destination. Riley came to understand this as a way to measure distance. On her own, Riley discovered that this was also a good way to spend time on the bus. At age five, Riley has discovered that she can count all the way up to 196 when she takes the bus home from school, but that she can count to only 140 when her mother drives her home. This means that “mom drives faster” than the bus.

**Math around the house**

Riley and her parents moved to a new house when she was three years old. Work around the house has involved many mathematical opportunities, for problem solving in particular. Riley is involved in all household activities, including renovations and purchases made. Her opinions and ideas are expected, considered, and valued by her parents.

During a trip to a lighting warehouse sale, five-year-old Riley was involved in choosing a chandelier for the dining room. She discovered that bigger chandeliers tend to have bigger prices, but not always. Her parents found an iron one they liked. Riley found a crystal one that she liked. When told that her choice would not “fit” the house decor, Riley insisted that it would because it was the same size as the iron one. This led to an interesting conversation about “design-fit” and style matching. Riley’s opinion was not swayed, so a family vote was held. The iron chandelier won, but Riley got to take home a small crystal heart, thanks to a salesperson who felt bad that Riley had lost the vote.

A significant problem-solving activity for four-year-old Riley occurred when she helped her parents determine how many boxes of holiday lights they had to buy to decorate the front of the house. Each set of lights was eighteen feet long. Her mom rounded eighteen to twenty to give Riley an easier number to work with and then set the boxes up on the floor. They needed to solve the following problem: *The house is 40 feet long. How many boxes of lights do we need?* With her mom’s help, Riley discovered they needed two boxes because there would be “too much with three. That would be more than the number of the house.”

Creative teachers will find many opportunities for natural mathematics around the classroom as well:

- **Cleaning up** after activities can incorporate discussions of what goes where and why.
- **Planning** a pizza party can involve a mathematical discussion regarding how many pizzas to order.
- **Setting up** a new bulletin board requires calculating how much paper to use for the background and the border.
Beyond counting candles
 Birthdays provide many natural mathematics opportunities. For Riley, birthday math goes beyond counting the candles on her cake. On Riley’s fourth birthday, her parents learned of her skills in logic and reasoning as she figured out what her gifts were before she opened them. Three gifts were set up on the table; two were

Solving tangram puzzles teaches Riley spatial visualization skills and develops spatial memory.

Playing with dominoes helps Riley build number sense and learn fact families.

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small, and one was big. When asked which she wanted to open, Riley said, “The big one.” At her parents’ request, Riley explained that she thought the gift was the school from a set of four play sets that were popular at the time. (She already owned one of the four sets). When asked to explain why she thought so, Riley replied, “Well, if you look at the other two presents, they are the same size as the ... play set that I have, and the big set is two times the size of the smaller one, and this box looks about two times as big.... And if you look at the back of the box that is on the table, you can see that the school one must be this big box.

Preparing for Riley’s birthday party offered another problem-solving opportunity for mother and daughter to engage in. Riley helped her mom figure out how many cupcakes they had to bake to have one for each child and two for each adult at the party. This is another problem-solving opportunity that teachers can easily transfer to the classroom as holiday parties are planned.

What to wear
NCTM recommends that young children in the prekindergarten–grade 2 range begin to sort and order by size, number, and other properties. Riley has been sorting and matching by color, shape, and size since well before her second birthday. She knows how to match like items, but when choosing her wardrobe for the day, she consciously chooses not to match. Riley’s outfits are usually a colorful mixture but will always be appropriate for the weather because she knows how to use temperature to determine which clothing she should wear. A digital thermometer in the living room tells her the indoor and outdoor temperatures. As Riley describes it, “When the two numbers are close to the same, it is warm. If the number for outside is smaller, it’s cold.” She knows that 32 degrees is freezing and that 34 degrees means it will be really cold when she waits for the bus in the morning. At around 45 degrees, Riley and her mom talk about seeing their breath outside. Riley can explain why this happens:

Breath is warmer because body temperature is 98 degrees, and it is colder outside. If it was 98 [degrees] inside, we wouldn’t wear any clothes. It would be hot.

A thermometer that reads temperatures inside and outside of the classroom could bring similar discussions of temperature into conversations with young students. An opportunity to graph the changing temperature also emerges from the simple addition of this one mathematical tool.

The classroom environment
Many of the strategies that Riley’s parents use to create a mathematically rich environment at home can be applied in the classroom as well. First, students need to be encouraged to cognitively engage with the world around them. Teachers should encourage their students to ask questions and should guide them toward figuring out the answers for themselves. When Riley wondered what she could do to get the four-dollar stuffed animal she wanted, her mom helped her develop and implement a plan, but she did not solve the problem for her. Like Riley, students must develop a sense of competence in their own ability to solve problems. This will develop through interactions with adults who demonstrate faith in the children’s developing problem-solving skills.

Second, teachers must require students to explain their thinking. When Riley figured out what was in her wrapped birthday presents, her parents asked her to explain how she knew. Explaining gave Riley the opportunity to think about her strategy and put it into words. She was also able to enjoy her parents’ pride in her developing logic and reasoning skills, helping
her expand her belief in herself as a learner. Students need to experience this kind of pride from their teachers, too.

Finally, teachers should engage their students in mathematically purposeful, meaningful activities. Counting in the car was meaningful for Riley because she used it as a way to measure speed and distance; the numbers on the thermometer held meaning because they were tied to discussions about weather and clothing choices. It can be argued that calculating sums on an activity sheet, memorizing multiplication tables, and committing algorithms to memory are not productive activities for students. As Riley can tell you, math is everywhere; find it, and use it purposefully in your classroom.

**Future learning**

This is not the end of Riley’s story. As she continues to grow, many chapters are yet to be written. Her parents are hopeful that as she progresses with her formal education, her enthusiasm for mathematics will continue to grow. For this to happen, Riley’s teachers will need to recognize all that this little mathematician has to offer and guide her in making connections between what she already knows and what she is learning in the classroom. Mathematics does not live in the class textbook—it is alive in the world around us. At the age of five years, Riley already knows this. Let’s hope her future teachers do, too.

**REFERENCE**


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