Five Easy Principles to Make Math Moments Count

How can early childhood teachers lead young children to meet mathematics learning standards? These practical recommendations show how to add an intentional, fun math twist to children’s everyday academic experiences.

Preschool children are learning so many skills—how to cut with scissors, zip zippers, recognize the alphabet and their names, and share toys with others. A strong academic curriculum also requires that children learn more about math (National Council of Teachers of Mathematics [NCTM], 2000). By following the five easy principles outlined here, teachers can maximize math moments that typically occur in the daily lives of young children in high-quality classrooms. As a result, children will deepen their mathematical understandings.

Principle 1: Recognize Everyday Math Moments

As keen observers of young children, teachers recognize that mathematics naturally happens in early childhood classrooms. The actions of preschoolers engaged in playful math experiences indicate that, while developmental variation is to be expected among young children, mathematics is accessible to children at every level and vital to their future success (National Association for the Education of Young Children [NAEYC] & NCTM, 2002). Key areas of growth in math skills and concepts from ages 3 to 6 are outlined in Table 1.

Table 1. Typical Mathematics Learning Progress for Children Ages 3 to 6. Adapted from NAEYC & NCTM, 2002.

<table>
<thead>
<tr>
<th>Content Standard</th>
<th>Around Age 3</th>
<th>By Age 6</th>
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</thead>
<tbody>
<tr>
<td><strong>Number and Operations</strong></td>
<td>Counts 1 to 4 items and begins to understand that the last counting word indicates “how many.”</td>
<td>Counts up to 100 using groups of 10.</td>
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<tr>
<td></td>
<td>Adds and subtracts nonverbally when numbers are very low.</td>
<td>Adds or subtracts using counting-based strategies such as counting on.</td>
</tr>
<tr>
<td><strong>Geometry</strong></td>
<td>Matches names to 2-D and 3-D shapes.</td>
<td>Describes basic features of shapes.</td>
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<tr>
<td></td>
<td>Uses shapes separately to create pictures.</td>
<td>Makes a picture by combining shapes.</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
<td>Recognizes and labels concrete attributes. (“I need a long string.” “This is heavy.”)</td>
<td>Tries out various processes and units for measurement.</td>
</tr>
<tr>
<td></td>
<td>Compares and sorts objects according to observable attributes.</td>
<td>Uses nonstandard measurement units and tools.</td>
</tr>
<tr>
<td><strong>Algebra</strong></td>
<td>Recognizes and copies simple repeating patterns.</td>
<td>Recognizes patterns in counting and arithmetic.</td>
</tr>
<tr>
<td><strong>Data Analysis and Probability</strong></td>
<td>Helps to make simple graphs using actual objects (apples) or pictures of objects (apple stickers or drawings).</td>
<td>Makes simple bar graphs to represent data.</td>
</tr>
</tbody>
</table>

Math is much more than a separate topic to study. It fits with any part of the school day and connects with all other curriculum areas (Copley, 2000). A quick glance around any early childhood classroom reveals plentiful,
purpose-driven mathematics experiences. Teachers can weave the NCTM content and process standards (see Table 2) into the work and play of children from PreK through senior high (NCTM, 2000). These examples demonstrate how the NCTM mathematical standards fit seamlessly into children’s play.

Four-year-olds Moira and Will are playing with a bucket full of small colorful wooden blocks. Moira sorts them by color and then creates patterns (geometry, representation). In doing so, she comments that “two reds put together are as long as one green” (measurement). At the same time, Will first names each shape (geometry). He carefully examines the pointy parts, curves, and sides to decide which ones might work to construct a tower (problem solving, data analysis).

At the sand table, Anders asks three friends about their favorite muffins (number). He invents a recipe that includes 2 cups of blueberries and 5 1/2 cups of flour (measurement), which he counts in both English and Spanish. After mixing and baking his muffins at 75 degrees for 10 minutes (measurement), he shares his delicious creations equally with his friends (number and operations).

Duncan and Sybil have opened a veterinarian’s office in the dramatic play center. They set up an examining table with a balance scale (measurement) and a billing office (problem solving, reasoning). They write a list of services and their prices, such as shots, food, and fixing broken legs (number and operations, communication). A cash register and credit card scanner are set up to accept payment and make change (number and operations, representation).

These children’s play connects simple mathematical concepts such as number and equal shares to real-world schemes. Because math is so concrete and embedded in their play, children who are English language learners may quickly learn to count and identify shapes, for example, in both languages. When teachers recognize the learning possibilities in everyday math moments, the goal of teaching more and better mathematics seems far more achievable.

Ayla has dressed up as the mother in the dramatic play center. She scribbles a grocery list using mock letters and numbers. Ayla drives to the grocery store (the block area), where she counts aloud to six while placing six items in her bag. She hands the cashier $20 and asks for $7 in change.

It appears that Ayla can count with one-to-one correspondence. A few thoughtful follow-up questions such as these will both confirm the teacher’s observations and extend Ayla’s mathematical thinking:

- What items did you have on your grocery list? Let’s read it.
- How many things did you buy? (count if needed)
- Did you buy more than one of anything? What item(s)? How many?
- How much did your groceries cost?
- Why did you give the cashier $20?
- Why did you ask for $7 in change?

Principle 2: Ask Questions to Extend Math Understandings

Informal math learnings are often the result of children’s innate curiosity and desire to make sense of their worlds, but coincidental learning is simply not enough to assure deeper understandings (NAEYC & NCTM, 2002). Teachers can deepen children’s intuitive mathematical experiences with thoughtful, purposeful comments and questions (Parks, 2009), either during children’s play or immediately after.

Coincidental learning is not enough to assure deep understandings.
In nearly every learning experience—from painting recycled boxes in art to zooming around in vehicles on the playground—teachers can ask concrete, thought-provoking questions to make the most of the math-learning possibilities.

**Principle 3: Keep Written Records of Math Learning**

Teachers develop a sharp eye for classroom math moments when they record and document students’ mathematical explorations. Capturing contextual math experiences is much different than conducting formal written assessments with older children. Developmentally appropriate practices require ongoing, authentic, and contextualized assessment (Copple & Bredekamp, 2009). Teachers who use portfolios and anecdotal observation records are more likely to be able to document, evaluate, and plan for children’s mathematical understanding, growth, and intuitive problem-solving strategies.

**Simple portfolio system.** Teachers who are just beginning to use mathematics portfolios may want to set up a simple documentation system. Large, recycled empty cereal boxes or unused pizza boxes work well to collect each child’s writings and drawings. Digital photos provide a permanent record of hard-to-store explorations such as block constructions, pretend play experiences, and water or sand measurements.

About every 2 weeks, children sort through their collection portfolios. They choose which items to take home and which ones to save in an assessment portfolio. Children discuss their reasons for selecting the items with their teachers, who make brief notes about the choices. Families delight in seeing children’s ongoing work as well as reviewing indicators of learning found in the assessment portfolio whenever they talk with their children’s teachers.

More experienced teachers may choose to develop sophisticated portfolio systems that include video recordings, skill progress checklists, and detailed observations, for example.

**Anecdotal records.** Anecdotal records also help teachers document children’s developing mathematical understanding, particularly over an extended period (NCTM, 2000). The information gathered guides intentional preparation of the learning environment and teaching strategies to further children’s learning.

Keeping anecdotal records can be time intensive, so sometimes volunteers or assistant teachers lend a hand. They might write students’ explanations about a math exploration on the back of a child’s work or on note cards, for example, or record the child’s voice while playing a matching game for later transcription.

For regular, authentic observations, teachers often use record sheets constructed in two different formats (see Figure 1).

- One type of observation form lists all children in the group on a single sheet. Space is provided for children’s names, the date, type of activity, and brief notes about what happened or was said.
- The other type of observation form is a separate sheet for each child, with space for dates, the activity, and much more detailed documentation.
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Principle 4: Use Math-Themed Books to Promote Progress

All good early childhood curriculums emphasize language, literacy, and early reading skills. With some thoughtful planning, read alouds and guided reading can infuse mathematics into the day. Many children’s picture books, poetry, fingerplays, nursery rhymes, and familiar stories carry a mathematical theme. These engaging picture books are just a few examples of how literacy can be the source of creative ideas for math explorations.

- Read *Who Sank the Boat?* (Allen, 1996). Explore the concept of volume using sand, birdseed, or pebbles and shoe boxes of various sizes. Weigh pretend animals on a postage scale, both individually and collectively. Record and compare their weights. A similarly captivating book about volume is *The Mitten* (Brett, 2009).

- After sharing *Shapes, Shapes, Shapes* (Hoban, 1996), go on a shape search. Children make sketches or take digital photos of the 2-D or solid geometrical shapes of everyday things they see. Discuss why objects are certain shapes—and imagine how those items might work if they were a different shape. What do you think would happen if wheels were square instead of round, for example?

- Reading *What Comes in 2’s, 3’s, and 4’s?* (Aker, 1990) might inspire children to find other things that come in pairs. They could cut out pictures from magazines and glue them on a poster or in their own books. Older children may follow up with collections of 3’s, 4’s, and even 5’s and 10’s.

Nursery rhymes and fairy tales also offer a strong connection between literacy and mathematics. Children might record their mathematical thinking with concrete objects such as manipulatives, art supplies, or in a math journal. Here are some ideas to imbed math concepts into familiar language experiences.

- Little Bo Peep lined up her sheep—black, black, white, black, black, white. What are the next three sheep in the pattern? Use colored paper circles, cotton balls (color some with marker), or checkers. Older children could draw the pattern in their journals. What other patterns can children create?

- How could you create a little pig with shapes? Think about the body, head, eyes, snout, and ears. Which parts are circles? Triangles? Ovals? How many shapes can you use? Try using modeling compound or felt cutouts instead.

- The Three Bears are getting ready for a walk. Papa Bear already is wearing his coat. How many bears still need to put on their coats? Use puppets, dolls, or rubber animals to figure out the answer. Then add another family member with a coat. Now how many still need a coat?

Creative teachers will find many other ways to build more captivating...
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Principle 5: Make Math Moments Playful

Making math moments playful keeps children engaged and motivated to learn (Johnson, Christie, & Yawkey, 1999). The following intentional teaching ideas honor play-based approaches while developing early concepts of measurement, number, patterns, shapes, and graphing.

Play With Measurement

Children naturally compare measurements, especially length, with familiar objects such as their shoes, unit blocks, or pieces of yarn for collages. Encouraging estimation prior to measurement also helps build a sense of number (Lang, 2001). Ask children to compare a marker and a doll for example. Which do they think is longer? Which is shorter? Which is wider? Use a unit of nonstandard measurement such as paper clips or craft sticks to measure and record the results. As children become more adept at measurement, increase the number of items for children to compare. Older children may use a ruler and standard units to formalize their comparisons.

After children have some understanding of measurement, introduce a learning activity such as this one. Work with small groups so all children can be actively involved. Together, create a child-friendly treasure hunt map using a plastic tablecloth or shower curtain, permanent markers, and a few large stickers. Randomly place stickers on the map. Use a straight edge to draw lines between some of the stickers.

Provide children with nonstandard measuring units such as craft sticks or drinking straws. Encourage problem solving and reasoning by asking questions such as these:

- Which stickers are the farthest away from each other? Which stickers are closest? (estimate first, recording predictions)
- How many craft stick lengths do you think it will take to reach from the car sticker to the flower sticker? (allow time for thinking, encourage multiple responses, record responses, lay craft sticks end to end along the line while counting aloud to confirm hypotheses)
- Will it take more craft sticks to reach from the octopus to the whale—or from the ship to the dinosaur? (record predictions, measure to find out)
- If it takes eight craft stick lengths to reach from the house to the school, how many straw lengths do you think it will take? (encourage discussion, then use both tools to measure)

The same activity can be repeated at another time, or with older children, using standard U.S. measures (inches) as well as metric (centimeters). Record measurements between sets of stickers. Compare and contrast distances between them.

Play With Number

Simple fractions are frequently used in early childhood classrooms. Children often want to fairly share game pieces, divide fruit evenly for snack, cut yarn equally, or fold paper in half, for example. In addition to fitting fraction puzzles together, children often find it fun to learn about fractions through play, perhaps by opening a pretend pizza parlor. Children can create real pizzas on English muffins with tomato sauce, cheese, and toppings. They can cut them with plastic knives to share. Or children can use thin cardboard or paper plates, colorful paper, and scissors to make endless types and sizes of imaginary pizzas—round or rectangular—to serve to their customers.
When pizzas are “baked,” children figure out to divide them—perhaps in half, or thirds, or fourths. Encourage them to label the pizza slices on the back with fractions such as 1/2, 1/3, and 1/4. After the pizzas have been “eaten,” reassemble the pies with the correct fraction pieces and the pizza bakers will be ready for new customers.

**Play With Patterns**

Patterns are all around. Help children find patterns in the stripes on their shirts or in the trees planted along the street. Listen for patterns when clapping a beat or marching to a drum. Notice rhyming patterns in poetry.

Children relish using symbols or simple pictures to recreate repetitious stories and songs such as *The Three Little Pigs*, *The Three Billy Goats Gruff*, *The Very Busy Spider*, and *There Was an Old Lady Who Swallowed a Fly*. Children can cut out suitable magazine pictures, find matching felt figures, or use puppets to retell almost any story. They also can use their imaginations to create their own new patterns that change the story.

**Play With Shapes**

Older kindergarten and first grade students often are intrigued to play detective to find out which objects, graphics, and shapes, including uppercase letters, are symmetrical. Symmetry is an important concept in the fields of science, math, and the visual arts, so it is a valuable skill for children to develop.

To introduce the idea of symmetry, show how an imaginary line or fold down the middle (line of symmetry) divides some objects exactly in half so that each side is an identical mirror image of the other. Start by experimenting with familiar items in the classroom such as sheets of paper, leaves, and children’s own faces. Ask children to find other items on the playground and at home that are symmetrical, perhaps butterflies and kites.

After children have mastered the concept of symmetry, introduce the idea that most upper-case letters also have line symmetry (usually A, B, C, D, E, H, I, K, M, O, T, U, V, W, X, Y). One effective way to find out which letters are symmetric is to provide large, block, upper-case letter stencils for children to cut out, perhaps to spell their names or other meaningful words. Or children can cut out large type from recycled magazines and fliers. Printing out large, bold letters on the computer is another option.

Offer children small, unbreakable mirrors to explore their cutout letters to see whether the letters have line symmetry. Demonstrate how children can try folding letters in different directions to look for a line of symmetry—or even find more than one line of symmetry.

Students who find lines of symmetry may want to cut the letter into two equal parts along the line of symmetry. They could glue the parts on separate sheets of paper to compile into a puzzle book. Trade books with friends, who draw the missing halves of the letters. Children check each other’s work for accuracy.

**Play With Graphs**

Graphs are quick, interactive ways to take attendance, record the results of surveys, look for trends, and develop mathematical vocabulary. Keep the topics relevant to children’s own lives—their favorite foods, colors, or how many people are in their families. Small groups are most effective initially to ensure that all children actively participate.

At first, use children themselves or objects to construct 3-D representations of bar graphs. Start with two choices, then increase the number of options as children become more familiar with graphing. Simple bar graphs can be constructed by asking increasingly difficult questions such as these:

- Are you wearing a sweater or a jacket today? (children stand in a sweater line or a jacket line)
- Which flavor do you like better, grape or strawberry?
- Does your first name have an E? Yes or no?
- Are your shoes fastened with Velcro®, laces, or are they slip-ons? (children form three lines, or place their shoes in three lines)
- What is your favorite veggie? Tomatoes, carrots, beans, or corn? (use cans or pictures of the veggie to help children divide themselves into four groups)

For each question, children stand in the line of their choice or choose an object to fit the category. For example, children could choose a favorite pet from among dogs, cats, fish, or birds. Lay play animals or puppets in columns on the floor bar-graph style. Look at the length of the lines. Ask children questions such as these:

- Which is the longest line? How do you know?
- Which is shortest line?
- Who can count how many are in each row?
- Which pet was chosen most often? Which one is the least favorite?

After children grasp the concept, they will be ready for pictorial graphs.
that use pictures to represent objects. Laminate poster board marked in columns so the graph can be used repeatedly. Tape pictures above each column to represent the choices. For example, with the pet question, ask children to cut out magazine pictures or draw their favorite pets on small pieces of paper. Children tape their pets in the correct column on the graph.

Discussion about every graph is critical to help children understand the mathematical vocabulary and concepts. Ask questions that encourage children to think even more deeply about the representation and what it means.

- What does the graph show? (give children time and invite several responses)
- Which choice was picked most often? How can you tell? (make sure children can justify their responses)
- Which was the next most-picked choice? The least?
- If you were a (pet store owner, pet sitter, maker of animal toys, pet food manufacturer), how could you use this information?
- What patterns do you see in this data? (especially for older children)

As children become more sophisticated with graphing, they can affix clothespins with their names to a chart or simply sign their names on bits of paper.

* * *

The hustle and bustle of young children’s purposeful play is often really all about mathematics—counting, grouping, sorting, solving problems, and much more. Teachers can maximize the value of math inquiries that come naturally to all children. By recognizing math moments, using thought-provoking questions to extend vocabulary and understandings, and recording students’ mathematical insights, teachers provide a vital foundation for life-long mathematics learning.

Math-themed literacy experiences integrate mathematics with languages and offer engaging ways to grasp mathematical concepts. Playful approaches to teaching measurement, number, pattern, shape, and graphing maintain children’s interest in exploring key mathematical ideas. Lively, imaginative play equals vibrant math learning.

References

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