Chapter 3

COUNTING

More Than Just 1, 2, 3

Big Ideas about Counting

- Counting can be used to find out "how many" in a collection.
- Counting has rules that apply to any collection.

Math Snapshot

Ms. Kami knows that rituals around seeing who is present and absent each day offer a wonderful opportunity to strengthen the children's sense of community in her blended classroom of 4- and 5-year-olds. Each child is standing at an assigned spot around the edge of the rug. Ms. Kami announces, "We will begin our count of who is here today with Ayla." The children join Ms. Kami in saying, "One child is here today," and Ayla sits down. Tony is on her left as the group chants, "Two children are here today," and then he sits down. So it goes around the circle until the count comes around to Asia, who is to Ayla's right and the only child left standing. Everyone joins in a triumphant, "Seventeen children are here today!!"

As Asia sits and takes her place "criss-cross applesauce" in the circle, Ms. Kami announces, "We have 17 children at school today. And we have 17 children in our class. So how many children are missing today?" Many children call out together, "Zero!" and everyone joins Ms. Kami in doing a Perfect Attendance Round of Applause.

There is no question that everyone delights in hearing young children count. The children themselves love the pattern and rhythm of the language as they chant or sing their way from 1 to 20 or 30 or even 100. They are warmed by the smiles and words of approval and admiration from important adults, just as the important adults, parents and teachers, take satisfaction in this demonstration of the beloved child's competence—the ability to count.

Counting is a part of young children's daily life. They love to count everything from the stairs they climb to the crackers they eat. But what is counting? What is there to be understood about counting? What do most children know about counting? What more is there to be learned? Counting seems very simple, but it is really quite complex. By developing a sophisticated sense of what counting is and what kind of counting we ought to emphasize in teaching, parents and teachers can better assist children with the development of counting skills and mathematical thinking.

There are two types of counting: rote counting and rational counting. **Rote counting** involves reciting the number names in order from memory. If a child says, "1, 2, 3, 4, 5, 6, 7, 8, 9, 10," the child has correctly counted up to 10 by rote. **Rational counting** involves matching each number name in order to an object in a collection. If a child says "one apple, two apples, and three apples" while tagging one apple at a time, the child has developed rational counting skills up to a certain number.

While accurate rote counting has its place in the process of learning to count, its function is rather limited. In contrast, when young children develop rational counting skills, they are armed with a tool that enables them to understand the concept of numerosity, to compare quantities of different sets, and eventually to engage in operations. Rational counting is a foundation for children's early work with numbers.

We have identified two Big Ideas teachers and adults should focus on to support the development of children's rational counting skills:

- The first Big Idea—*Counting can be used to find out "how many" in a collection*—speaks to the purpose of counting. Why do we count? We count because we want to know the quantity of a collection. And the collections can be physical objects (for example, chairs, apples) and nonphysical objects (for example, sounds in the room, ideas).
- *Counting has rules that apply to any collection*—this is the second Big Idea in counting. The four basic rules are *stable order; one-to-one correspondence*; *order irrelevance,* and *cardinality*. When a child applies these rules to a counting activity, he has mastered rational counting skills.

Big Idea: Counting Can Be Used to Find Out "How Many" in a Collection

Math Snapshot

Ms. Kami routinely has a Question of the Day for children to answer upon arrival at school. She always structures the questions for a yes or no answer, such as, "Did you wear a jacket to school today?" Each child has a clothespin with his or her photo glued on it, and they all clip the clothespins to a YES/NO T-chart to show their answers to the question.

One of the favorite classroom jobs in Ms. Kami's classroom is to be one of the two **Counting Captains** who serve for a week. One captain counts the YES responses, and the other captain counts the NO responses. At the end of the morning, Ms. Kami confers briefly with them, helping them count up the clothespins and record the number. Before dismissal, the Counting Captains report to the group how many responses in each column.

How much? and *How many?* are fundamental Big Idea questions that are so embedded in our everyday life that we often are not conscious that in fact we are doing math. We think of counting the children on the bus at the end of a field trip as a safety issue; or our focus is on balancing storage space and our family's eating habits when we calculate how many juice boxes, yogurts, or cans of soup we want to stock up on during a sale.

Knowing or understanding "how many," however, is a complex developmental process, which is closely related to the development of number sense discussed in Chapter 2. Recall, there are four different ways we use numbers in our daily life: referential, nominal, ordinal, and cardinal. Finding out how many is the **cardinal use of numbers**—the primary purpose of a counting activity. Knowing how many enables children to carry out number operation activities meaningfully. For example, children can compare sets (e.g., *here are three apples and two peaches—there are more apples than peaches*) and identify equivalence (e.g., *you have two crackers and I have two crackers, we have the same*).

Counting to know how many is also closely tied to children's **subitizing skills**—the ability to perceive a small amount of objects and know "how many" there are instantly without counting, which were discussed in Chapter 2. A goal shared by subitizing and counting is to find out how many. They differ by method: subitizing does not require a sequence of steps, whereas a highly structured set of coordinated actions is the very core of counting. With or without elaborate procedures, the goal is the same.

Subitizing can play a supporting role in the development of children's cardinal understanding. By naming small sets with numbers, children eventually connect that a set of three that they can instantly recognize, for example, is both *three* and counted by enumerating *1, 2, 3.* Imagine a child who can subitize three objects and who can rote count to three, saying *1, 2, 3* in the correct sequence. Each experience counting a set of three provides the child the opportunity to use what he knows—*there are three*!—to figure out how counting and cardinality works.

Another connection between number sense and the ability to find out how many by counting relates to the concept of **numerosity**. As you will recall, the concept of "threeness" has little to do with the particular objects that children are counting. That is, when counting a set, each number name (*one, two*, or *three*) is not attached to any particular object, at least not in a permanent way. The number names are used only temporarily, as a method of being sure each item is included

TEACHER TALK

Barbara, Preschool Teacher

Yesterday, I worked with my 3-year-olds to count to find out how many. We used five chairs. At the end, children chanted in unison, "Five chairs," as I circled all of the chairs with my gesture to indicate the total amount. I was happy because they seemed to know the concept of how many. Today, I went back to the same activity but used five apples. You know what, at the end of the counting when I used the same gesture to bring children's attention to the total, they made a big announcement with a great joy, "*Five chairs*!"First, I was puzzled. Then I realized: to them, the number 5 was acting like a name! If it was attached to chairs yesterday, it stays there today. I can see we will need more experiences counting and naming other sets of five objects!

TEACHER TALK

Aliya, 2.5- to 3-Year-Olds Day Care Room Teacher

The kids in my room are whizzes at counting up to 8 but that's where it stops. I can't seem to get them to do 9 or 10. But when I said that to my colleague, she just laughed and pointed out that there are eight children in my room and added, "They'll get to 10 fast enough when they are a little older—or if you get to 10 children in the room!" I can kind of see her point. We are counting 8-this and 8-that all the time. So I guess I don't have to worry.

in the count. In fact, these relationships between number names and particular objects are so temporary that they can be switched around without causing any problems, so that the object that is "one" the first time you count can be "two" the next time, and you will still get the same overall result.

This temporary naming idea is a rather abstract and alien concept for young children. Most of children's experiences with names tie them specifically to one item, or a particular set of items. *Mommy* is not any woman but the one who loves you and takes care of you daily. *Chair* refers to a kind of furniture for people to sit on, and can't be applied to the table without confusion. The counting words are different. They are used whether children count themselves, stuffed animals on their bed, shoes they wear, or crackers they eat. Further, we can count not only physical objects, like jelly beans, boys, and girls, but also actions, like hugs or kisses, sensations, like sounds and smells, and ideas, like wishes and imaginary friends. Numerosity is such a powerful concept that it can be applied to literally anything!

Last but not least, similar to number sense development discussed in Chapter 2, counting to find out how many relates to children's **concrete experiences**. That is, counting has to be meaningful to young children in order to make sense. For example, counting out four meatballs to place on one's plate during lunchtime is much more interesting and meaningful than counting to find out how many stars are printed on a worksheet. The former connects to children's personal interest whereas the latter is detached from their needs. Similarly, counting physical objects is easier than nonphysical objects, because it is less abstract. Repeated experiences with four meatballs, four crayons, and four toy cars provide the right input to help young children generate a meaningful understanding of *fourness*!

Big Idea: Counting Has Rules That Apply to Any Collection

Thanks to TV shows like *Sesame Street*, many children enter preschool chanting or singing the number names from 1 to 20. Learning to count meaningfully requires both memorizing arbitrary terms or number names (rote counting) and rule-governed counting (rational counting). As described earlier, rote recitation of the number words is not the same as having a good number sense for what 20, 25, or 100 means. Experts agree that **rational counting** takes place only after children have mastered four key principles or "rules" of counting: *stable order*, *one-to-one correspondence*, *order irrelevance*, and *cardinality.* Each principle builds on understandings developed in the previous ones.

Stable Order Principle

Math Snapshot

After a group activity that involved counting and moving at Family Night, Danny's dad pulls Ms. Kami aside. "I noticed Danny was right in there with all the motions; but after 10 he was just saying random numbers like *two-teen, seventeen, five-teen, nineteen!* Should we get some flashcards to drill him at home so he doesn't get behind?"

Ms. Kami smiles reassuringly. "There's nothing to worry about. The more Danny hears the number words in the right order, the better he will learn them. But flashcards aren't nearly as effective as you counting things with him. Make a kind of game of it. Since you live on the second floor, count the steps as you go up and down. Count how many red cars you see in oncoming traffic. Or just for fun, count how many fingers or toes you have as a family."

The definition of the **stable order principle** seems obvious to those of us who have been counting for many decades: *Counting words have to be said in the same order every time.* The order—*one, two, three, four*, and so on, is fixed, meaning that *three* is always after *two* and before *four*. When Danny says *two-teen, seventeen, five-teen*, it is clear he has not mastered the **stable order** rule in counting. As Ms. Kami suggested to Danny's dad, repeated practice through games and daily experiences will help him develop both the understanding and the skills.

Because the order of number names is conventional, memorizing the sequence is a prerequisite to the use of the stable order rule in counting. However, understanding the stable order rule is more than just the rote recitation of the number sequence. Mathematical structures and patterns are embedded in the process of the rule's applications.

First, no matter what word or symbol we use to designate a quantity, *each number is always one more than the number before it and one less than the number after*. That is, the number sequence we use has an embedded mathematical structure. In terms of number sequence, three is always after two and before four. With regard to its mathematical structure, three is always one bigger than two and one smaller than four. Rote counting alone won't help to reveal this mathematical structure, but having the words in the right order makes their cardinal amount meaningful.

Number sequence also includes many interesting patterns that are central to our understanding of numerosity and place value. As you can see on the Hundred Chart illustration, our Arabic numerical system is base-10, or based on a system of 10s. Because we group numbers by 10s, we can represent all numbers using 10 digits (0 to 9), and there are patterns to how numbers are represented. Because of these patterns, we know that when we reach a number

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

A Hundred Chart

that has 9 in the 1s place, the next higher number will end in 0, and have a decade one digit higher. In this way, the fixed order of the digits 1 through 9, combined with our place value system, creates a fixed, predictable, meaningful, and powerful system.

It is well known that the teens in English are the one decade whose number names distort the pattern—while twenty-one, twenty-two, and twenty-three follow the pattern (name of decade number + name of ones-place number) with satisfying consistency, *eleven, twelve, thirteen, fourteen*, and so on sound like a random string. This is why Danny gets confused when he starts counting teen numbers. The Hundred Chart can be useful to help children, particularly kindergarteners and older, see how the number pattern *does continue* through the teens while practicing the stable order rule. For example, children can clap and say each number in the 1 to 9 sequence but jump up and shout at each 10 while looking at the Hundred Chart—and if it is not clear why we say *fifteen* instead of *five-teen* (or even *teen-five*), at least the numerical representation on the chart makes sense.

TEACHER TALK

Florence, Pre-K Teacher

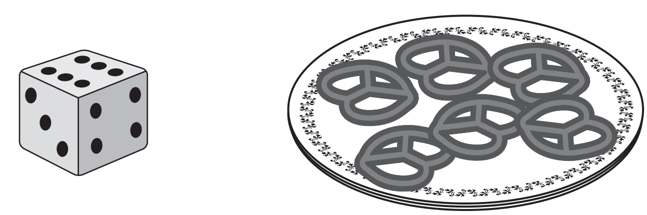
I have found that the rhythm of a child's voice often indicates how confident he or she is about counting. Some children will fall into the counting chant from 1 to 10; in the teens you can hear some hesitancy and stop/starting. They may pick up the chant again for the 20s and 30s; but then at 39, they stop; sometimes after a pause they remember that 40 is next and sometimes they just get stuck.

One-to-One Correspondence Principle

Math Snapshot

Ms. Kami has been very thoughtful about working meaningful counting activities into the routine of her classroom. At snack time, each table of five has a Snack Chief. Whoever has the job for the week is responsible for putting out the correct number of paper plates or napkins, putting out the snack dish and taking the drink orders. Ms. Kami knows that this is excellent practice with one-to-one correspondence.

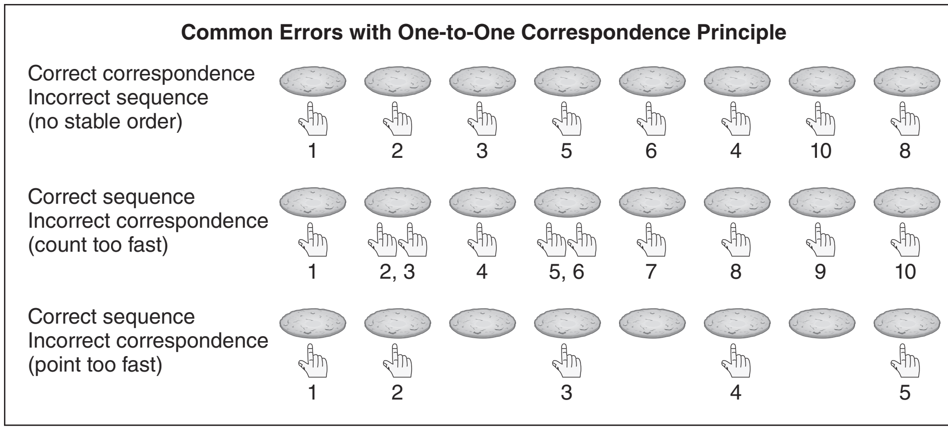
At the same time, Ms. Kami tends to use snacks that come in munchable bits like goldfish crackers or pretzels. When everyone is seated, one of the Counting Captains rolls the magic number cube. It is marked with dots; the faces are 3, 3, 4, 4, 5, 6. Once the Counting Captain has counted the winning die face and announced the result, the snack bowl starts its way around the table, with each child counting out the designated number of treats. Ms. Kami reports that the whole table joins in monitoring and helping everyone get a "fair share."



A Die with Six Up and Six Pretzels

Most of us are clear about the fact that the **one-to-one correspondence principle** means that *one number is named for each object.* While the principle seems obvious to adults, it does take practice and time for children to fully grasp it. That is, the child has to learn to coordinate the number words with the physical movements of a finger and the eye along a line of objects, matching one number word to one object until all of the objects have been used up.

In the process of developing one-to-one correspondence, young children often make three types of errors: (1) sometimes children tag each object one at a time but say the number words incorrectly, either missing words altogether or getting them out of order; (2) sometimes children tag certain objects more than once, also called double tagging; and (3) sometimes children miss tagging some objects, as shown in the following illustration.



To help children develop the one-to-one correspondence principle, teachers with strong mathematical understanding like Ms. Kami are very intentional about making sure that all counting activities are linked to *counting something*—including movements like the Full Body Count routine she used at Family Night. When that something is an object, like toy cars in a line-up or goldfish crackers, she reminds the children to *tag* by pointing at each object as they count it.

When children are making an error, rather than telling them they are wrong, Ms. Kami asks them if they are sure—or uses opportunities when two children arrive at a different total to get them to check. In Ms. Kami's classroom, counting is always directly linked to an authentic situation, such as daily routines and jobs like Counting Captain or Snack Chief. Ms. Kami knows that children will better understand and use one-to-one correspondence when the problems are real to them and they are truly motivated to get the "correct answer."

Order Irrelevance Principle

Math Snapshot

It's another morning in Ms. Kami's classroom, and time to count how many children are here. Ms. Kami says, "Today we will start with Asia. One child is here today . . ." but before Asia can sit down, Ayla speaks up. "Yesterday I was the one child, but today it's Asia. We won't get the right number if it's Asia."

The **order irrelevance principle** builds on the rule of stable order and further generalizes the idea behind one-to-one correspondence. It can be defined as *no matter in what order the items in a collection are counted, the result is the same.* Children who fully comprehend the meaning of counting realize that rearranging the group of objects does not affect the total. Unlike reading, in which we go from left to right, it does not really matter whether the counting procedure is carried out from left to right, from right to left, or from somewhere else, so long as every item in the collection is counted once and only once. Children who understand the order irrelevance principle also understand that the number words are applied only temporarily to the object being counted and have nothing to do with the objects themselves.

This principle reflects the reality that in the world around us, most collections we want to count are scattered every which way so that we need a system to mark which items have been counted and which have not. Common strategies include:

- As each item is counted, it is pushed into another pile.
- A mark is put next to the items that have been counted.
- With a very large collection, items might be sorted into clusters of 2s, 5s, or 10s—those friendly numbers that we can easily skip-count.

Children's mathematical understanding has to be at a certain stage of development before they themselves begin to use one of these strategies. However, just as it is valuable to have the number sequence in long-term rote memory before full number sense is established, it is important to have model strategies so they seem natural when the child knows to use them.

Thus, Ms. Kami purposefully does think-alouds when doing any of the many counting tasks that teachers are responsible for. When counting children during circle time, she purposefully starts from her left side one day, her right side on another day, and from a random point on a third day. When seeing a small collection of cubes on the table, she counts one by one and drops the cube into a basket. When counting up money for a field trip, she might say, "Children, will you thank your parents for me. Everyone sent in dollar bills instead of coins so I can easily count how much we have. I'm putting all the $5s together in this pile and that one is the $1s." Children standing nearby chime in as she puts the stack of bills in her hand and lays them down as she counts—first the $5s by fives and then the singles by ones.

The order irrelevance principle helps children develop flexible thinking skills. They gradually learn that there is more than one way to count a set of objects and there are many useful strategies that make counting scattered objects easier.

Cardinality Principle

Math Snapshot

Today there are no children absent. As a group, when they get to the last children to be counted, the class chants ". . . 15, 16, 17." Ms. Kami always follows up the process by asking, "So how many children are here today?" When the children respond "17" she knows they understand that the last word used in a counting sequence tells you how many are in the set.

As simple as it might seem, understanding cardinality actually involves two different uses of number: first, the child applies the numbers to the objects being counted, using the correct number sequence (stable order principle) and counting each item once and only once (one-to-one correspondence principle). Second, once the count has finished, the counter reuses the last number word she said during the count to name the total amount of the set. In this way, the final number name is different from the earlier ones in that it not only "names" the final object and signals the end of the count, but also tells you how many objects have been counted altogether.

When a child counts, there are a number of ways that we can find out whether the child has grasped the principle of cardinality:

- When asked, "How many altogether?" the child names the last number that was counted and does not need to count over again.
- The child can *count out* a specified number of items to create a set of given quantity. When asked, "Give me five from that pile of cubes," the child counts out five cubes and hands them over as a set.
- When given more items to add or subtract from a set, the child can *count on* or *count back*, instead of *counting all*. When told, "Sam had five toy cars and Nana gave him four more for his birthday, how many does he have now?" The child may need to count actual items of manipulatives but responds by saying, "So he had five and got six, seven, eight, nine—he had nine altogether."
- The child knows that the quantity remains the same despite of the fact that the arrangement of objects changes. For example, the child responds, "It is still five" when a linear array of five items is arranged in a circular pattern.

Once again, children whose primary experience in counting is "naked number" recitation of the number sequence are less likely to understand the cardinality principle and apply it to counting activities. Those who have experienced counting as an authentic and useful way to establish "how many" can make much more sense of number operations that call for joining, separating and comparing sets—the topics that will be explored more thoroughly in Chapter 4, Number Operations.

Implications for Teaching

In many ways, number sense and counting are so closely connected it seems they should be considered together. However, over the years the Early Math Collaborative has come to a deeper appreciation of how complex the concept of *number* is and how important it is to allow young children to construct their understanding as they move back and forth from concrete to pictorial to symbolic representations of number. Thus, we devoted one chapter to exploring how humans come hardwired with an intuitive sense of *numerosity* or quantity for very small amounts. We looked at the importance of nurturing and building on that instinct in early childhood classrooms: we need to offer the children many engaging and authentic experiences that use the natural capacity for subitizing so that the children develop visual number sense.

In this chapter, the focus has shifted to conventional words and symbols that are used to represent numbers and to answer the essential question of *How many?* that dominates so many aspects of our daily lives. Indeed, counting is one of the earliest mathematical abilities that young children develop. There is strong evidence that children's mastery of counting principles at the end of kindergarten predicts their level of arithmetic abilities in the primary grades. To help young children master the counting principles, we suggest several teaching strategies to keep in mind.

Develop Rational Counting Skills through Authentic Experiences

Full rational counting with a strong grasp of cardinality up to 10 is a process that takes usually two to three years to develop. For most children, rational counting starts to show up at the end of preschool or beginning of kindergarten. In kindergarten, many children master good number sense to about 20 or 25. Developmentally, most kindergarteners and even some first graders do not have a precise idea of "how many" numbers over 50 and 100 really represent. This has some serious implications for teaching. *Overemphasizing rote counting to high numbers before the counting principles are established for small numbers is counterproductive.* It can completely blind an adult to the fact that a child who can count to 100 may understand "how many" only in quantities under 20 or 10.

To help children develop a strong foundational understanding of counting rules, it is critical to start with small numbers through many authentic experiences and mathematical conversations. The daily routines in the classroom are a good place to explore counting. Whether it is taking attendance, making sure there are enough smocks in the art center, or seeing how many snacks there are, it is important to provide authentic opportunities for children to count. Table 3.1 is a list of activities that can be used to support the development of the four counting principles in young children.

Counting activities that include movement or other cues literally put the odd/even or the 5s and 10s structure of the number system into children's eyes, ears, and bodies and thus firmly fix them in long-term memory.

TABLE 3.1 Activities to Support the Counting Principles

Principle	Evidence/Skills	Activities and Routines
Stable Order	Fluency in counting using number *names* correctly first by 1s, then skip-counting by 2s, 5s, and 10s Knows number sequence forward and backward—can continue an "interrupted" count	• Counting songs and movement/games • Counting up and back from any number • Posting and referencing a 1–10 number line that uses dots plus numerals
One-to-One Correspondence	Coordinates saying one number word with one point to each object	• Daily routines such as in snack, passing out this or that, and lunch tickets • Music/movement games such as marching to a drumbeat • Board games with paths to move along by counting spaces
Order Irrelevance	Arranges and rearranges a collection to confirm count Groups objects for more efficient counting	• Starting counts of a fixed set such as taking attendance beginning with different children • Using think-alouds and modeling using a system such as lining up, clustering, counting by 2s, 5s, or 10s
Cardinality	Labels small sets by quantity (with or without counting) Counts out a given number Counts on (or back) from a given quantity	• Label the cardinal value of a set after counting (*1, 2, 3, 4 . . . 4 books)* • Routines that involve counting out a specified number such as snack (*4 crackers and 2 slices of cheese)*

Use Routines to Practice Counting

Math Snapshot

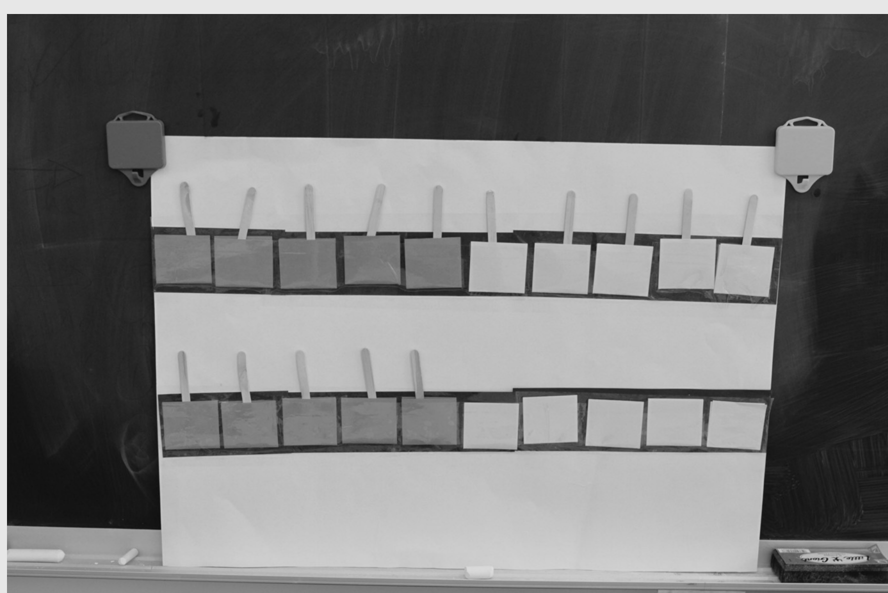
Shortly after the winter holiday break, Ms. Kami introduces a new attendance system. She has arranged 20 peel-and-stick library pockets in two lines on a poster board. Each line features five red pockets and five white pockets. In front of the poster, a can holds 17 wooden sticks, one for each child in the class.

Ms. Kami explains that when the children arrive each morning, they place one wooden stick in any pocket on the chart. At group time, she brings out the chart and the can, which has two sticks left in it, since Becca and Dagan are absent, and asks, "Does anybody have any ideas about how we can use our new chart to figure out how many children are here today?" A number of children have suggestions and Ms. Kami tries each one out with the group watching.

"Just count the pockets with sticks in them," Jane says. As Ms. Kami points, the children count to 15. "So how many children are here today?" Ms. Kami asks. Several respond "15" and Ms. Kami writes the number on the board.

"It would be easier to count if we put all the sticks in pockets next to each other and left the empty ones at the end," Danny says. Ms. Kami does that and the group again counts 15 sticks.

"I know it's 15 because there's 2 sticks left in the can," Chris shares, and Ms. Kami has him demonstrate. He pulls out the two sticks and counts up, "See, it's 15 up there and these sticks are 16 and 17. And 17 is all we have."



TEACHER TALK

Tammy, Kindergarten Teacher

I know the children are going to be expected to rote count to 100 before first grade, so we count every day. Sometimes we'll count from 1 to 100; other times I'll change things up by having us start at a number like 47 or 48 and then go up to 100 or down to 1.

I use an action count when the kids just need to shake their sillies out. One of their favorites is the Punch Right/Punch Left—that has the children punching with their right hand on odd numbers and punching left on the even. They love it.

This new attendance routine that Ms. Kami uses for her classroom helps children practice the rules of counting in a number of ways:

- There are 17 sticks in the can; each child has one stick and every pocket can hold one stick—a clear case of *one-to-one correspondence*.
- The attendance chart has 20 pockets broken into 4 sets of 5 to strengthen children's visual understanding of how many, or *cardinality*, using the sets of 5s and 10s.
- Children can put their sticks in any pocket, which reinforces *order irrelevance.* The arrangement of the pockets embeds the idea that there could be a system used—and when children have developed sufficient understanding, they will apply it on their own, as Danny does with his suggestion.
- Chris's suggestion that they count up from 15 (the number of children present) to 17 (the total number of children in the class) is another instance of *cardinality* understanding. Fifteen names *the set* of children who are present. Chris starts with 15 and counts on two more for the two absent children, rather than counting from one again.

In addition to helping children master the counting principles through daily exercise, Ms. Kami also uses the opportunity to illustrate multiple ways to reach the same result. Such experience is fun to participate in and encourages children to think mathematically and flexibly.

Highlight Number Pattern and Structure to Advance Rational Counting Skills

For many adults, reciting numbers and the alphabet seem equal accomplishments. In fact, when the sequence has been committed to memory, the two feats are equivalent. However, there is a significant difference between the alphabet and the number sequence when pattern and structure are considered. Compare how quickly you can say what comes before and after

- The letter *H*
- The number 25

If asked what comes four places before or after H or 25, the difference in retrieval time is considerably greater for H than for 25. Why is that? That's because starting the alphabet with ABC is a convention; if the Greeks had begun with their letter string with *chi*, *rho*, *zeta*, we probably would be learning our CRZs.

While the ABC sequence is arbitrary, numbers follow a well-defined and predictable pattern. Once we understand the structure, we can continue accurately counting up or down from any amount. As well, our number system is a base-10 system. Each time we get to the next 10, we begin the sequence 1, 2, 3, 4, 5, 6, 7, 8, 9 again. Knowing such a pattern, counting big numbers become so much easier. Also, there are “friendly”numbers such as 5 and 10, which are easy-to-remember landmarks in our number system. Maybe because we have five fingers on each hand and 10 fingers altogether, children learn to group and skip count by these “friendly” numbers first. Counting games and experiences that integrate the number structure and patterns, such as Ms. Kami’s attendance chart, not only help children with their counting skills but also advance their understanding of our number system.

The calendar routines that have become the staple of many preschool and Head Start classrooms are unfortunately not an activity conducive to children’s number sense and counting skill. In the first place, the 7-column, 5-row grid gets filled in a different way each month, since the day on which the month begins and the number of days is highly variable. Even if that is not the case, 7 is a very “unfriendly” number—most people find it very challenging to count by 7s; it is an unnatural break in the 0–9 sequence of digits and does not invite use of our natural counting tools, our fingers and hands. The base-10 structure of our number system is completely lost by the calendar format.

Furthermore, for young children, psychological time, which is much more important to them than clock or calendar time, doesn’t correspond at all to regular units like minutes, hours, days, weeks, or months. Though they may be able to rote recite or sing the days of the week and the months of the year, these units mean little if anything to young children. They are likely to feel they have to wait forever for their birthday next week; but if they are enjoying themselves, that same week seems to pass in no time at all. Children may know a song giving the days of the week, but be unable to answer or make sense of question such as “If your birthday is on a Tuesday, what day of the week is it before your birthday?”

The 10 to 20 minutes spent daily on calendar would be much more productive if teachers put the number structure and patterns into the children’s bodies by including counting games, songs, and movement activities.

There are some alternative ways to do calendar in preschool that do help children see how the number of days in a month grows. Some find that creating paper link chains, with a new link added each day is an effective and engaging visual picture of the increase. Such calendars reinforces the **plus-one** structure of the number system. School day links can be made with one color and home days with another.

Others have found creating a linear calendar is effective. Each month, the teacher puts up a long roll of paper marked from 1 to 28, 30, or 31. Anticipated events like birthdays, field trips, and holidays are written in balloons above the date. If something special happens on a given day, that event is also entered. Each day a marker such as a large clip is moved to the next date. At the end of the month, the class reviews all that has happened in the month, so that it becomes a kind of classroom timeline. Teachers using this method report children develop a much stronger sense of time because the linear strip gives them a visual measure of how long it will be to an anticipated event as well as a concrete sense of what happened in the immediate past and what happened longer ago.

Finding Great Math in Great Books

Every year a host of new counting books comes out. We can reference only a few here, so we have chosen ones that bring out the principles of counting.

- ***One Gorilla*** by A. Morozumi and ***Fish Eyes*** by Lois Ehlert are two great counting books that emphasize the plus-one structure of our number system. The illustrations increase children's engagement with these books. In addition, both name other attributes of the collections, helping underscore the idea that number is one of several possible attributes.
- ***One Duck Stuck*** by Phyllis Root and ***A Frog in the Bog*** by Karma Wilson are among some of the most appealing counting books that build a theme or story into the number sequence. In these books, children find it natural to use one-to-one correspondence to show how many are in each new set of creatures. The books also have delightful illustrations and rich language. There are a number of editions of counting songs that work in a similar way, including ***Over in the Meadow***, which is available in several beautifully illustrated editions, and ***This Jazz Man*** by Karen Ehrdhart, which uses the traditional chant *Knick, Knack, Paddy Whack* to celebrate African American musicians.
- ***Ten in the Bed*** by Penny Dale or ***Five Little Monkeys*** by Eileen Christelow, ***Ten, Nine, Eight*** by Molly Bang and ***10 Minutes till Bedtime*** by Peggy Rathman are additional delightful stories and songs that emphasize the idea of counting on or counting back.

Video Link

In the **Movement Counts** activity, the teacher first reminds children of the book *From Head to Toe* by Eric Carle that they have read together before. The teacher then leads a game with the whole class of children in which they move their bodies like the animals in the pictures of *From Head to Toe*. As you reflect on what the video indicates about counting, here are a few questions to consider:

1. What is the value of matching movements to counting words with one-to-one correspondence? What does such exercise do to English language learners?
2. Why is there a need to exaggerate each body movement in this activity?
3. Why is it important that teacher and children count aloud with one-to-one correspondence to the body movements?
4. What evidence do you see of children's understanding of the counting rules?