# What Children Need to Learn About Number

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When young children begin to repeat the counting sequence, saying, "one, two, three, four, five ...," parents and teachers are pleased. They are happy that the child is learning to count and encourage the child to count "higher and higher." But knowing how to say the counting sequence is not what is most important for children to learn. Counting is more than repeating the rote sequence and recognizing numerals. Counting is finding out "how many."

Learning to count is a complex task that requires children to integrate several ideas. It develops over a long period of time. We are often unaware of how complex the concept of counting is. Consider how different it is to learn to count compared to developing language in general. When acquiring language, children begin to observe and name the things around them. They learn "ball" and "milk" and "truck." They notice how these things look and feel. They learn "round" and "wet" and "red" because these words describe what they can see. Learning about number is not the same process. It requires children to think about their world in a different way. When they count, children must ignore the physical properties of what they are counting. Number can't be seen. Number is an idea.

In the beginning, as children focus on making sure they touch one counter for each counting word, they think of what they are counting as a series of one, and another one, and so on. From the child's perspective, they are labeling each counter rather than determining how many all together. Thus, the answer to "How many?" is whatever number they happen to land on when they finish pointing at each object. I refer to this stage as the "count and land" stage.

If children are to understand what it means to count, they must realize that the number they say when they count the last object in a group includes all the objects previously counted. A young child who is counting oranges but has not developed the idea of inclusion might respond to the command "Bring me three," by picking up the orange she was pointing at when she counted three. She is naming the "three" orange in the same way she labeled "book" or "chair." What she must learn is that "three" is not the name of a particular orange but includes the oranges labeled "one" and "two" as well. She must also recognize that it doesn't matter in which order she counts the oranges. The orange she labeled "three" could just as well have been labeled "one" or "two."

It is an achievement for children to count objects correctly and land on the right number. But that is not all the children need to learn. As children become more proficient with counting, they must move their attention from accurately landing at the right place to thinking about how many they have counted. Numbers will then begin to have meaning for them and they will be able to tell when their answer is reasonable or not reasonable.

### **The Critical Learning Phases**

There are certain concepts that must be in place in children's thinking to ensure they are not just imitating procedures or saying words they don't really understand. I have identified these milestones or hurdles in children's growth of understanding as Critical Learning Phases. The *Assessing Math Concepts* assessments can help you recognize which Critical Learning Phase describes where each of your students are in their development of number concepts. This in turn will help you identify the kinds of experiences and interactions the children need in order to continue their growth in mathematical understanding.

The Critical Learning Phases associated with these concepts are attained over a sustained period of time. We recognize that we cannot simply "get the students to perform" mathematical tasks but must be aware of their stage of development as guides to our teaching. Numerous and varied experiences are essential as your students progress towards understanding of each Critical Learning Phase.

#### **Understanding Counting**

#### THE CRITICAL LEARNING PHASES FOR COUNTING

- Counts one item for each number (one-to-one correspondence)
- Keeps track of an unorganized pile (counts every object once and only once)
- Notices when recounting a group results in a different number
- Is bothered when counting a group results in the same number after some have been added or taken away
- Spontaneously checks by recounting to see if the result is the same
- Knows "how many" after counting
- Counts out a particular quantity

Young children who are just discovering the idea of counting notice that people point to objects while they say number words. Children who are still not secure with the idea will say words faster or slower than they point, having noticed only that they must stop pointing and stop saying words at the same time. In this process they may skip or recount any object. It takes a while for children to recognize that one must say (or think) one word for each object. Children develop this skill gradually. A child who has developed one-to-one counting to eight or ten may not be able to apply this idea when working with larger numbers.

## Understanding One More/One Less

#### THE CRITICAL LEARNING PHASES FOR ONE MORE/ONE LESS

- Knows one more in sequence without counting
- Knows one less in sequence without counting
- Notices when a counting pattern doesn't make sense (Ex: after one is taken away, is bothered if the count begins with "4, 5, 6" instead of "4, 3, 2")

Determining how many there are when one is added or taken away is a harder challenge for young children than it might seem. They do not always trust that they will land on the same number every time they count and recount the same group of objects. If they are at that stage of thinking and one is added or taken away from a group of objects, they know of no other way to determine how many there are "now" except by counting the pile. As they develop an understanding of numbers, children eventually realize they will always land on the same number. It is only then (as long as they know the counting sequence) that they will be willing to say "how many" without counting when one is added or taken away.

They may know "how many" when one is added to or taken away from 3, but still not be confident that the result will be the same when one is added to or taken away as the numbers get larger.

#### **Understanding Parts of Numbers: Recognizing Small Groups**

#### THE CRITICAL LEARNING PHASES FOR RECOGNIZING SMALL GROUPS

• Recognizes groups of numbers to 5 in a variety of configurations

Learning parts of numbers is the foundation for acquiring basic addition and subtraction facts. For example, if a child knows the parts of 7, they know that 7 is made up of 4 and 3, and 2 and 5. This enables them to see that 4 + 3 is 7, or 7 - 5 is 2. Children typically begin to see parts of numbers in kindergarten and first grade. But before they can distinguish the parts, they must be able to recognize small groups of objects when presented independently. For example, they must to be able to look at a group of 4 and know it is 4, without counting, before they will be able to find that group of 4 in an arrangement of 7 as in shown with these dot cards.

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Recognizing small groups (called subitizing) requires children to learn to think of 3, for example, as a group and not as 1 and 1 and 1. Many children will be able to recognize a group of 2 much sooner than groups of 3 or more.

#### **Understanding Number Relationships: Changing Numbers**

#### THE CRITICAL LEARNING PHASES FOR CHANGING NUMBERS

- Changes a number to a larger number (by counting all, counting on, or adding on a group)
- Changes a number to a smaller number (by counting all and removing extras, counting back, or removing a group)

Numbers have meaning in relationship to other numbers. When you have 8 cookies, you have quite a few more than if you have only 2 cookies, but not that much more than if you have 6. When children are first learning about numbers, they don't see these relationships. They see each number as distinct from every other number: 6 is 6 and 9 is 9 and that is that. If they are asked to change a group of 6 into a group of 9, they remove the 6 and make a new pile of 9.

The ability to change one number to another is one of the first indications that children are beginning to move beyond looking at numbers as one and another one and another one, to seeing that one number is part of another number. This is a very challenging step for young children.

#### **Understanding Symbols**

It is not unusual for a child to have learned the names of the numerals before they have any idea what those squiggles are about, just as an adult can learn to say and write the symbols for " $e = mc^2$ " without any real understanding. But, naming a symbol without knowing the concept represented by that symbol is virtually useless. Clearly, numerals should not be dealt with in isolation but always in association with the quantity represented. The goal is for the symbols to trigger in the child's mind the visual images of what they stand for. Symbols come to have meaning when they are introduced as labels for quantities.