Notes for Single Ten-Frame Video

The instructional activities described here are part of the Patterning and Partitioning instructional sequence. They use the ten-frame as an organizing tool for numbers to 10. These activities follow naturally after the dot pattern activities that used dot patterns for numbers only up to 6. As noted in the discussion of dot patterns, most individuals and even some animals just recognize quantities of 4 and under when shown visually. When numbers get larger, such as 7 and beyond, some means of organizing the visual material is useful. We have chosen to use the single ten-frame for that purpose. Through these activities children will continue to build a strong conceptual foundation for numbers to 10.

These activities are intended for very early in grade 1, immediately following dot pattern activities. A suggested timeline is given at the end of these notes. First grade teachers often devote up to four weeks to these activities, combining them with other patterning activities. For example, a typical lesson might involve a few minutes devoted to finger patterns followed by single ten-frame flashing and ending with a ten-frame game. In kindergarten these activities can be used for a much longer time, again immediately following the dot pattern activities.

The instructional activities described here are:
- Single ten-frame flashing, which includes introducing the ten-frame and an accompanying scenario
- Ten-frame card games

The purposes of the single ten-frame are that children begin to develop:
- Spatial (i.e., visual) patterns for quantities up to ten using five-referenced and doubles-referenced patterns.
- A composite unit of five.
- Number relationships related to doubles and fives, i.e., 7 is 5 and 2 more; 6 is 3 and 3 more.
- Partitions of ten, i.e., if there are 3 missing and the quantity is 7, then 7+3=10

Single Ten-Frame Flashing

Introducing the Ten-Frame and the Scenario
We first describe a scenario to introduce the ten-frame. Farmer Earl has an apple orchard. He sells his apples at his farm stand. He brings the apples to his stand in crates that look like this.
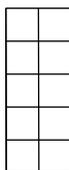
Farmer Earl puts one apple in each space of his crate. When it is full it looks like this.
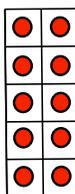
Why use a scenario? Scenarios play a key role in many of our inquiry math instructional activities. They are selected because of their potential to contribute to the overall instruction of the content at hand. In the case of the single ten-frame, the scenario of Earl's Farm Stand serves several important functions. Children can imagine acting within the scenario. This is a critical point because while the flashing approach described below is deliberately designed to promote mental imagery, the scenario provides a bridge between *actually acting* to create the pattern to *imagining acting*. Even though young children have never worked at a farm stand, they can imagine helping Farmer Earl at his stand. For example, they can imagine filling the crate. Or they can imagine removing apples from the crate as they sell them to a customer. In other situations the child can imagine moving an apple from one row (or column) to another. These imaginary actions in the realistic scenario of the farm stand form the basis from which actions on mathematical objects emerge. For the scenario to function in this way, it is important that the teacher takes the time to make the scenario seem real to the children. They need to buy into it as something they can imagine participating in. In this way the original real world scenario is crucial to the mathematical learning the instructional activities are designed to promote.

On a pragmatic level, the scenario makes it possible to pose a variety of question naturally. For example, when introducing the ten-frame and the scenario to students it is important to begin by asking students what they notice about the crate. Typically students say things such as, "When it's full there are ten apples." Or if they don't say that you can ask questions, such as:
- How many apples are in the crate when it's full?
- How many apples are there if only the first column is full?
- How many apples are there if only the second column is full?
- How many in each row?

The entire purpose of this discussion is to ensure that students are aware of how many in each column, how many in each row, how many when the crate is full.

Flashing Activity
In this activity the teacher flashes a ten-frame that contains chips that are arranged in a pattern. The children's task is to figure out how many there are. The visual material is shown briefly, say two to three seconds, and then removed from view for a short time, say five to six seconds. This process is repeated for up to three peeks. The class then engages in a discussion about how many apples are in the crate and how they figured it out. It is important to begin the discussion while the ten-frame is not visible. The purpose of flashing the pattern is to promote mental imagery. If the material is visible as the discussion begins

children might simply count the number of chips and the teacher will have no way of knowing anything about the mental imagery they are developing.

Example:
The teacher flashes the image shown here using the approach described above. The question is, "How many apples are there and how did you figure it out?"
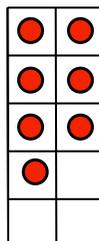
What do children do? Since this instructional activity is used very early in the first grade year there will be some children that need to count all of the dots by ones. In our experience, these children often do so by "pointing in the air." They begin to count the dots, pointing to them as they go, during the first peek, hold their finger in place until the second peek, continue on during that peek, and so on.

 If a child, Sam, counted all, we acknowledge that. However, one of the goals of this activity is to move children beyond counting to grouping strategies. Therefore we are not going to devote a lot of time to Sam's solution. We are not going to say, "Sam, how did you count them? Point to them. Show us which ones you counted first." We're not going to do any of that.

What might another child do that didn't count them all? Another child, Maria, counted by two's. "I saw two and two more makes four, and two more makes six and one more makes seven." This is another counting solution. It is more sophisticated than Sam's solution. So as the teacher you might say, "Maria said she knew that two and two more make four and two more make six and one more makes seven." But nevertheless, it is still a counting solution so we are not going to devote a lot of time to it. Instead, we are going to ask, "Who did it a different way?" or even better, "Who did it without counting?"

Now we might have a student, Joe, who says, "I saw four and three more and that makes seven." Joe might just know that four and three makes seven. Or he might have used his finger patterns to figure it out. It is useful to take time to discuss this solution since it is a non-counting solution. The purpose is get other children to think about this solution even though they might not have figured it out this way themselves. Since this is early in the school year so the teacher may have to be directing this discussion. For example, the teacher might say, "Who knows where Joe got a four and a three?" That question will open up the discussion. Someone will say where he or she thinks Joe saw the four and where Joe saw the three. A natural follow up to that would be, "Did anyone see the 4 and the 3 in a different way?" One child might have seen the four in the left column and the three in the right column and another might have seen the four on the top and the three below. Those

are different ways that we would expect because students have been working with dot patterns.

If a child says that he saw four and three but didn't say that it was seven, a natural question would be, "How did you know that four and three are seven?" It might be also appropriate to go back and ask Joe that question because even though he said four and three more is seven we don't know how he figured that out.

In the above discussion, we are making the assumption that the teacher has to be the one that directs the discussion. That is likely the case because this is early in the school year. However, if most of the students in the class had been in a kindergarten class that used an instructional approach like this, they would be more likely to participate in class discussions with less direct prompting. In that case, more open-ended questions such as "Who understands what Joe is talking about?" or even better, "What do you understand about what Joe is saying?" would be appropriate.

So far we have discussed solutions where a child, Sam, counted all, where another child, Maria, counted by two's, and Joe's solution, where he said, "4 and three more make 7." It is also possible that a child, Mya, might have a solution of a completely different type. Mya might say, "I know that 4 and 4 are 8 and this is one less so it has to be seven." This solution is what we call a thinking strategy solution so this is a very interesting one for the teacher to highlight. The teacher might ask, "What do you understand about what Mya is saying?" or, "Who else just knows that 4 and 4 make 8?" or "How did 4 and 4 make 8 help Mya figure out what four and three makes?" These questions would result in devoting considerable time in the class discussion to this type of productive solution.

In addition to the other learning goals of this task, including developing a composite unit of five and developing number relationships related to doubles and fives, an additional goal is to continue the emphasis begun in dot patterns that grouping is valued over counting. We remind the teacher that valuing grouping over counting is a deliberate choice that we have made. We know that children that use grouping strategies with small numbers continue to do so when they encounter larger numbers later on. On the other hand, children that persist with counting strategies with small numbers often continue to use them with larger numbers when such strategies are very inefficient and often lead to errors.

Which patterns to show. Our purpose for using the ten-frame is not simply to show any collection of dots and ask students to figure out the total. We have deliberately chosen to focus on five-referenced and doubles-referenced patterns because doing so contributes to children developing productive grouping strategies for numbers to 10. The pattern that we described in the previous example is doubles-referenced. We say that a pattern is doubles-referenced if it shown with equal numbers of chips in the two columns, if the number is even, and with one additional chip in one column if the number is odd.
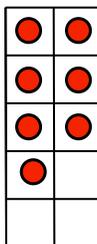
Doubles-referenced seven

Here is a different configuration for 7.
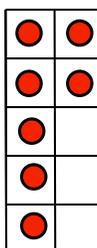
Five-referenced seven

This is a five-referenced 7. A pattern for a number is five-referenced if it shows the quantity by filling up a column of 5, if possible, with any remaining chips in the other column.

In addition to deciding which pattern format to use, another important decision the teacher has to make is which tasks to pose, including which tasks might productively follow one another. These decisions are typically part of lesson planning. Consider the learning opportunities that might occur if a doubles-referenced 7 is followed by a doubles-referenced 8.
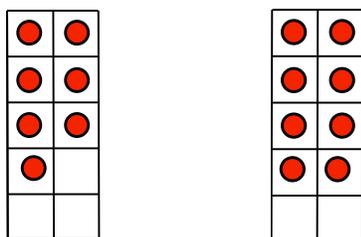
The discussion of the second task will surely include some child saying, "There's just one more than last time. So it's 8." Someone else will "see" it as 4 and 4 and just know that's 8. Someone else might note, "Last time it was 4 and 3 more and this time it's 4 and 4 more. So it 's 8." This combination of remarks provides the genesis of developing the +1 thinking strategy. The +1 thinking strategy is a way of reasoning that concludes that the sum of two numbers increases by one if one of the summands increases by one. In this sequence of tasks, the visual material is important to seeing the second as one more than the first. It is a particular example of a general way of reasoning that children will begin to develop through continued use of sequences such as this one. We want to clarify that we do not

intend that the ten-frame showing seven remains visible when flashing the ten-frame with eight. Here we show both for purposes of clarifying our discussion about the ways children might relate the two tasks.

In our work with teachers it is apparent that as they become experienced with using these tasks, it becomes easier for them to make adjustments based on what has just happened in the discussion. Thus, a teacher may abandon a task that she has planned as part of a sequence for a lesson based on the immediately preceding conversation. It may become apparent to her that another task would be very relevant and useful instead.

Finally, we repeat a comment we made in the discussion of dot patterns. Our intention is never that one lesson is devoted to a particular number, say 7, and another lesson is devoted to another number, say 9. Our goals go well beyond that children develop five-referenced and doubles-referenced patterns for numbers to 10. Our goals include that children develop a variety of number relationships and grouping strategies as well.

Variations of Flashing Activity
Here are two variations on the flashing activity. Flash a ten frame such as this one.
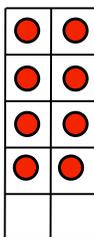
Ask:
- How many more apples does Farmer Earl need to fill the crate?

Or
- Farmer Earl's crate was full this morning. Now it looks like this. How many apples did he sell today?

These variations lead to a focus on the relationship between the number of apples in the crate and the number of empty spaces. In the resulting discussions, ten-referenced ways of seeing a number and partitions of ten emerge.

Additional Comments on the flashing activity. The quantities 1, 2 and 3 are so easily recognized that the ten-frame provides no organizing benefit. Therefore we recommend not showing these small quantities in the ten-frame flashing activity.
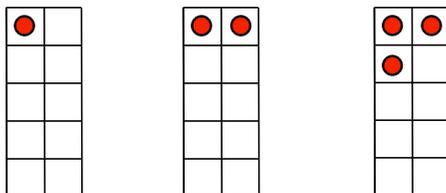
Quantities not to flash

As a further pragmatic point, we note that all of the chips should be of the same color. The purpose is to create a sense of unity, a single quantity that is itself comprised of individual units. As can be seen in the ten-frame shown below, the sense of a composite is lost when more than one color is used.
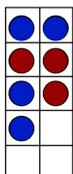

Further, our choice of using actual chips in the ten-frame in the flashing activity rather than pre-printed patterns is deliberate. During the discussions it is often useful for the teacher to move one or more chips on the frame to clarify or elaborate a child's remarks. This possibility is absent with pre-printed materials.

Ten-Frame Card Games

The games described here are intended for partner work following a whole class activity such as ten-frame flashing. They are predicated on the assumption that the class has been introduced to the single ten-frame. Many teachers plan a lesson to consist of a few minutes devoted to finger patterns, followed by ten-frame flashing, and ending with partner work in which children play one or more of the games. The games are ideal for two players but can also be played by three players.

All of these games use ten-frame cards. A template for the cards needed for these games is available on the website and is pictured below. The template includes both a five-referenced and a doubles-referenced pattern for each of the numbers 1 through 10.
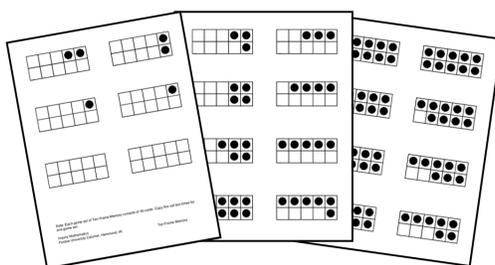

Template for Ten-Frame Cards

Two cards that show 0 are also included and can be used when desired or needed. Excluding the zero cards, the template includes 20 cards. For use in first grade we recommend using two copies of the template for one set of cards. Thus, one set will include 40 cards. To clarify, a set of ten-frame cards contains four cards of each number 1 through 10. Two of the cards show the five-referenced pattern for the number and two of the cards show the doubles-referenced pattern for the number. (If the zero cards are included one set of cards contains 44 cards.)

In the descriptions of the games we avoid saying how to decide who wins but rather indicate how to decide when the game is over. Throughout the inquiry approach an overarching theme is that students work together so that everyone can learn. They are not in competition with one another. Having said that, we are fully aware that some children will, nevertheless, talk about which partner won when playing these games.

Ten-Frame Memory (Concentration)
Players begin by laying down all of the cards, face down, preferably in some sort of pattern, e.g. in rows.
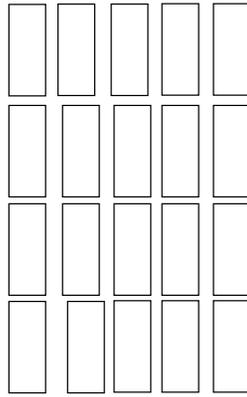
Players take turns. Play consists of tuning over two cards. If the cards are the same quantity, for example, if both of them have 4 dots, the player has a match, keeps the pair of cards, and takes another turn.
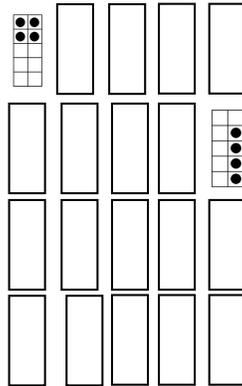
His turn continues until he turns over two cards that do not match, for example, as shown below.
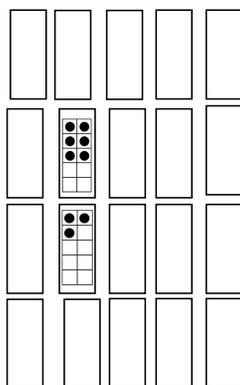
When the cards do not match, the player places them back down in the same location from which he picked them up. (This is an important aspect of the game because it makes it possible for each player to remember where the various cards are.) It is then the other player's turn. Play continues until no cards are left.

Since in one deck of cards every number appears twice in two formats, as a five-referenced quantity and as a doubles-referenced quantity, there are several possibilities for a match. For example, six appears twice as five and one and twice as three and three. When playing the game, players have a match when the quantity is the same. It is not required that the format be the same. This is an important aspect of the game because it means that a player needs to recognize or be able to figure out that a five-referenced six and a doubles-referenced six represent the same quantity.

As a pragmatic point, some teachers limit the number of cards to 20 when the game is first played (or 22 if the zero cards are included) to prevent students from becoming overwhelmed by the large number of cards. The task of laying out all of the cards face down to begin the game is itself a huge task for some students.

What do children do? This game is used early in the first grade year (or somewhat later in kindergarten) at a time when a number of children have not yet developed concepts of composite unit. Such children will (need to) count all of the dots by ones to figure out the total except for the cards showing 1, 2, 3 and possibly 4. As they play the game repeatedly over a number of lessons, the teacher will notice that these children gradually advance in the way they play. Eventually they no longer count all of the dots. For example, for a five-referenced pattern, they might begin to count on from 5. Other children are able to capitalize on noticing doubles within a pattern to figure out the amount. In general, children often use the same strategies to figure out the quantities when playing the game as they use in the ten-frame flashing activity especially if the teacher reminds the class to do so. The teacher might say, "Try to use your grouping strategies to figure out how many the pattern shows."

Top It (formerly also called War)
The purposes of the Top It game are similar to Ten-Frame Memory but also include providing opportunities to estimate quantities. Often players can tell which is larger simply

by noticing which card has more dots, without actually knowing the quantity each represents. Thus, this game is a natural way to promote informal estimation.

This game uses the Ten-Frame game cards. In this version of the game, the cards are dealt equally to the players. Each player keeps his cards face down in a stack. A turn consists of each player simultaneously turning over the top card in his or her stack. The person with the larger quantity gets both cards and places them face down at the bottom of his stack. If the cards show the same quantity, the players each lay down another card. The person with the larger quantity now gets all of the cards. Play continues until one player has no cards remaining. (By placing the cards they get on a turn face down at the bottom of his stack neither player ever runs out of cards and the game continues until the teacher indicates the time is up.)

In a variation of Top It, players simultaneously turn over the top two cards in their stack. This variation is appropriate for students for whom the original game no longer provides any learning.

Make Ten Game
In this variation of Ten-Frame Memory, a player has a match when the two cards turned over total to 10. In this variation the set of cards should include the zero cards. These are needed to create a match with the cards showing the number 10. One function this game serves is that it uses the same deck of cards as Ten-Frame Memory but for a different purpose. Therefore, the teacher can have children who are at different cognitive levels play two different games but use the same materials. For example, if the class is playing Ten-Frame Memory and the teacher observes one group that already recognizes all of the number patterns (and therefore is no longer learning anything new from playing the game), she can suggest that they switch the game so that they have a match when the two cards turned over total 10. This switch is easy and natural and does not create obvious differences in what the various children are doing. The purpose of this game is to provide an opportunity to develop partitions of ten based on number patterns.

Our experience with the Make Ten game is that it is not productive for children to play the game if they do not already recognize (most of) the number patterns. Such children can be effective in playing the game simply by counting the empty spaces on a card and identifying matches in that way. Thus, they can play successfully without engaging in the cognitive activity that promotes thinking about the two quantities that comprise ten, the expressed purpose of the game. Some teachers require that at each turn the child "say" the quantity on each card out loud to his or her partner to ensure that he or she is aware of what the quantities are.

Variations on the games
The games described here can be played using a set of cards that is comprised of one ten-frame card and one numeral card for each number to 10. For example, in the Ten-Frame Memory game using such a set of cards, a match consists of one ten-frame card and the corresponding numeral card. This variation is especially appropriate for children that are still learning to associate a quantity with its numerical symbol. In our experience many

teachers report that using a mixed set of cards of this type is also very useful for the Make Ten game after children have played it several times using only ten-frame cards. Doing so brings specific attention to the number combinations that make ten.

Teachers we have worked with have been creative in using mixed sets of cards. For example, one approach is to place the ten-frame cards face down in one group and the numeral cards face down in another group. The child's turn then consists of turning over one card in each group to see if they match.

Ten-frame cards   Numeral cards
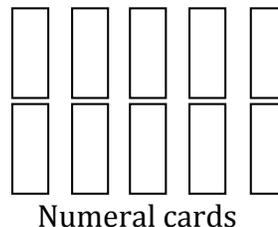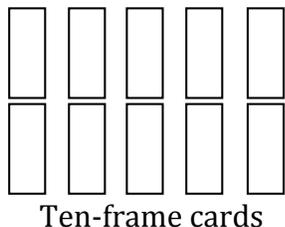
Who to pair together? It is very important to pair together children of like cognitive ability. The rationale is that if you pair a child that has already developed a number of sophisticated concepts with a child whose concepts are much less sophisticated, the more sophisticated child will tell the other what to do. In that case, the other child is not learning anything so it is not a productive learning experience for him.

Timeline

SUGGESTED TIMELINE FOR FIRST 6 WEEKS OF GRADE 1

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
PATTERNING						
Finger Patterns	-----------	-----------	------- --- ---	--- --- --- --- ---	-- -- --	-- -- --
Dot Patterns		-------------				
Single Ten-Frame			-----------	-----------	-----------	-----------
PARTITIONING						
Monkeys in the Trees					--- ---	---
Double Decker Bus						-- --
All the ways						-- --
ADDITIONAL ACTIVITIES						
Hidden Objects			--- --- ---	--- --- ---	--- --- --- ---	
Single Bus				--- --- --- ---	--- --- --- --- ---	--- --- --- --- ---
Doubles		--- --- --- ---	--- --- --- ---			
Money					--- --- --- ---	--- --- --- ---

As the timeline shows, these activities are intended for very early in grade 1, immediately following dot pattern activities. First grade teachers often devote up to four weeks to these activities, combining them with other patterning activities. For example, a typical lesson might involve a few minutes devoted to finger patterns followed by single ten-frame flashing and ending with a ten-frame game. In kindergarten these activities can be used for a much longer time, again immediately following the dot pattern activities.

Please note that while the timeline is shown for the first six weeks of grade 1, many teachers extend the time to nine weeks by using these activities only four days a week and reserving the fifth day for other important mathematical content such as, counting forward and backward by ones, twos, fives, and tens, and the important area of geometry.