

Ten-Frames – A Games Approach to Number Sense

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How can you help young children develop number sense? Let's *frame* the question this way: How can you help students visualize numbers in a way that is compatible with our base-ten number system?

Answer: Use *ten-frames*. Ten-frames are rectangles divided into a grid with two columns of five with dots filling in some or all of the ten spaces.

How are ten-frames helpful in developing number sense? Research shows that children and adults have an innate ability to subitize, to instantaneously recognize the number of objects in a small group. Two-year-olds can confidently identify one, two or three objects before they can actually count with understanding; 4-year olds can see five objects (this may be close to the maximum for most adults). Subitizing is based on the mind's ability to form mental images of patterns and associate them with a number (think dice and dominoes). Unlike most other patterns of objects, ten-frames are designed to help the mind organize numbers into chunks of five and ten to match our base ten-number system. For example, the most "efficient" way of seeing 7 with a ten-frame card is one column of 5 dots and another of 2 dots equivalent to thinking of 7 as $5 + 2$.

Another very important potential benefit of using ten-frames is that they promote composing and decomposing of numbers. Decomposing numbers in relation to ten is very important in developing base-ten compatible addition and subtraction strategies. When you see the number 9 in a ten-frame as one dot shy of 10, you can think about taking one dot from another ten-frame (for example a 5) and filling in the space to make the 9 into a 10, leaving 4 on the 5 card. This is the "make a ten" strategy and transforms $9 + 5$ into the easier base-ten friendly equation $10 + 4$. Students who can see how this works and can later use this in their thinking as they work with numbers have developed a very important strategy.

Be sure to encourage students to talk about their mathematical thinking in order to bring the strategy to a conscious level. When children listen to others explaining their strategies, it may spark some new thinking and help them move along the continuum to more efficient strategies. Listening to students as they think out loud also provides a real-time formative assessment that you can use to adjust your questions and instruction.

To introduce students to ten-frames, begin by showing them small numbers of dots (perhaps using stickers on a page). Arrange some of the dots in a familiar pattern (like dice) and others just randomly. Have them talk about how easy or how difficult it is to see how many there are in each group of dots without counting (to make counting impossible you need to quickly flash the dot groups). Then show them ten-frame cards and have them talk about how many dots they see and how they see them.

Class routines: Have several sets of ten-frame cards in a container and use them as a way to decide who goes first in an activity (decide first whether largest or smallest number wins). Or pass them out as a way to form groups (all the 4's in one group, all the 6's in another, etc.). Use them as a quick quiz when lining up; show the ten-frame and the student quickly says how many and then gets in line. Keep the container of ten-frames nearby when your class is gathered and you'll think of other fun ways to incorporate them into your routines.

Introducing double-ten frames: When your class can consistently recognize single ten-frame cards quickly, change to "double ten-frames." These feature the numbers from 10 to 20, a set of numbers that is often confusing to young students. Hold these double-ten frames so that the full-ten is on the left and the partial ten is on the right to mimic the way we write double-digit numbers and to provide a subtle introduction to place value. Just as you introduced single ten-frames, use class routines to introduce double-tens.

Once students have been introduced to single and double ten-frames, it's time to use them in games that help develop computation strategies.

Games using ten-frames:

Who Has More?

This is the traditional game (a.k.a. War) where each player turns over the top card from his own pile, says how many (should be instantaneous recognition not by counting), and the player with the largest card wins all the cards. In this version with ten-frames, it is important that students be required to say how many they have not just look and see which card has more dots. In the event of ties, everyone turns over an additional card and the winner takes both sets of cards.

Math focus: *Number recognition, relative number value, and the concepts of greater than and less than.*

Assessment note: *Use to diagnose counting strategies a child uses in this developmental order: counting all, counting on, adding zero, skip counting.*

Adaptation – make it easier: *Use only the low value cards and gradually add in the larger value. The object is to INSTANTLY recognize the number, not count.*

Adaptation – make it harder: *The winner must state how much larger his number is than the other number. For example, with an 8 and a 5, the winner must say “8 is 3 more than 5.”*

Terrific Tens:

Each player removes the full ten-frame card and places it face up in front of him. This “10” card becomes one of the addends in each face off. Players mix their remaining cards and then turn over the top card of their deck. Add the card to the ten and say the addition problem, e.g. “10 + 4 is 14.” The player with the greatest sum wins all of the non-ten cards. All players retain their original “10” card for the next face off.

Math focus: *Understanding that when adding ten to a single digit number, the sum is a “teen” with the single digit number in the ones’ place. Great demonstration of the meaning of the numbers 10-20 and how they are portrayed in our base-ten system. Students can be encouraged to “see” the full-ten card as a giant one in the tens’ place.*

Adaptation – make it harder: *Play Tremendous Twenties or Titanic Thirties by dealing two (or three) full-ten frames to each player and then dealing one partial-ten. Students will see the pattern when playing the twenty or thirty game and it's not necessary to try to play Fabulous Forties or Fantastic Fifties.*

Nifty Nines, Fantastic Fives, Excellent Eights:

Played like Terrific Tens except that each player removes a “9”, “8” or “5” card from the deck to use as an addend for each face off. This is an excellent way for children to practice addition facts using a visual model. Encourage thinking and visual strategies rather than counting strategies. Have her explain how she knows her answer. For example, for $8 + 4$ a child might say “The eight has two empty spaces to make a ten, so two of the dots from the four could slide over and fill up the ten and then it would be $10 + 2$ which is 12.” Suggested order of difficulty for this game: 9, 1, 2, 8, 7, 3, 6, 4

Math focus: *Composing and decomposing numbers around ten to easily add using the make-a-ten strategy.*

Adaptation – make it easier: *Be sure a student is successful at Terrific Tens before playing this variation. The easier beginning addend cards are 9, 1, 2, and 8 in that order.*

Adaptation – make it harder: *Use the more difficult addends: 7, 3, 6, 4*

Make-a-Ten Solitaire.

Mix the deck (some full-tens and all the partial-ten frame cards) and turn five cards face up. Remove any two cards which have a sum of 10. Replace any cards which are removed with new cards, face up. Again remove combinations of ten. Continue until you have no cards left in the deck or no sums of ten can be made. When you get stuck, turn over cards singly from the deck and make pairs equaling ten with the cards on the table. If the total sum of all the cards you removed is greater than 100, you win. If all cards are used up and none remain face up, you made a slam dunk!

Math focus: *Learning the “combos of ten,” a precursor to composing and decomposing numbers around ten (important addition and subtraction strategy). When tallying up the cards at the end to see if you exceed 100, learning to keep the combos of ten together and count by 10's..*

Adaptation – make it easier: *Deal out ten cards face up and fill in spaces, keeping ten cards available at all times. Skip the counting of pairs by ten and just count cards to get your score.*

Make-a-Ten (for 2-4 players):

This game is played like “Go Fish”. Use a deck with full and partial ten-frames. Each player needs to make pairs that add up to 10 (0+10, 1+9, 2+8, etc.). If a player has any such pairs, she lays them down in front of her. On her turn she asks another player for a card. For example, if she has a 3 in her hand, she would want to ask for a 7. If the player she asks, has the card, he must give it to her. If not, she draws a card from the deck. It is then the next player’s turn. The object is to make as many pairs as possible. The game is over when the last card is taken from the deck. Tip: Have cardboard barriers available for students to spread out their cards behind instead of holding them in their hands.

Math focus: *Practice combos of ten facts. Work with missing addends (and see the connection to subtraction) when asking other players for cards.*

Adaptation – make it easier: *Two players is easier.*

Adaptation – make it harder: *Keep all cards hidden until you can go out. Double points if you have collected a full set of the combos (5 different sets).*

So what are you waiting for? Make up some sets of ten-frames and start playing your way to increased number sense. Blacklines for number frames can be found at <http://steps.oregonstate.edu/settingup>