Strategies for Learning the Addition Combinations

To develop efficient computation strategies, students need to become fluent with the addition combinations from 1 + 1 to 10 + 10. Fluency means that combinations are quickly accessible mentally, either because they are immediately known or because the calculation that is used is so effortless as to be essentially automatic (in the way that some adults quickly derive one combination from another—for example, thinking 8 + 9 = 8 + 10 – 1). In *Investigations* students will be fluent with all of the addition combinations to 10 + 10 by the end of Grade 2.

Why Do We Call Them Combinations?

The addition problems from 1 + 1 through 10 + 10 are traditionally referred to as "addition facts"—those combinations with which students are expected to be fluent. The *Investigations* curriculum follows the National Council of Teachers of Mathematics (NCTM) convention of calling these expressions *combinations* rather than *facts*. *Investigations* does this for two reasons. First, naming *only* particular addition and multiplication combinations as *facts* seems to give them elevated status and make them more important than other critical parts of mathematics.

Second, the word *fact* implies that something cannot be learned through reasoning. For example, it is a fact that the first president of the United States was George Washington, and it is a fact that Rosa Parks was born in Alabama in 1913. If these facts are important for us to know, we can remember them or use reference materials to look them up. However, the sum of the 7 + 8 can be determined in many ways; it is logically connected to our system of numbers and operations. If we forget the sum but understand what addition is and know some related combinations, we can find the sum through reasoning. For example, if we know that 7 + 7 = 14, we can add 1 more to get 15. If we know that 8 + 8 = 16, we can take one away and get 15. If we know that 7 + 3 = 10, we can then add the 5 that's left to get 15 (7 + 8 = 7 + 3 + 5 = 15).

The term *facts* conveys a meaning that is generally understood by some students and family members, so you might decide to use the term *facts* along with *combinations* in certain settings in order to make your meaning clear.

Learning the Addition Combinations Fluently

The *Investigations* curriculum, like NCTM, supports the importance of students' learning the basic combinations fluently through a focus on reasoning about number relationships: "Fluency with whole-number computation depends, in large part, on fluency with basic number combinations—the single-digit addition and multiplication pairs and their counterparts for subtraction and division. Fluency with basic number combinations develops from well-understood meanings for the four operations and from a focus on thinking strategies. . . ." [*Principles and Standards for School Mathematics,* pages 152–153].

In other words, students learn these combinations best by using strategies, not simply by rote memorization. Relying on memory alone is not sufficient, as many of us know from our own schooling. If you forget—as we all do at times—you are left with nothing. If, on the other hand, your learning is based on understanding of numbers and their relationships, you have a way to rethink and restructure your knowledge when you do not remember something.

Learning in Groups

Second graders will learn these combinations in groups (e.g., combinations that make 10; Plus 1, 2, or 10 Combinations; Doubles and Near Doubles) that help them learn effective strategies for finding solutions. Fluency develops through frequent and repeated use; therefore, as students work on a particular category of combinations, they play games and engage in activities that focus on those combinations. For example, in this unit, students review the combinations that make 10 by playing *Make 10* and

Tens Go Fish, and by doing *Today's Number* for 10, or for other numbers, *using* combinations of 10.

Second graders will also be using Addition Cards to think about combinations they know and to practice those that they do not yet know. Over the course of the year, students get a set of Addition Cards for each category of combinations and sort them into two envelopes: Combinations I Know and Combinations I Am Still Working On. In Session 3.5 and beyond, students write clues that help them remember the combinations they find difficult.

Knowledge of the addition combinations should be judged by fluency in use, not necessarily by instantaneous recall. Through repeated use and familiarity, students will come to know most of the addition combinations quickly and a few others by using some quick and comfortable strategy that is based on reasoning about the numbers.

Categories of Addition Combinations

What follows is a list of the categories of combinations, sorted by the unit in which students are expected to achieve fluency with them. Note that some combinations fall into more than one category. For example, $1 + 9$ and $9 + 1$ is a Make 10 Combination and a Plus 1 Combination.

Counting, Coins, and Combinations

Plus 1 and Plus 2 Combinations Many children leave first grade fluent with the combinations that involve adding 1 or 2 to any single-digit number (e.g., $8 + 1$ and $7 + 2$). As your second graders come to understand that addition is commutative, they will become fluent with the reverse of those problems (e.g., $1 + 8$ and $2 + 7$).

Combinations that Make 10 These two-addend combinations of 10 were a benchmark at the end of Grade 1 and are reviewed in this unit.

Shapes, Blocks, and Symmetry

Doubles By the end of Grade 1, many children know their Doubles Combinations up to $5 + 5$. *Counting, Coins, and Combinations* introduces these combinations up to $10 + 10$. Students practice and become fluent with these combinations in *Shapes, Blocks, and Symmetry.*

Stickers, Number Strings, and Story Problems

Near Doubles (Or, Doubles Plus or Minus 1) Students learn these combinations—those that are one more or one less than the doubles—by relating them to the Doubles.

Pockets, Teeth, and Favorite Things

Plus 10 Combinations As students work on ideas in place value, they learn the Plus 10 Combinations—all of the single-digit numbers (and 10) plus 10.

Partners, Teams, and Paper Clips

Plus 9 Combinations Students learn these combinations —all of the single-digit numbers (and 10), plus 9—by relating them to the Plus 10 Combinations.

Remaining Combinations Eight combinations remain.

$3 + 5$ and $5 + 3$	$4 + 7$ and $7 + 4$
$3 + 6$ and $6 + 3$	$4 + 8$ and $8 + 4$
$3 + 8$ and $8 + 3$	$5 + 7$ and $7 + 5$
$5 + 8$ and $8 + 5$	$6 + 8$ and $8 + 6$

For students who are fluent with Doubles Plus or Minus 1, several are Doubles Plus or Minus 2. For students who are fluent with their Combinations that Make 10, and with breaking apart numbers, most problems can be solved quickly ($7 + 5 \rightarrow 7 + 3 + 2$). Similarly, students can use their knowledge of Combinations that Make 10 to solve Near 10 Combinations ($6 + 3$, $7 + 4$, $8 + 3$).

Students should review the addition combinations that they have mastered throughout the year to maintain fluency.