Mathematical Representations for Addition and Subtraction

As students work on addition and subtraction, it is important for them to develop visual images of these operations to help them make sense of problems, solve them, and represent the strategies they use. Students may develop their own images as they work on addition and subtraction. However, throughout the *Investigations* curriculum, they are also introduced to specific representations, which they are encouraged to use as they solve problems.

In earlier grades, students used a variety of manipulatives and representations to make sense of numbers and operations. In this unit, use of the following math tools and representations is continued from earlier grades:

- interlocking cubes (stored in towers of 10 for ease of use and counting out how many are needed, and to reinforce the concept of 10 as the basis of our number system)
- 100 Chart
- 300 Chart
- 1,000 Chart
- sets of coins and dollars
- number line
- place value model: stickers as "singles" (units), "strips" (tens), and "sheets" (hundreds)

Two of these models are extended in this unit: the place value model and the number line.

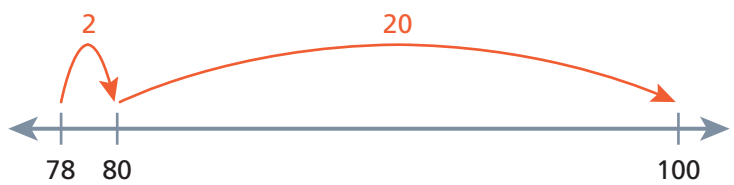
The Place Value Model

In Grade 2 and Grade 3, students work with a place value activity called "Sticker Station." In this context, people buy stickers that come in singles, strips of 10, and sheets of 100 from the Sticker Station. Students represent 2- and 3-digit numbers with stickers ("Show the number 137 with stickers"). They come to see the equivalence of different combinations of 100s, 10s, and 1s for the same number. For example, 137 can be composed from 1 hundred, 3 tens, and 7 ones; 1 hundred, 2 tens, and 17 ones; 13 tens and 7 ones; and so on. This place value model highlights the structure of numbers in our base-10 number system.

As students solve addition and subtraction problems, they use this model to consider what happens when multiples of 10 are added to or subtracted from numbers. They also use this model to break numbers apart by place as they solve multi-digit addition and subtraction problems.

Number Line

In Grades K–4, a physical number line that extends from –20 to 120 is displayed in the classroom. In this unit, students' work with number lines is expanded to include unmarked number lines—number lines that show only those numbers relevant to a problem. Students use this representation to solve problems and represent strategies. As they add or subtract quantities by groups or chunks, as well as by ones, moves are shown with curved lines and arrows as jumps on the number line. For example, for the problem 78 + ____ = 100, one student showed her work as follows:



Number lines are useful tools in helping students visualize addition and subtraction situations. For example, when adding two numbers, students can start at one number and visualize adding the second number in one or more jumps on a number line. Students can visualize any subtraction problem as jumping back on a number line by the amount being subtracted or as finding the distance between two numbers on a line.

By providing images of the size and composition of numbers, as well as the action of an operation, place value models and number lines help students develop images of what is happening in problems and think about ways to solve them. They highlight important aspects of our number system and number relationships. Therefore, using these representations helps students develop efficient problem solving strategies based on their understanding of our number system.

Third-graders can be expected to use math tools both to solve problems and to represent their thinking. Once students have become comfortable with a math tool or representation, they can begin to use it as a reference point. For example, when a student needs help solving a problem, you may ask him or her to "imagine what this problem would look like on a number line." Over time, students internalize these tools and representations as visual images that they can refer to as they think through a problem.