# Math Background

Concept Building

Place Value Drawings

Students represent 3-digit numbers with drawings that show hundreds, tens, and ones. To start, students make drawings on the dot arrays on their MathBoards. They show ones by circling individual dots, tens by drawing lines through groups of ten dots, and hundreds by drawing squares around groups of 100 dots. *Math Expressions* uses the terms *ones, ten-sticks,* and *hundred-boxes* to describe the three representations.

Dot Drawing of 178

1 hundred-box   7 ten-sticks   8 ones

Place Value Drawing of 178


1 hundred-box   7 ten-sticks   8 ones

Students soon move on to free-hand drawings, making squares for hundreds, lines for tens, and circles for ones. Students group ten-sticks and circles in subgroups of five to avoid errors and to make their drawings easier to read. These drawings are used to visually illustrate the grouping process in addition and the ungrouping process in subtraction.

Students choose to use any method they understand and can explain. Some enjoy using several methods, while others concentrate on one method. The most important part of the learning process is to link each step of a proof drawing to each step of a numerical method. This gives meaning to the numerical method and helps students self-correct later on. Students then begin to do only the numerical method but they can think of a drawing to self-correct. Occasionally, it is helpful for students to make a proof drawing to explain their numerical method to someone else and to keep the meanings attached to the numerical method.
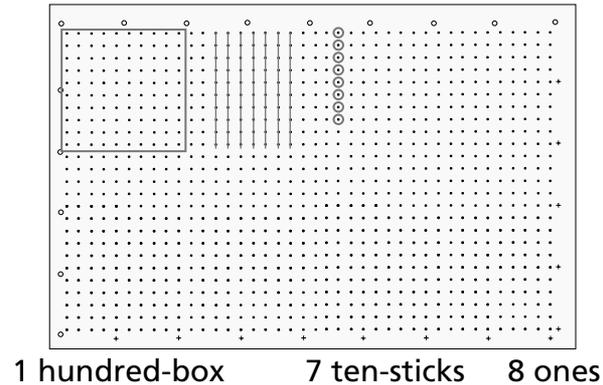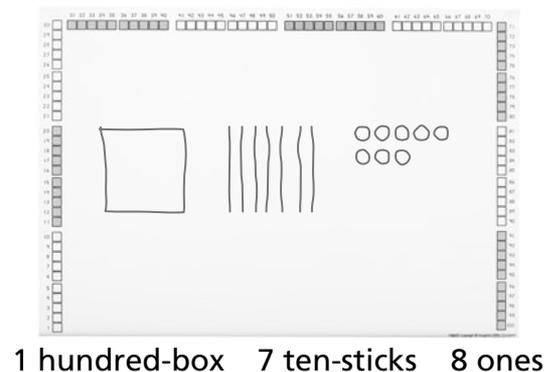
Alternative Accessible Algorithms for Multi-Digit Addition and Subtraction

Addition: New Groups Below Method

Students record a regrouped digit on the line below the addition example, instead of above them.

the new hundred
the new ten
the new thousand

$$\begin{array}{r} 728 \\ +\ 596 \\ \hline 1\ 1\ 1 \\ \hline 1,324 \end{array}$$

Addition: Show All Totals Method

Students add in each place, record the total for each place, then add these totals to find the sum.

the new thousand
the new hundred
the new ten

$$\begin{array}{r} 728 \\ +\ 596 \\ \hline 1,200 \\ 110 \\ 14 \\ \hline 1,324 \end{array}$$

Subtraction: Ungroup First

Students draw a "magnifying glass" around the top number to see which places need to be ungrouped. After ungrouping, they subtract in any direction. Students make proof drawings with boxes, sticks, and circles to show ungrouping.

15
0 16 13
1̶6̶3̶
$-\ 75$
88

Place value drawing of 163
1 hundred + 6 tens + 3 ones   Drawing ungrouped to subtract   Cross out 75. There are 88 left.

Subtraction: Expanded Method

Students write each number in expanded form. They ungroup as needed to subtract. They subtract in each place. Then they add the differences.

$$\begin{array}{r} 163 = \overset{0}{\cancel{100}} + \overset{150}{\cancel{60}} + \overset{13}{\cancel{3}} \\ -75\ -\quad \underline{70 + 5} \\ 80 + 8 = 88 \end{array}$$