# Place Value in First Grade

Understanding the place value structure of our base-ten number system, and how it applies to and supports number composition and computation, is a central piece of work in the number and operations strand of the *Investigations* curriculum. The base-ten number system is a "place value" system. That is, any numeral, say 2, can represent different values, depending on where it appears in a written number: it can represent 2 ones, 2 tens, 2 hundreds, 2 thousands, and so forth. Understanding our place value system requires coordinating the way we write numbers —e.g., 217—and the way we name numbers in words—two hundred seventeen—with how the value of each place represents quantities.

In order to successfully work with place value, students need to know that one ten is equal to ten ones, and be able to coordinate groups of tens and ones. Consider for example the number 32. One aspect of understanding the value of each place in this number is knowing that the 3 represents 3 groups of ten, the 2 represents 2 ones, and this can be expressed as $30 + 2$. It is also important for students to understand 32 as 2 groups of ten and 12 ones ($20 + 12$). The compactness of the Base 10 system is what makes it powerful, but that very compactness means it is dense with ideas which young students must put together.

Kindergarteners count and develop fluency with ones, use Ten Frames to reinforce the foundational idea that ten ones can also be thought of as a *group* of ten ones, and explore the two addend combinations of 10. These are precursors to work with place value. Similarly, representing teen numbers on Ten Frames, seeing them as ten ones and some leftover number of ones, and using equations (e.g., $15 = 10 + 5$) to represent this information helps students notice important regularities in these numbers and the way we write them (i.e., the 1 in 15 refers to the group of ten and the 5 refers to the number of leftover ones).

In Grade 1, students make a critical shift from thinking and working primarily in ones, to thinking and working with *groups* of tens and ones. They develop an understanding that ten ones is equivalent to one ten. It is this 10:1 relationship that forms the foundation for understanding the base-ten number system. In grade 2 and beyond, students *apply* this 10:1 relationship as they work with multi-digit numbers (e.g., 10 tens is 1 hundred, 10 hundreds is 1 thousand, etc.), and as they work with decimal numbers (e.g., ten tenths is 1, 10 hundredths is one tenth, etc.).

First grade students strengthen their understanding of this critical 10:1 relationship as they work with contexts and models (e.g., fingers, Ten Frame cards, connecting cubes organized into towers of ten) that represent groups of tens and ones. The purpose of these models is to help students build mental images that they can then use in visualizing, representing, and solving problems. While no one model is a perfect match for every idea, it is helpful to have a range of examples to use and compare. With these models in mind, students can represent 2-digit quantities and more easily discuss how 15 and 51 are different as they begin to understand that numbers have different values depending on their place and that the way we write, read, and say 2-digit numbers is connected to the number of tens and ones. They can also discuss what happens to a number when 10 is added or subtracted, looking at both how the digit in the tens place changes (increases/decreases by 1), and how the value of the number changes (increases/ decreases by 10).

First graders also use these place value models to represent addition and subtraction of 2-digit numbers. In doing so they not only connect the model to notation but they also use the model to explain their thinking. Students use these models to represent two 2-digit numbers as tens and ones and add the quantities by combining tens with tens and ones with ones. This place value strategy for addition relies on decomposing numbers by place and using such decompositions to calculate. Because almost all efficient computation strategies for numbers greater than 10 make use of the base-ten structure of numbers, using these skills and strategies with understanding influences the development of computational fluency with whole-numbers for all four operations in later grades.

While first grade students vary in their understanding of and facility with the ideas and relationships that underlie place value and the base-ten number system, it is essential that they be allowed the time and opportunity to repeatedly grapple with, use, and discuss these ideas over time. The first grade curriculum provides games, activities, and discussions that support the development of these critical ideas over the course of the year, laying the foundation for future work with number and operations in elementary school.