Teacher Note

Place Value

The base-ten number system is a place-value system; that is, any numeral can represent different values, depending on where it appears in a written number: 2 can represent 2 ones, 2 tens, 2 hundreds, 2 thousands, and so on. Understanding our place-value system requires coordinating the way we write the numerals that represent a particular number (e.g., 5,217) and the way we name numbers in words (e.g., five thousand, two hundred seventeen) with how those symbols represent quantities. See **Part 6: Teacher Notes for the *Investigations* Curriculum** in *Implementing Investigations in Grade 4:* Computational Fluency and Place Value. In Grade 3, students learned to use and understand numbers in the 100s and into the 1,000s. In this unit, students in Grade 4 revisit their work on 1,000s and expand their work up to 10,000.

The Base-Ten Number System

In Grade 4, students review ways in which 1,000 can be composed and then focus on how numbers up to 10,000 are composed. The heart of this work is relating the written numerals to the quantity. Being able to do this is not simply a matter of saying that "5,217 has 5 thousands, 2 hundreds, 1 ten, and 7 ones," which we know students can easily learn to do without attaching meaning to the quantity these numerals represent. Students must learn to visualize how 5,217 is built up from 1,000s, 100s, 10s, and 1s, in a way that helps them relate its value to other quantities. Understanding the place value of a number such as 5,217 entails knowing that 5,217 is closer to 5,000 than to 6,000; that it is 1,000 more than 4,217; that it is 100 more than 5,117; that it is 17 more than 5,200; that it is 3 less than 5,220; and that it can be decomposed in a number of ways (e.g., as 52 hundreds, 1 ten, and 7 ones).

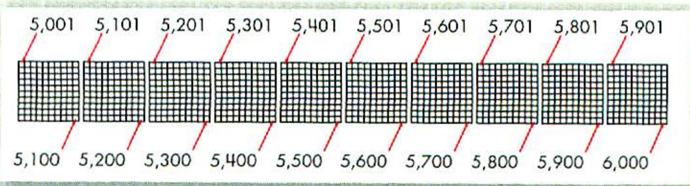
In this unit students construct and use 1,000 books and the classroom 10,000 chart to build and visualize numbers in the 1,000s and their relationships. Using their 1,000 books, they can easily see how 1,000 is composed of ten 100s. Furthermore, they notice how each hundred is composed of ten 10s; therefore, with ten 10s on each of 10 pages, there are 10 × 10 or 100 tens in the whole 1,000 book. They can review how the sequence of written numbers shows a pattern on each 100 page: the page with 801–900 looks like the page with 101–200, except for the digits in the 100s place.

101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830
831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850
851	852	853	854	855	856	857	858	859	860
861	862	863	864	865	866	867	868	869	870
871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890
891	892	893	894	895	896	897	898	899	900

Young children learn that 10 represents both ten 1s and one 10 and that 100 represents one hundred 1s and ten 10s, as well as 1 hundred. Students in Grades 3–5 continue to build their understanding of how larger numbers are composed. In their 1,000 books, they can see the individual units grouped into rows of 10, which are in turn grouped into sheets of 100, ten of which make up the 1,000 book.

The 10,000 chart further extends this work. Some place-value models, such as base-ten blocks, use three dimensions to help students visualize how 1,000 is composed. We have chosen to continue building on the 100s chart that students have been using throughout the grades and which they can now visualize well. They build a new unit—a row of ten 100 charts that includes 1,000 squares—as the building block for composing 10,000.



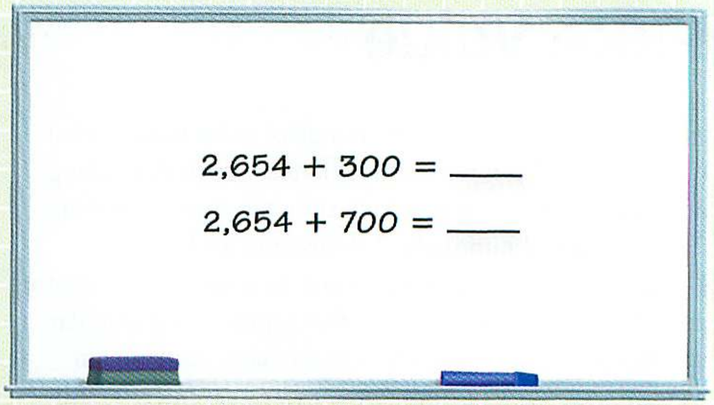
By using this flat model composed of 100 hundreds, students see *all* 10,000 squares arranged in a way that helps them visualize the structure of the base-ten system. Through placing numbers on the chart, they consider relationships among numbers: About where would the number 7,927 be? To place this number, students bring into play their knowledge of the relationship of this number to 10,000, to 8,000, to 7,900, and to 7,930. In this process, they are associating the written number with its meaning: Numbers between 7,000 and 8,000 are in the row of 100 charts that begins with 7,001 and ends with 8,000. They can see that seven rows of 1,000 squares precede the row that contains this number. They can see that it is closer to the end of its row than to the beginning because it is over nine 100s more than 7,000.

Place Value and Computational Fluency

A thorough understanding of the base-ten number system is one of the critical building blocks for developing computational fluency. The composition of numbers from multiples of 10, 100, 1,000, and so on is the basis of most of the strategies students use for computation with whole numbers.

In Grade 3, students learned about using multiples of 10 and 100 as "landmarks" in their computation work. In this unit, students focus on using these landmarks through adding and subtracting multiples of 10, 100, and 1,000 (e.g., in *Changing Places,* introduced in Investigation 1 and expanded to 10,000 in Investigation 3) and on finding combinations of numbers that add to 1,000 (e.g., in How Many Miles to 1,000?, introduced in Investigation 1, and in *Close to 1,000,* introduced in Investigation 2).

By considering which digits of a number will be changed by adding or subtracting multiples of 10, 100, and 1,000, students focus on a key aspect of estimation—looking carefully at the place value of the numbers in a problem. For example, consider the following two problems:



How much will 2,654 increase in each case? The first sum will now have nine hundreds, but the other digits will not change. The second situation is more complicated: The 100s will change, but so will the 1,000s, because the addition problem 600 + 700 results in a sum larger than 1,000. Considering the magnitude of the numbers in addition and subtraction problems provides the basis for developing a reasonable estimate of the result.

In Grade 4, students continue using their knowledge of the basic single-digit addition combinations (the "facts") to easily add multiples of 100 and 1,000: 6 + 7 = 13 (13 *ones*), 60 + 70 = 130 (13 *tens*), 600 + 700 = 1,300 (13 *hundreds*). Adding 6 and 7 in any place is the same, except that the *units* being added are ten times larger in each successive place to the left. In Grade 4, students should work on adding or subtracting the largest possible chunks of numbers, rather than counting by 100s or 1,000s.

Students' work on adding and subtracting relates directly to their work on the place-value system. The strategies for addition used by many students—adding by place or adding one number in parts—depend on an understanding of how to decompose numbers (see **Teacher Note:** Addition Strategies, page 171). The common subtraction strategies of subtracting in parts, adding up, or subtracting back also depend on this understanding (see **Teacher Note:** Subtraction Strategies, page 183). The U.S. algorithm for addition, which students study in Investigation 2, also depends on a firm grasp of place value.