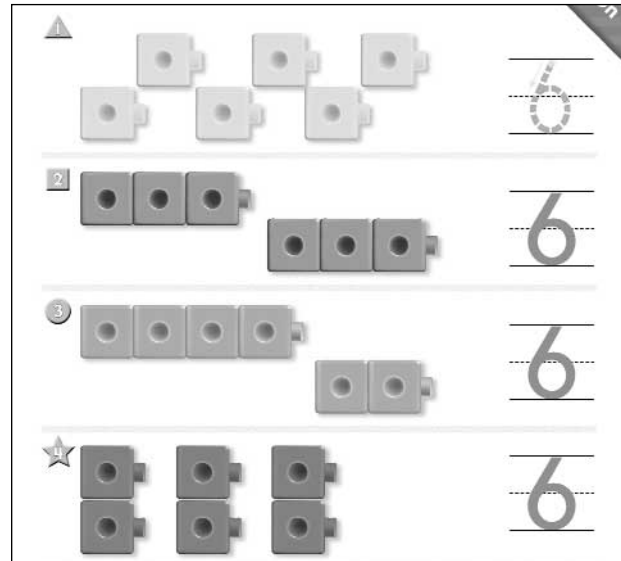


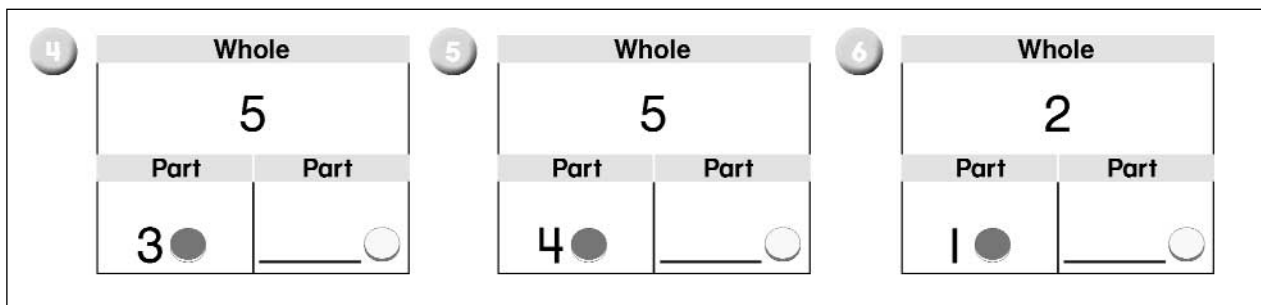
Number and Numeration

At a young age, children in China and other East Asian countries learn to compose (put together) and decompose (take apart) numbers in many ways. This is key to their understanding of mathematics that comes later, particularly addition and subtraction (Ma, 1999, pp. 7–12).

The research cited above is implemented in *Houghton Mifflin Math*. Students are given many opportunities to compose and decompose numbers. For example, on page 125 in the kindergarten book, several different ways to decompose six are shown. Richardson (1997) supports this kind of informal work with numbers by suggesting that when deciding which experiences will challenge kindergarten children, we must not be unduly impressed by their work with large numbers. It is significantly more important that children develop number sense and know number combinations. This study explains that these higher-level thinking activities are far more likely to occur when children are working with smaller numbers. In grade 1, work with part-part-whole mats builds on students' understanding of composing and decomposing numbers.



Student Book, grade K, page 125



Student Book, grade 1, page 64

When children begin to count above 12, they often make mistakes because they are unable to identify patterns and relationships. Researchers have found that children’s spoken language affects how they think (Miura et al., 1994). Some studies have argued that the English language is not always conducive to pattern detection (Miller and Parades, 1996). For example, decade transition is not consistent: after “ten,” we do not have “ten-one,” and instead, we have a unique-sounding number called “eleven.” “Ten-two” is also unique—we call it “twelve.” Further, the “teen” numbers are spoken as if the ones come before the tens—unlike the “twenties,” “thirties,” and above, where the first spoken number is the tens digit followed by the ones digit. In contrast, the Chinese number-word system illustrates straightforwardly the relationship between numbers and their names. In Chinese, *yi* is one, *er* is two, *shi* is ten, *shi yi* is eleven, *shi er* is twelve, *er shi* is twenty, *er shi yi* is twenty-one, and so on (Ma, 1999, p. xix).

The above research implies that American children may have more difficulties understanding place value than children in other countries because of their language.

Teachers...need to know the ideas with which students often have difficulty and ways to help bridge common misunderstandings (NCTM, 2000).

With these ideas in mind, *Houghton Mifflin Math* provides students with numerous experiences to identify the tens and ones in numbers to help them better understand place value.

The Chinese also place great emphasis on *jin lu* (the rate for composing a higher value unit). Rather than memorize that 10 ones compose 1 ten and then 10 tens compose 1 hundred, etc., Chinese children learn the basic idea of our number system—that each place is 10 times the value of the place to its right and each place decomposes as 10 of the value of the place to its right (Ma, 1999, p.10). Extensive use of place value models in *Houghton Mifflin Math* help students grasp this idea of *jin lu*.

The image shows a page from a student book with the following content:

- Name:** _____
- Objective:** Show two-digit numbers in different ways.
- Text:** You can write a number in different ways.
- Model:** 3 tens and 4 ones. $30 + 4 = 34$. A speech bubble says: "3 tens and 4 ones is the same as $30 + 4$." An illustration shows two children holding a sign that says "30 + 4 = 34".
- Guided Practice:** Write the number in different ways.
 - Problem 1: Think 5 tens and 9 ones is the same as $50 + 9$. _____ tens _____ ones. _____ + _____ = _____.
 - Problem 2: _____ tens _____ ones. _____ + _____ = _____.
 - Problem 3: _____ tens _____ ones. _____ + _____ = _____.
- TESTIPS:** Explain Your Thinking In the number 45, does the number 4 mean 40 or 4? How do you know?
- Page Info:** Chapter 10 Lesson 6 two hundred eighty-nine 289

Student Book, grade 1, page 289

The idea of *jin lu* must be extended to decimal numbers less than one also.

Research indicates that much of students' difficulty with decimal fractions stems from their failure to understand the base-10 representations. Decimal representations need to be connected to multidigit whole numbers as groups getting 10 times larger (to the left) and one tenth as large (to the right). Referents (diagrams or objects) showing the size of the quantities in different places can be helpful in understanding decimal fractions and calculations with them (NRC, 2001, p. 417).

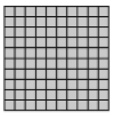
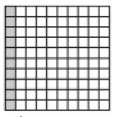
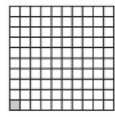
Use of such diagrams can be found on page 542 of grade 4 in *Houghton Mifflin Math*.

One way to show parts of a whole is to use fractions. Another way is to use decimals.

Materials
Decimal Grids or Learning Tools
38 and 39

A **decimal** is a number with one or more digits to the right of the **decimal point**.

Look at the models below.

<p>One whole is shaded.</p>  <p>1 whole one 1.0 ↑ decimal point</p>	<p>One tenth is shaded.</p>  <p>$\frac{1}{10}$ of a whole one tenth 0.1 ↑ decimal point</p>	<p>One hundredth is shaded.</p>  <p>$\frac{1}{100}$ of a whole one hundredth 0.01 ↑ decimal point</p>
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Student Book, grade 4, page 542

Another key concept in the study of numbers is the connection between different kinds of numbers.

Students often view the study of whole numbers, decimal fractions, common fractions, and integers as disconnected topics. One tool that we believe may be useful in developing numerical understanding and in making connections across number systems is the number line, a geometric representation of numbers that gives each number a unique point on the line and an oriented distance from the origin, depicting its magnitude and direction (NRC, 2001, p. 418).

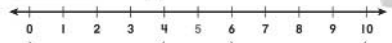
The number line is used extensively in *Houghton Mifflin Math*. Examples can be found at every grade, including grades 2 and 6, as shown below.

Name _____

Ordering Numbers

MathTracks 1-1
Lines and Unshaded

A **number line** can help you count and order numbers.





Objective
Order numbers through 50.
Vocabulary
number line
before
after
less
more

These numbers come **before** 5.
4 is just before 5.
4 is one **less** than 5.

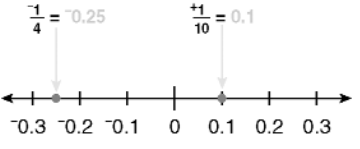
These numbers come **after** 5.
6 is just after 5.
6 is one **more** than 5.

Guided Practice
Use the number line below.
Complete the sentence.

Student Book, grade 2, page 11

You can use a number line to graph rational numbers.



Student Book, grade 6, page 588