GENERATION**GENIUS**
ALWAYS QUESTION. ALWAYS WONDER.

TEACHER GUIDE

MULTIPLYING FRACTIONS BY WHOLE NUMBERS
GRADES 3-5

COMMON MISCONCEPTIONS

- **All fractions represent quantities less than 1.**
  Fractions can be used to represent quantities less than 1, such as $\frac{1}{2}$, but also can be used to represent quantities greater than 1, such as $\frac{3}{2}$. Have students work with fractions greater than 1 often so they do not develop the misconception that all fractions represent quantities less than 1.

- **When multiplying fractions by whole numbers, multiply the whole number by both the numerator and the denominator.**
  Adding fractions is adding parts of the same whole. If you have 3 parts and 5 parts of the whole, you have 8 parts in all. The size of the parts does not change, only the number of parts you have. Because of this, you add the numerator and keep the denominator the same. 3 eighths and 4 eighths are 7 eighths in all. Multiplying a fraction by a whole number is equivalent to repeatedly adding the fraction, so only the numerator should change, and not the denominator.

- **If you multiply a fraction less than 1 by a whole number, the answer will be less than 1.**
  When multiplying a fraction by a whole number, the larger the whole number, the more likely the answer will be greater than 1. Students may discover that when multiplying a unit fraction by a whole number, the answer will be equal to 1 if the whole number is equal to the denominator and the answer will be greater than 1 if the whole number is greater than the denominator.

CONNECTING ADDITION AND MULTIPLICATION

Multiplication was developed as a convenient way to show repeated addition. This connection can be made clearly and easily if one factor in the product is a whole number. Since students already have the tools to add fractions with like denominators, the connection between addition and multiplication can be used to help students develop and understand the algorithm for multiplying fractions by whole numbers.

SIMPLIFYING FRACTIONS

Students should understand the importance of simplifying fractions that result from their calculations. Like when Derek tried to order $\frac{32}{8}$ pizzas, most real-world applications will require knowing how many *'wholes'* the solution shows. For example, Derek's $\frac{32}{8}$ pizzas are equivalent to 4 whole pizzas.

Students can convert between fractions greater than 1 and mixed numbers by identifying how many *'wholes'* are represented by the fraction greater than 1.

For example, how many $\frac{8}{8}$ are in $\frac{32}{8}$?

$$\frac{32}{8} = \frac{8}{8} + \frac{8}{8} + \frac{8}{8} + \frac{8}{8}$$

$$= 1 + 1 + 1 + 1$$

$$= 4$$

Accelerated students may recognize division as the strategy they are applying to simplify fractions. They may notice that if they divide the numerator by the denominator the quotient gives the number of *'wholes'* and the remainder shows the number of parts remaining.

For example, rewrite $\frac{11}{4}$ as a mixed number.

$11 \div 4 = 2$ R 3

The 11 parts could be divided into 2 equal groups of 4 with 3 parts remaining. $\frac{11}{4} = 2\,\frac{3}{4}$.

FRACTIONS GREATER THAN 1

Fractions greater than 1, such as $\frac{5}{4}$ or $\frac{23}{5}$, used to be called improper fractions. However, this made students feel that there was something wrong with these fractions or that they were doing something wrong if they used them. In fact, there are many instances in mathematics where it is correct and easier to work with a fraction that is greater than 1 rather than with a mixed number. The term *fraction greater than 1* is what is commonly used now so that students will not feel that there is something wrong with these fractions.

TEACHER TIPS

One of the very important ways you can help your students understand multiplying fractions by whole numbers is by modeling the problems. Circles and number lines make very good models. A circle can easily be divided into equal parts and the whole can be marked on a number line and then divided into equal parts. One of the confusions that students often have when working with fractions, is to forget what the whole represents as they are solving a problem that involves fractions. If you see this happening, ask *What is the whole in this problem?*

