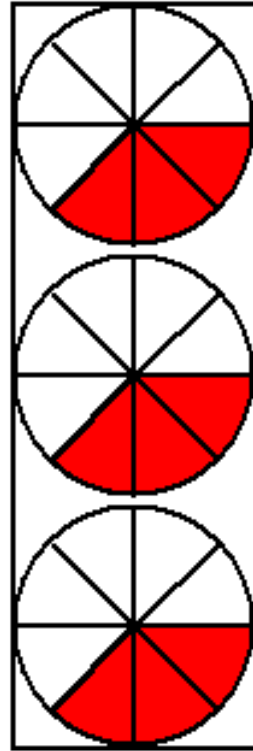


# HOW TO MULTIPLY FRACTIONS

Introducing:

- factor
- product
- reciprocal
- multiplicative inverse
- identity
- invert

First Factor (number in each row)

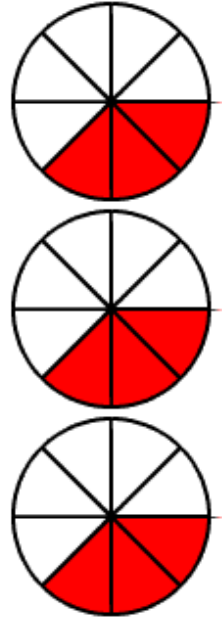


Product

Second Factor (number of rows)

$$\frac{3}{8} \times 3$$

# Multiply Fractions 1

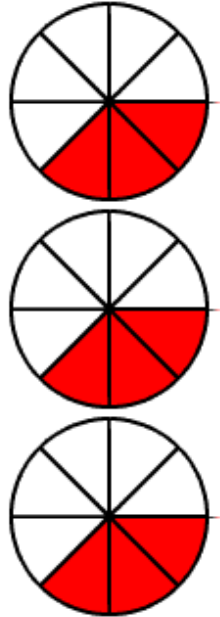


$$\frac{3}{8} \times 3 =$$

**first factor**                      **second factor**  
**(number in each row)**   **(number of rows)**

The parts of this multiplication example are the first *factor*  $\frac{3}{8}$ , and a second *factor* 3. There are 3 rows with  $\frac{3}{8}$  in each row.

# Multiply Fractions 2



$$\frac{3}{8} \times 3 =$$

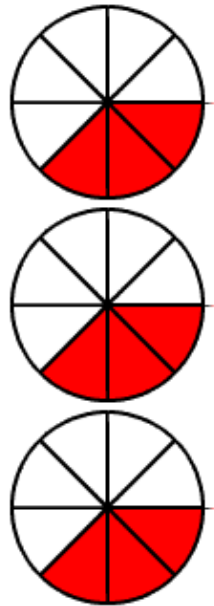
**first factor**  
(number in each row)

**second factor**  
(number of rows)

Multiplication is a form of addition. This picture shows that  $\frac{3}{8}$  is added 3 times. The *product* can be found by addition of like amounts:

$$\frac{3}{8} + \frac{3}{8} + \frac{3}{8} = \frac{9}{8}$$

# Multiply Fractions 3



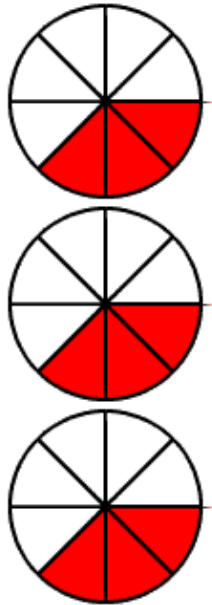
$$\frac{3}{8} \times 3 = \frac{3}{8} \times \frac{3}{1} = \frac{9}{8} = 1 \frac{1}{8}$$

first factor (number in each row)      second factor (number of rows)

Write in fraction form and multiply.      Simplify.

To calculate the *product*, write both *factors* in fraction form. Then multiply the numerators 3 and 3 for 9 in the *product* numerator and the denominators 8 and 1 for 8 in the *product* denominator.

# Multiply Fractions 4



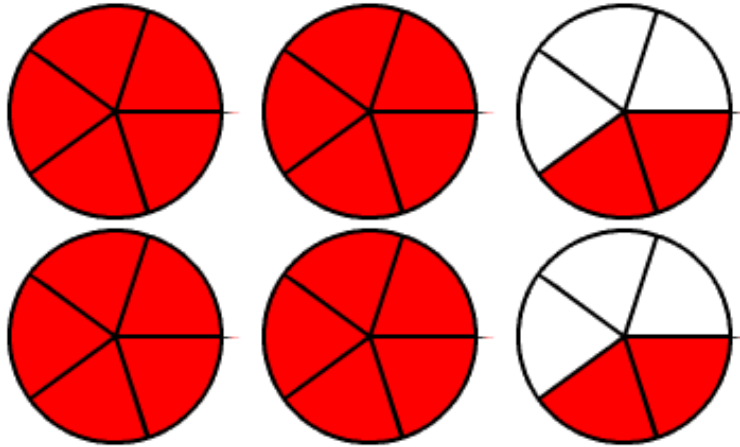
$$\frac{3}{8} \times 3 = \frac{3}{8} \times \frac{3}{1} = \frac{9}{8} = 1 \frac{1}{8}$$

first factor (number in each row)      second factor (number of rows)

Write in fraction form and multiply.      Simplify.

The *product*  $\frac{9}{8}$  can be written in mixed form  $1 \frac{1}{8}$

# Multiply Fractions 5



$$2 \frac{2}{5} \times$$

first factor  
(number in each row)

$$2 =$$

second factor  
(number of rows)

$$\frac{12}{5} \times \frac{2}{1} = \frac{24}{5} =$$

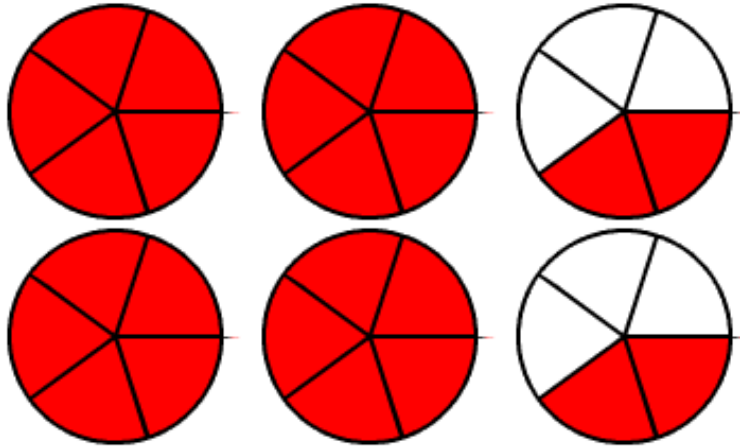
Write in fraction form and multiply.

$$4 \frac{4}{5}$$

Simplify.

It is easy to tell the *product*  $4 \frac{4}{5}$  from this picture. Notice the 4 complete circles and the  $\frac{2}{5} + \frac{2}{5}$  circles for a *product* of  $4 \frac{4}{5}$ .

# Multiply Fractions 6



$$2 \frac{2}{5} \times 2 =$$

first factor (number in each row)      second factor (number of rows)

$$\frac{12}{5} \times \frac{2}{1} = \frac{24}{5} =$$

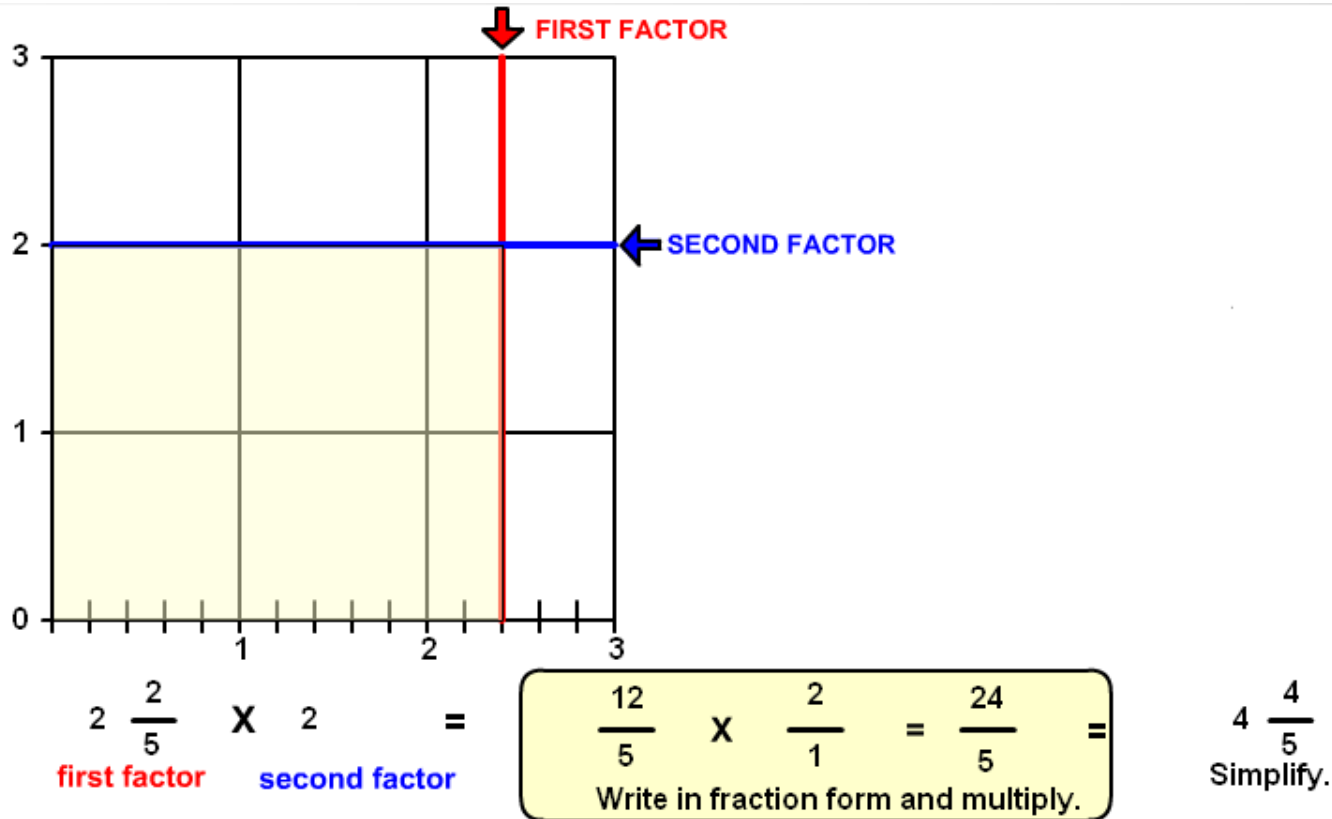
Write in fraction form and multiply.

$$4 \frac{4}{5}$$

Simplify.

To calculate the *product*, write both *factors* in fraction form. Then multiply the numerators 12 and 2 for 24 in the *product* numerator and the denominators 5 and 1 for 5 in the *product* denominator.

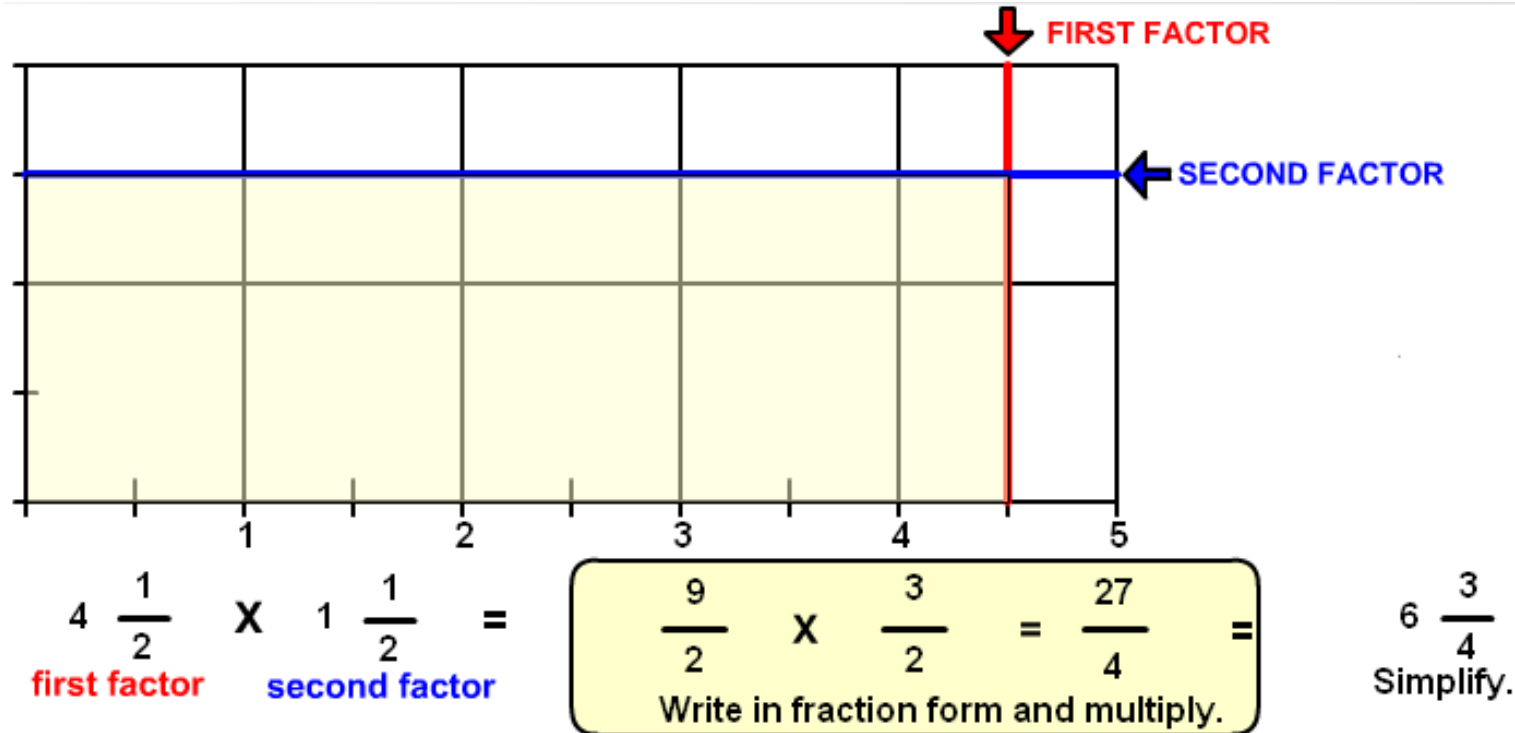
# Multiply Fractions 7



The same example,  $2 \frac{2}{5} \times 2$  using a rectangular array. The first *factor*  $2 \frac{2}{5}$ , is shown by the red arrow - the horizontal distance. The second *factor* 2, is shown by the blue arrow - the vertical distance from the bottom. The *product*,  $4 \frac{4}{5}$  is enclosed by the yellow rectangle.

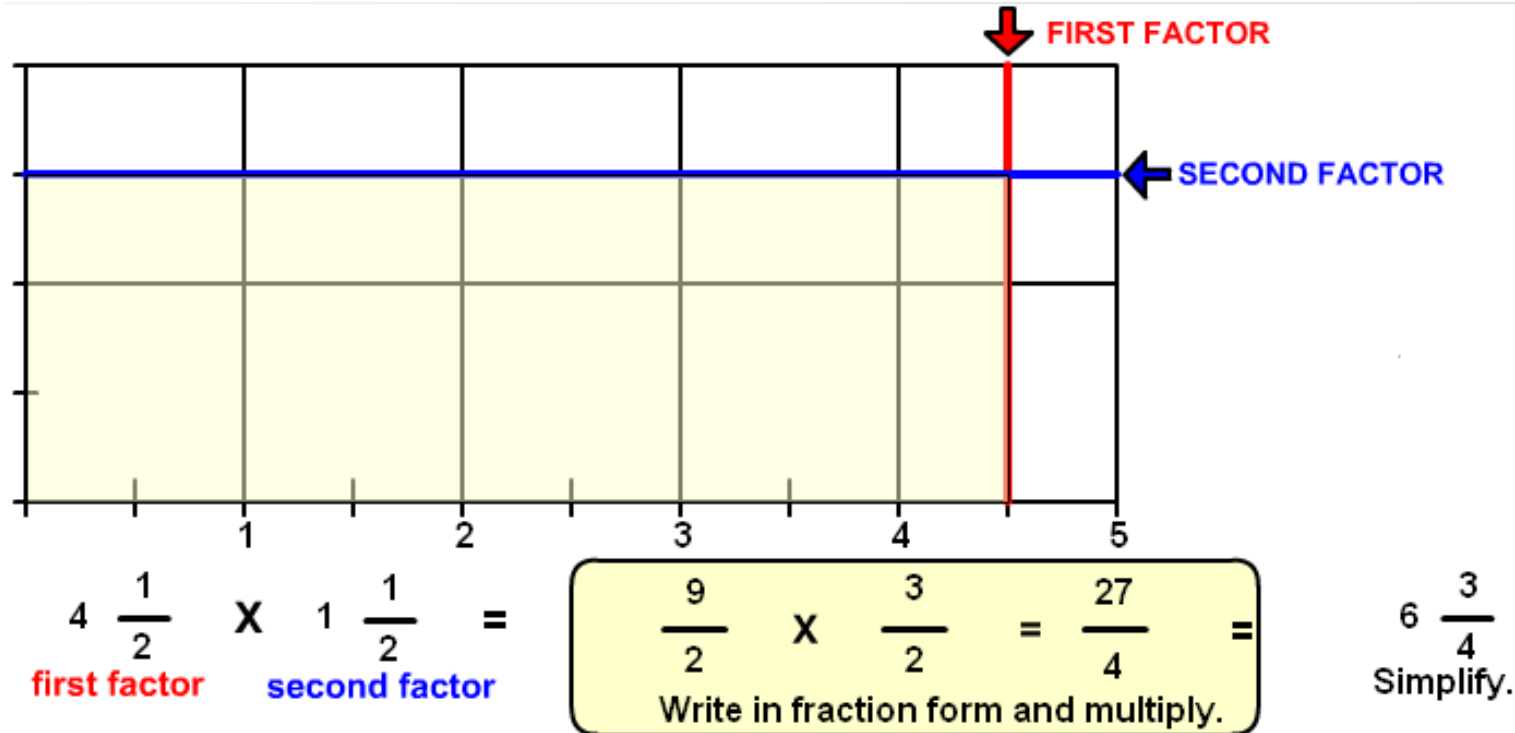


# Multiply Fractions 8



This rectangular array shows the *product* of  $4 \frac{1}{2}$  and  $1 \frac{1}{2}$ . Notice how each *factor* has been written in fraction form before multiplying. You can see in the picture that there are 27 fourths.

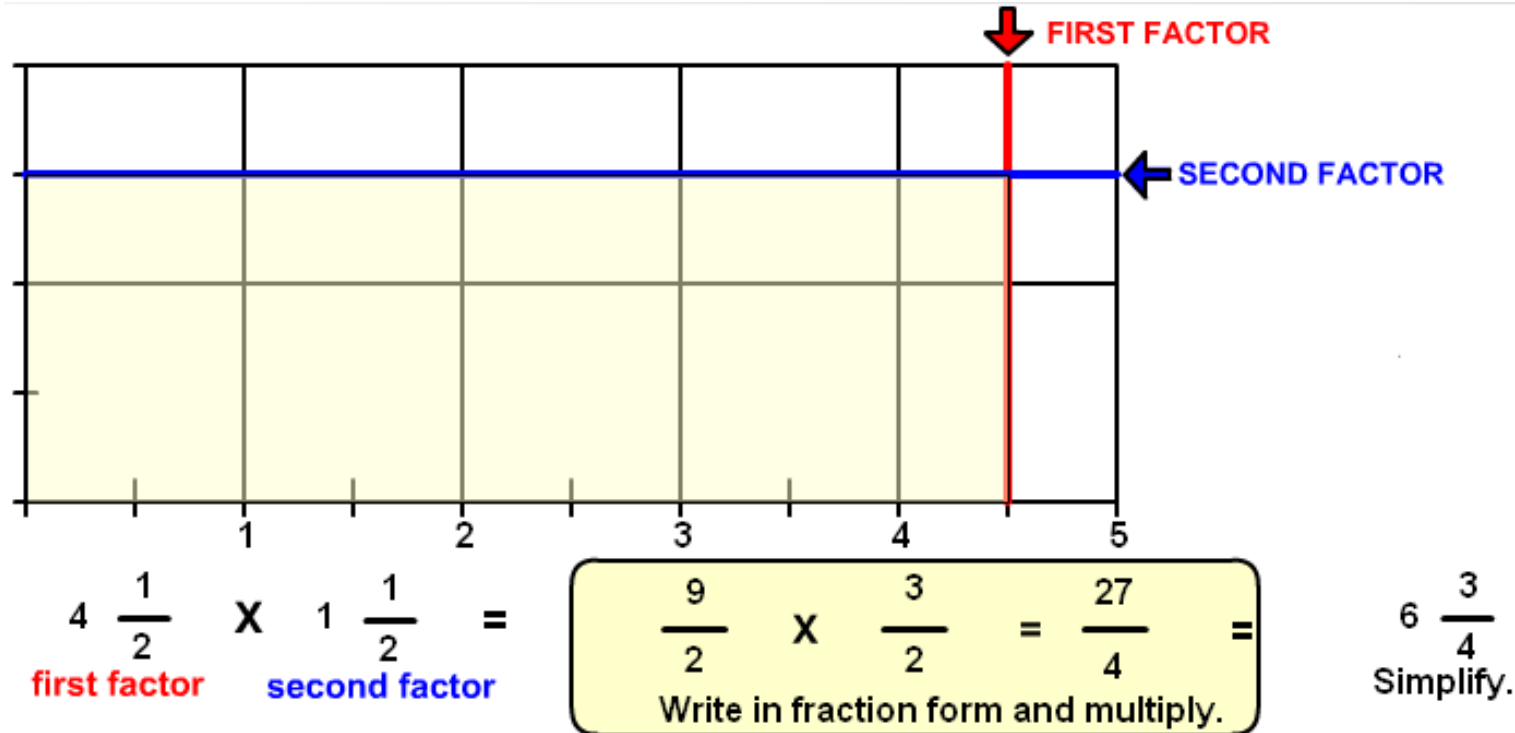
# Multiply Fractions 9



By rounding up the first *factor*  $4 \frac{1}{2}$  to 5 and the second *factor*  $1 \frac{1}{2}$  to 2 you would have a *product* of 10. If you rounded down the first *factor*  $4 \frac{1}{2}$  to 4 and the second *factor*  $1 \frac{1}{2}$  to 1 you would have a *product* of 4.

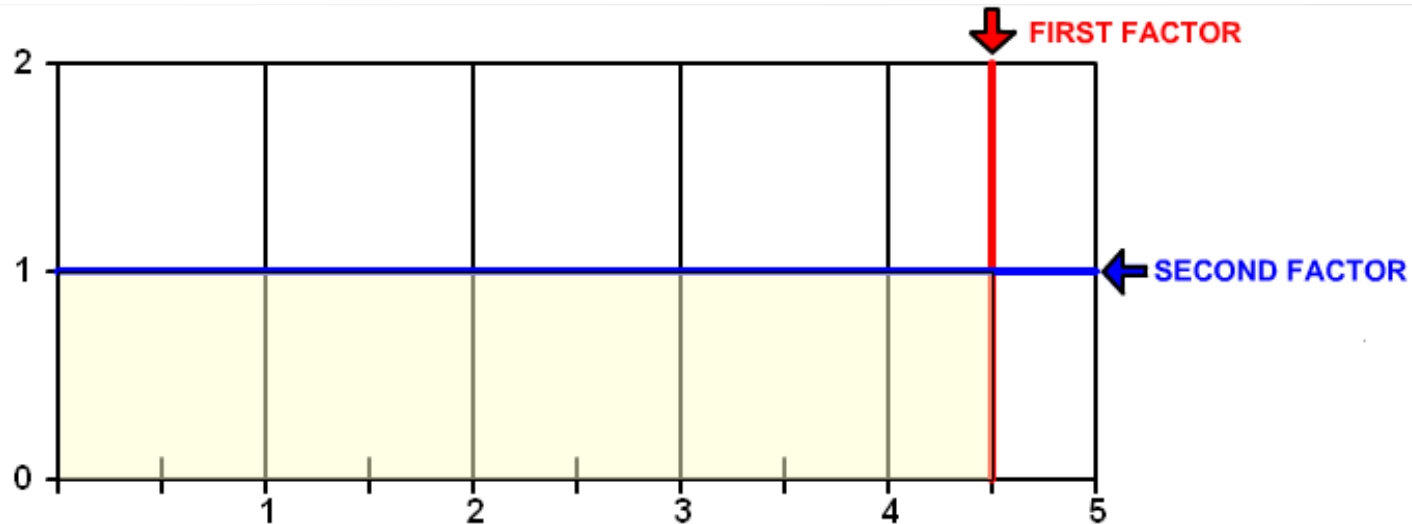
The *product* is greater than  $4 \times 1$  but less than  $5 \times 2$  so the *product*  $6 \frac{3}{4}$  makes sense.

# Multiply Fractions 10



You can tell by the picture that there are 4 whole units, five  $\frac{1}{2}$  units, and one  $\frac{1}{4}$  units. The sum of the units is  $4 + \frac{5}{2} + \frac{1}{4} = 6 \frac{3}{4}$ .

# Multiply Fractions 11



$$4 \frac{1}{2} \times 1 =$$

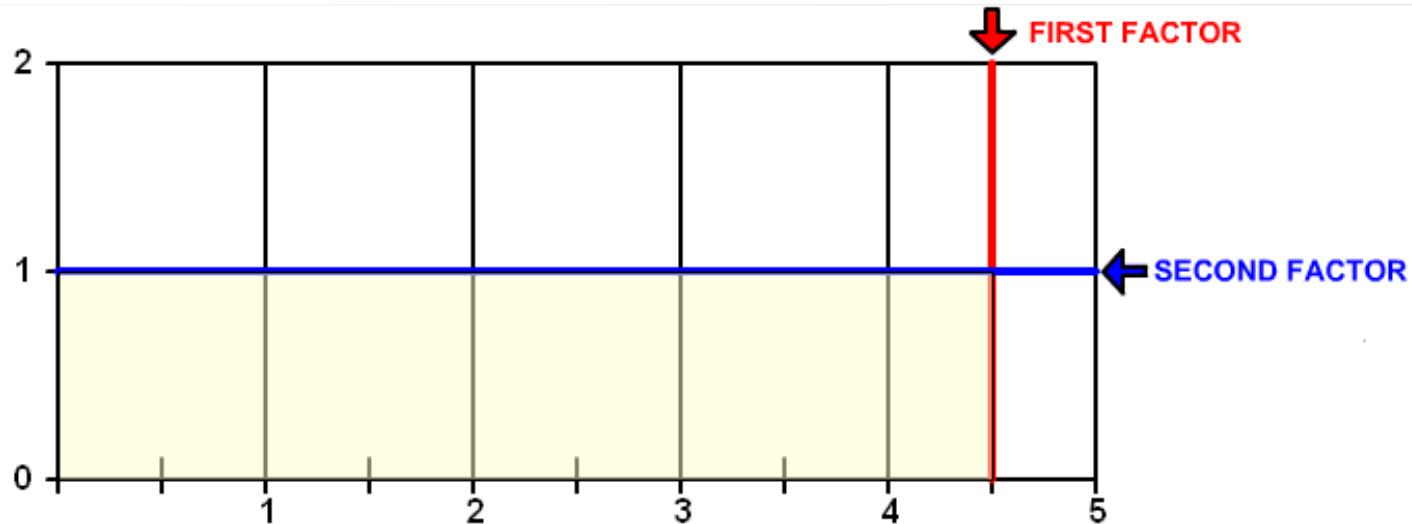
**first factor**      **second factor**

$$4 \frac{1}{2}$$

Multiplying by 1

The second *factor* has been decreased to 1. The *product* has been decreased to  $4 \frac{1}{2}$ .

# Multiply Fractions 12



$$4 \frac{1}{2} \times 1 =$$

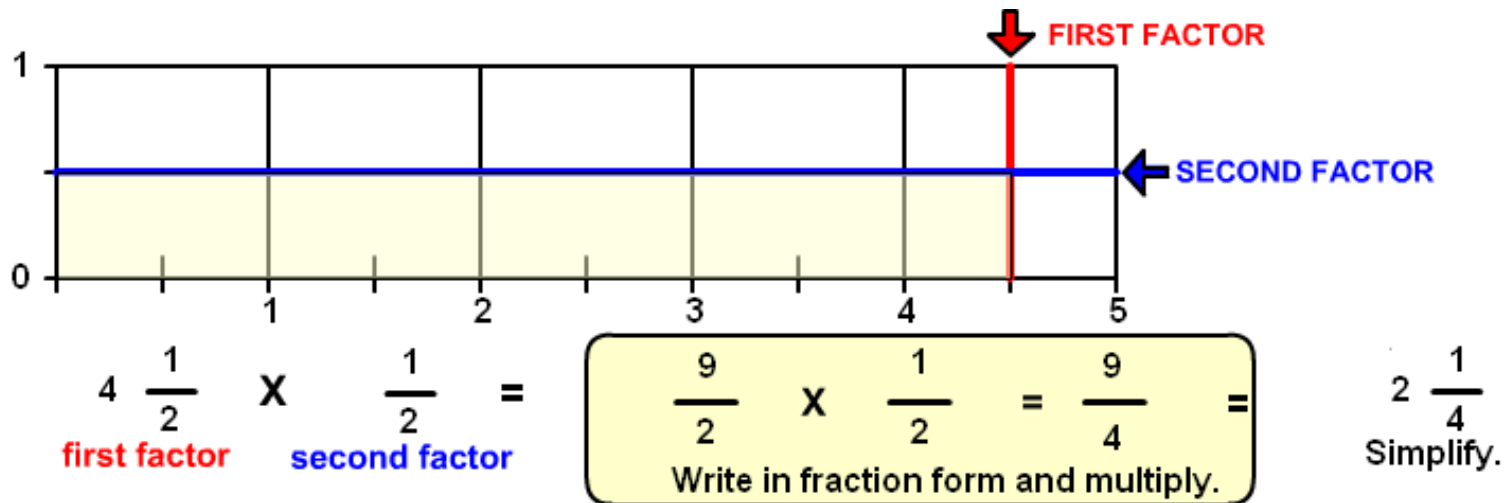
**first factor**      **second factor**

$$4 \frac{1}{2}$$

Multiplying by 1

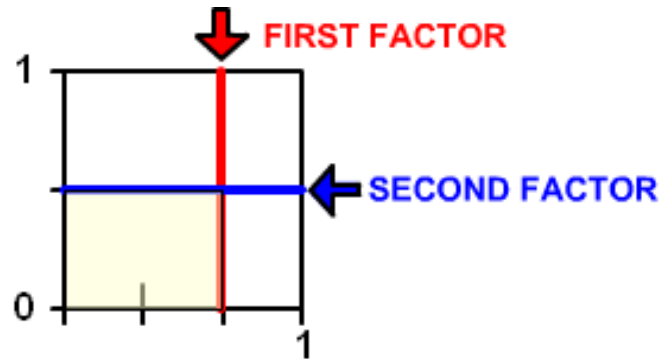
When 1 is used as a *factor*, the *product* is equal to the other *factor*. One is called the *identity* for multiplication.

# Multiply Fractions 13



The second *factor* has been decreased to  $\frac{1}{2}$ . Notice the *product* has been decreased to  $2 \frac{1}{4}$ . When one of the *factors* is smaller than 1, the *product* is smaller than the other *factor*.

# Multiply Fractions 14

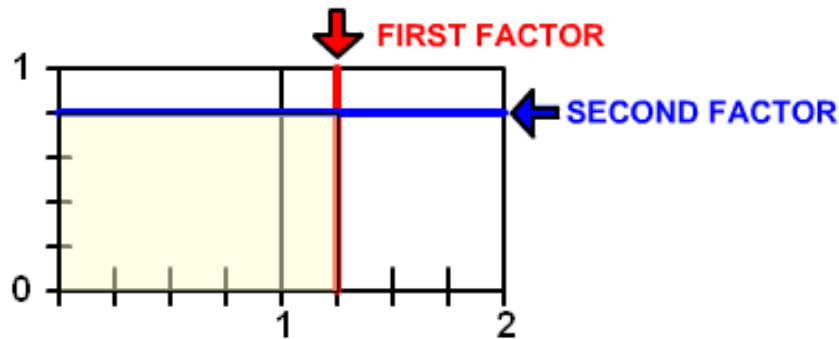


$$\frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$$

**first factor**      **second factor**      Simplify.

Both *factors* are less than 1. The *product*  $1/3$  is smaller than either *factor*.

# Multiply Fractions 15



$$1 \frac{1}{4} \times \frac{4}{5} =$$

first factor      second factor

$$\frac{5}{4} \times \frac{4}{5} = \frac{20}{20} =$$

Write in fraction form and multiply.

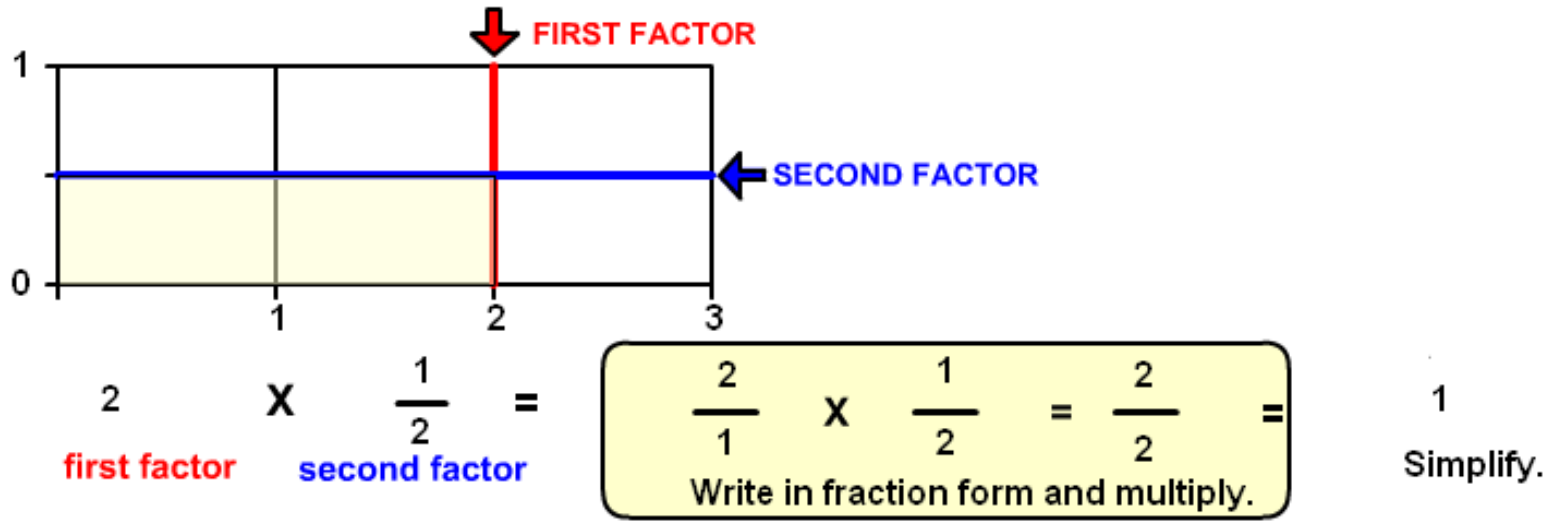
1  
Simplify.

The *factors*  $1 \frac{1}{4}$  and  $\frac{4}{5}$  are *reciprocals*. As you can see, multiplying  $\frac{5}{4}$  by  $\frac{4}{5}$  gives a *product* of 1. Two numbers are reciprocals or *multiplicative inverses* of each other if their *product* is 1 (one).

If you are asked to *invert* or write the *reciprocal* of  $\frac{5}{4}$  you will write  $\frac{4}{5}$ .

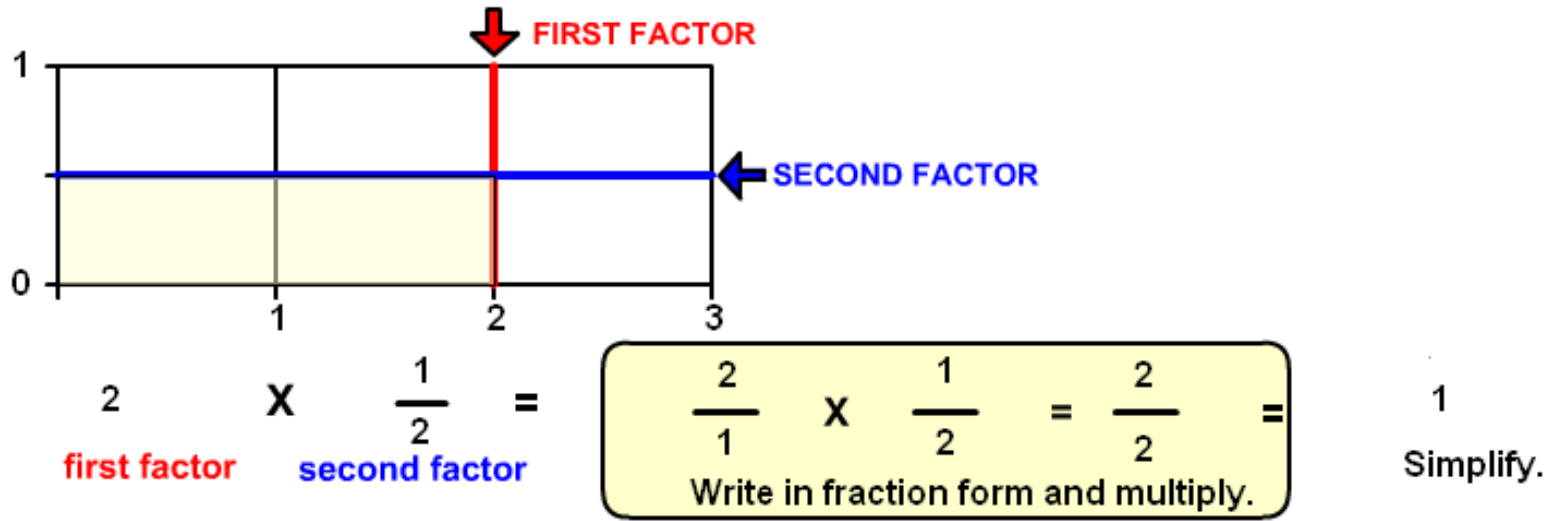


# Multiply Fractions 16



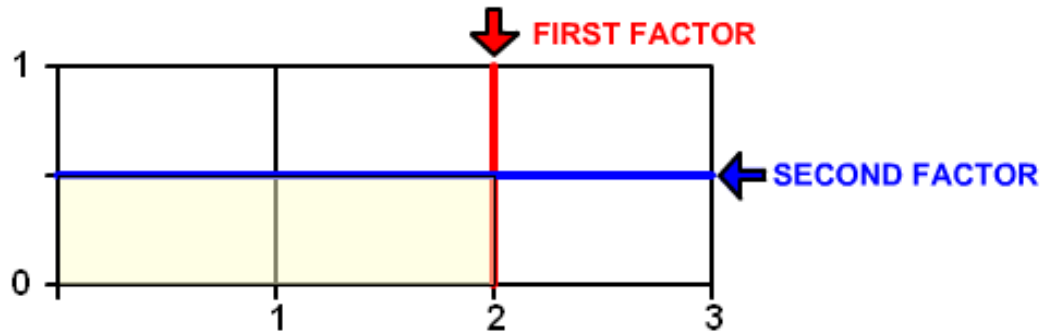
To find the *reciprocal* of a fraction, replace the denominator with the numerator and the numerator with the denominator. The *reciprocal* or *inverse* of  $\frac{2}{1}$  is  $\frac{1}{2}$ .

# Multiply Fractions 17



This picture shows 3 square units. Two  $\frac{1}{2}$  units are selected. Added together,  $\frac{1}{2}$  and  $\frac{1}{2}$  units give a *sum* of 1 unit. This shows that multiplication is a form of addition.

# Multiply Fractions 18



$$2 \times \frac{1}{2} =$$

first factor      second factor

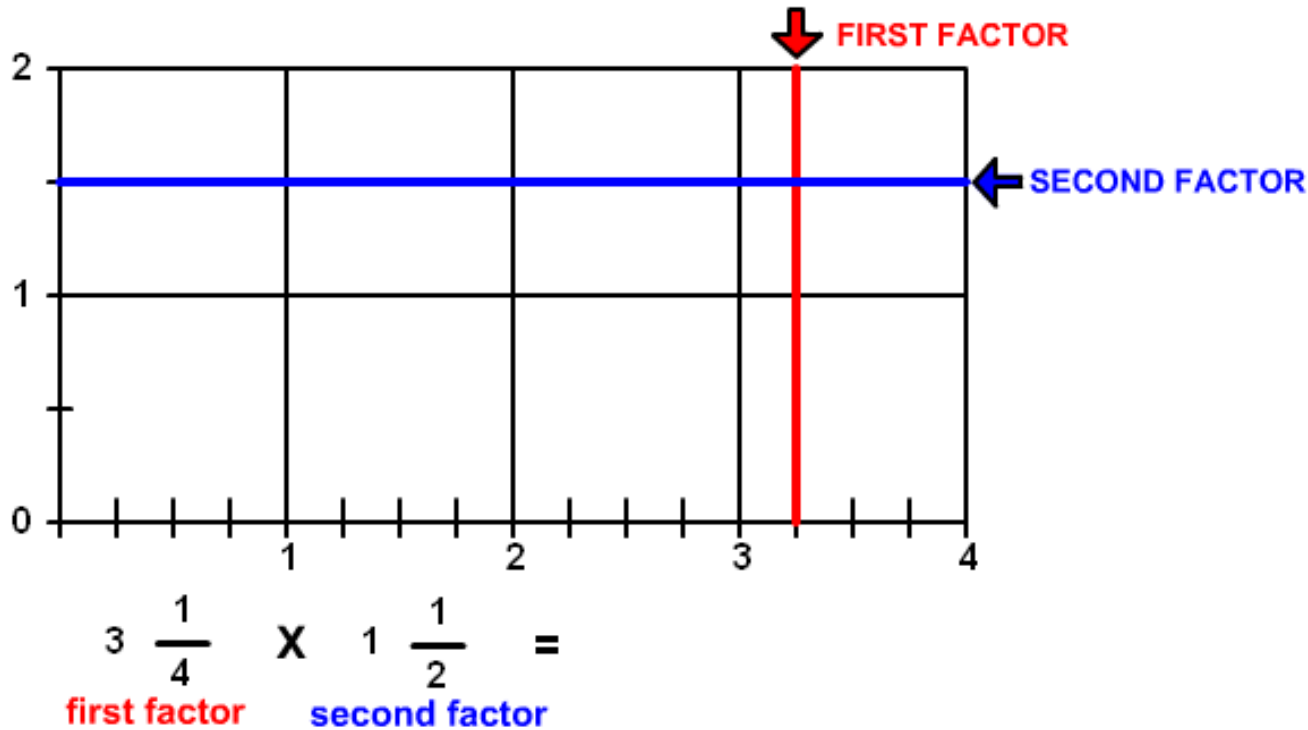
$$\frac{2}{1} \times \frac{1}{2} = \frac{2}{2} =$$

Write in fraction form and multiply.

1  
Simplify.

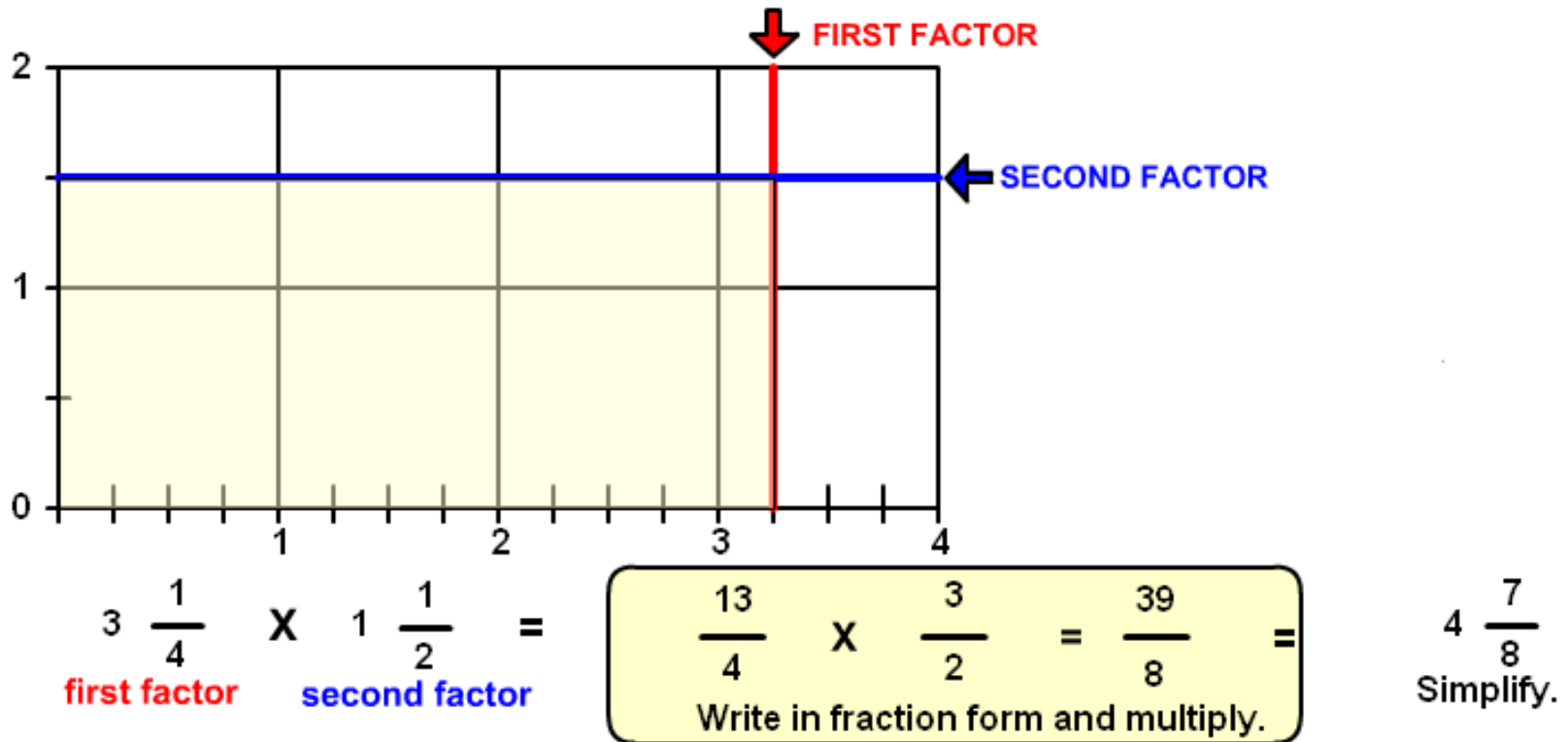
The *factors* 2 and  $\frac{1}{2}$  are *reciprocals* because their *product* is 1.

# Multiply Fractions 19



What is the *product* of  $3 \frac{1}{4}$  and  $1 \frac{1}{2}$  ?

# Multiply Fractions 20



The area within the *factors* is shaded. Altogether there are three whole squares, three  $\frac{1}{2}$  squares, one  $\frac{1}{4}$  square, and one  $\frac{1}{8}$  square. Add these parts up and you have the *product* of  $4 \frac{7}{8}$ .

The picture shows how the *product* of  $3 \frac{1}{4}$  and  $1 \frac{1}{2}$  is calculated.