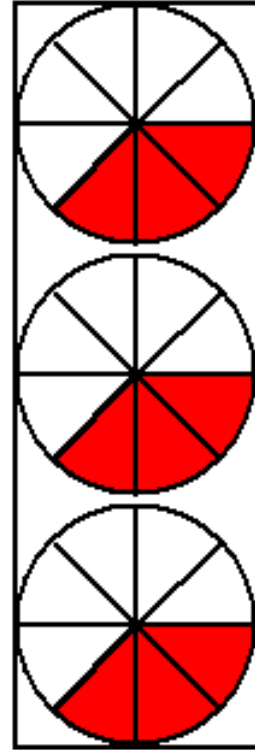


HOW TO MULTIPLY FRACTIONS

Introducing:

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

First Factor (number in each row)

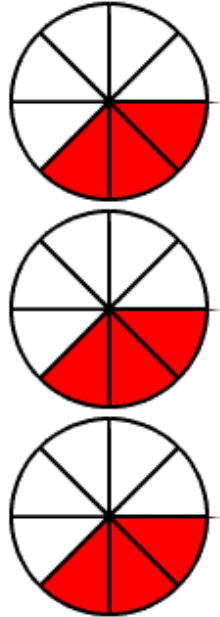


Product

Second Factor (number of rows)

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

Multiply Fractions 1

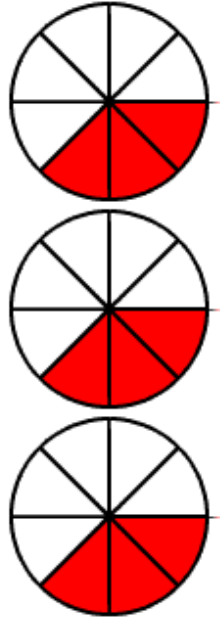


$$\frac{3}{8} \times 3 =$$

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



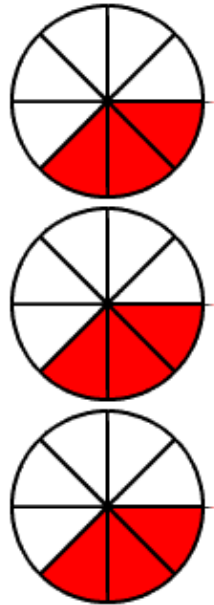
$$\frac{3}{8} \times 3 =$$

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



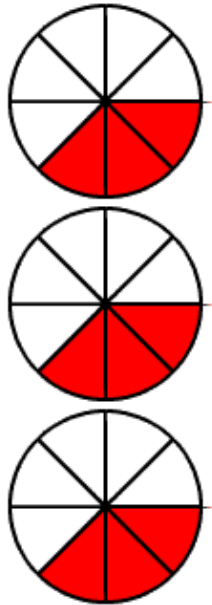
$$\frac{3}{8} \times 3 = \frac{3}{8} \times \frac{3}{1} = \frac{9}{8} = 1 \frac{1}{8}$$

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



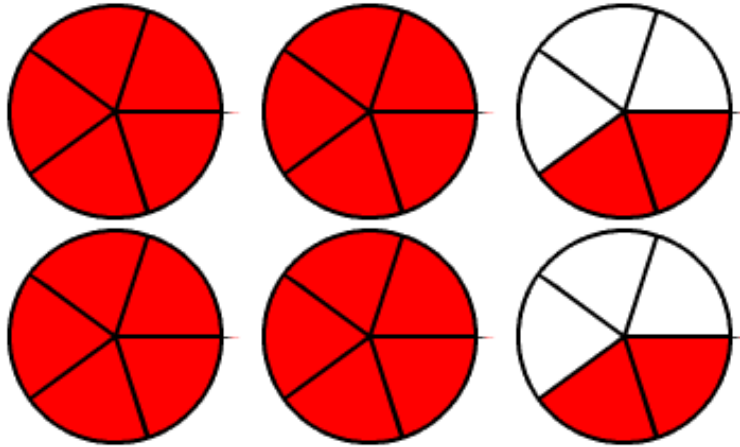
$$\frac{3}{8} \times 3 = \frac{3}{8} \times \frac{3}{1} = \frac{9}{8} = 1 \frac{1}{8}$$

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)

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

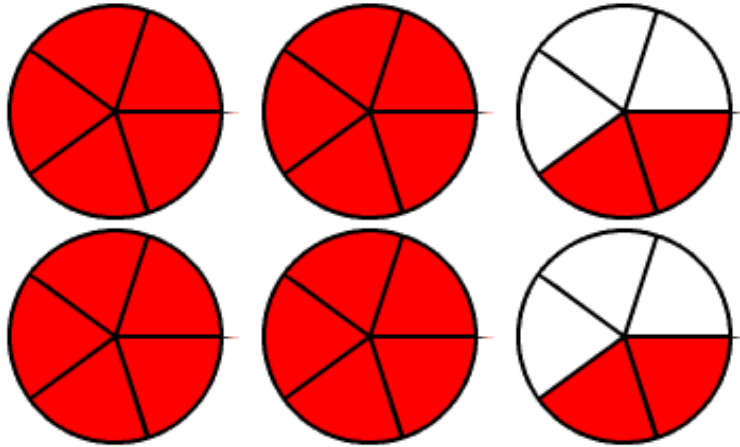
Write in fraction form and multiply.

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

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)

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

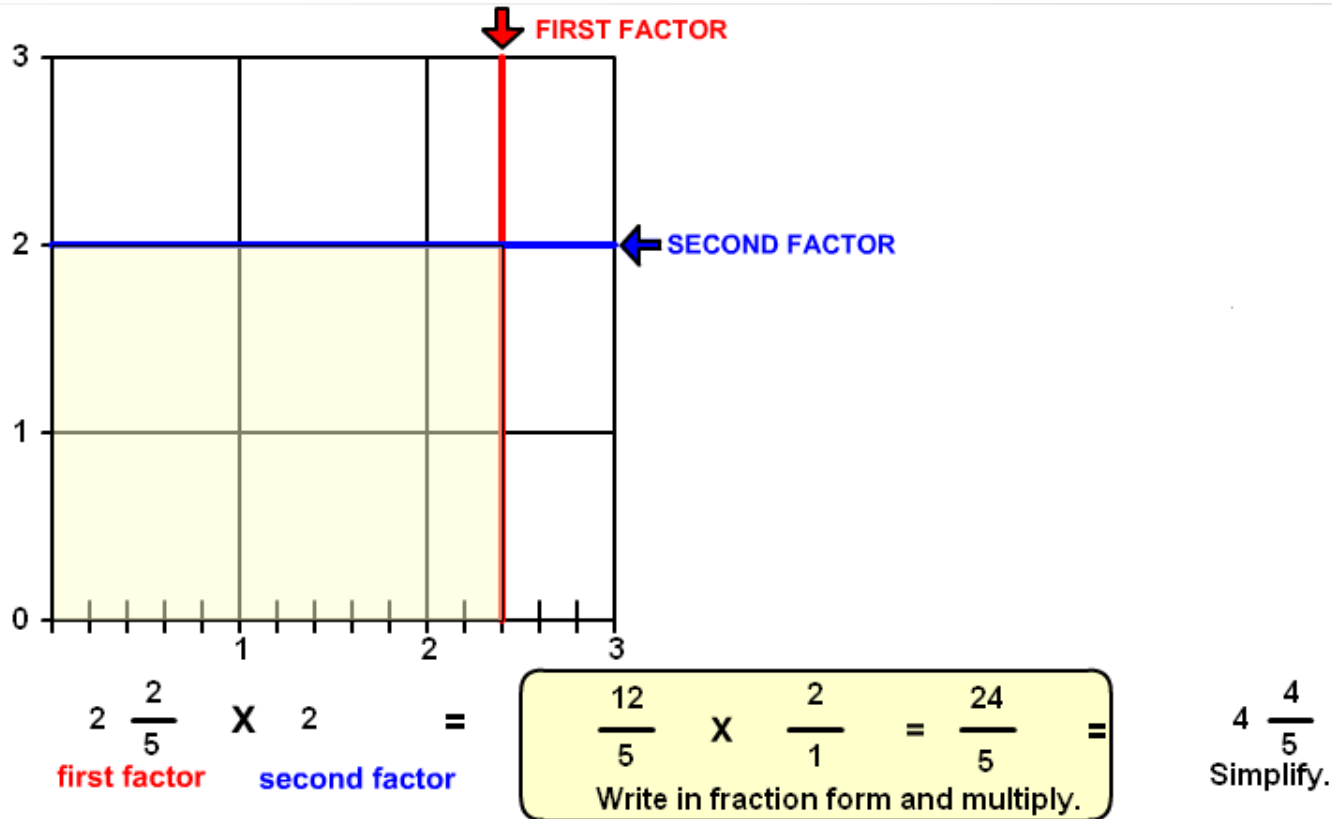
Write in fraction form and multiply.

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

Simplify.

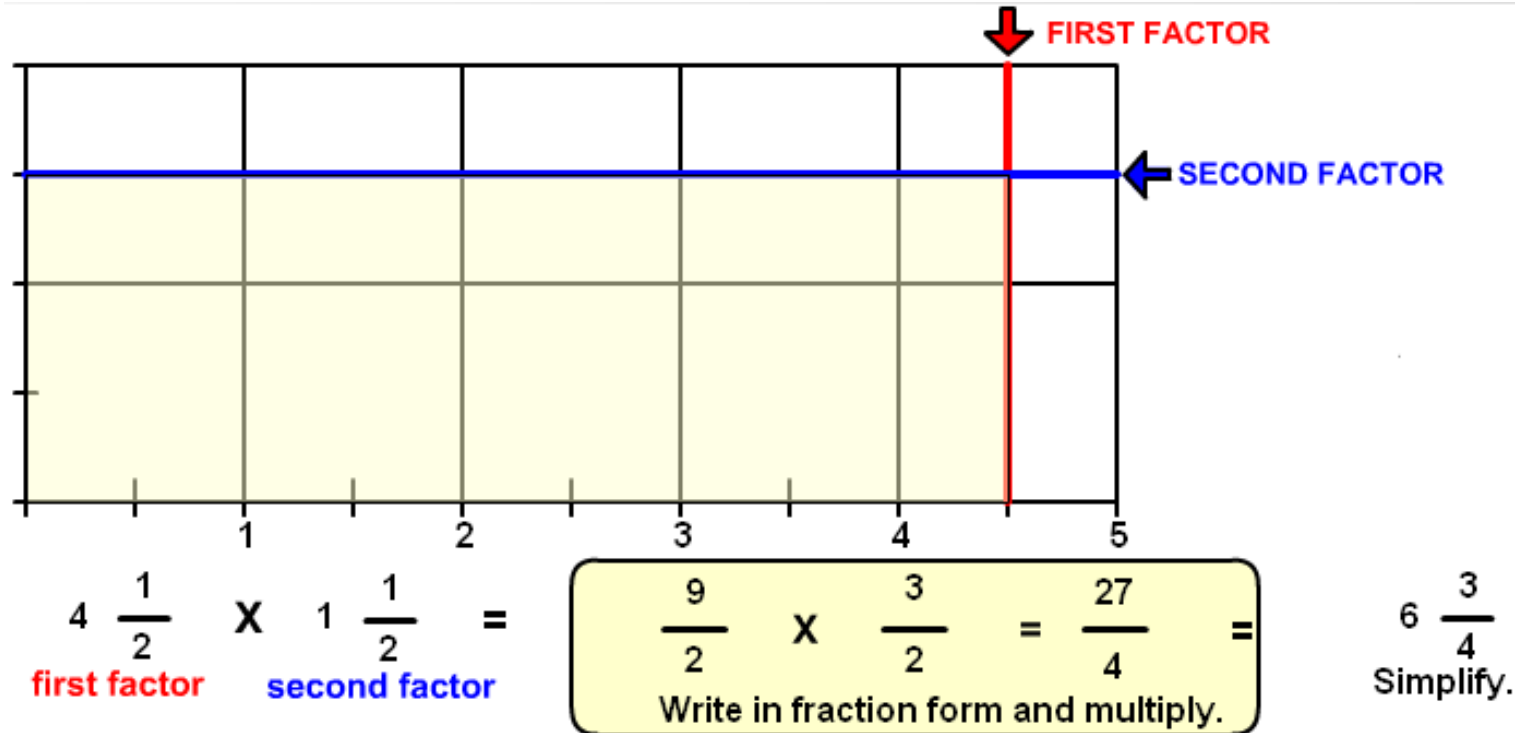
To calculate the *product*, write both *factors* in fraction form. Then multiply the numerators 12 and 2 for 24 in the *product* numerator and the denominators 5 and 1 for 5 in the *product* denominator.

Multiply Fractions 7



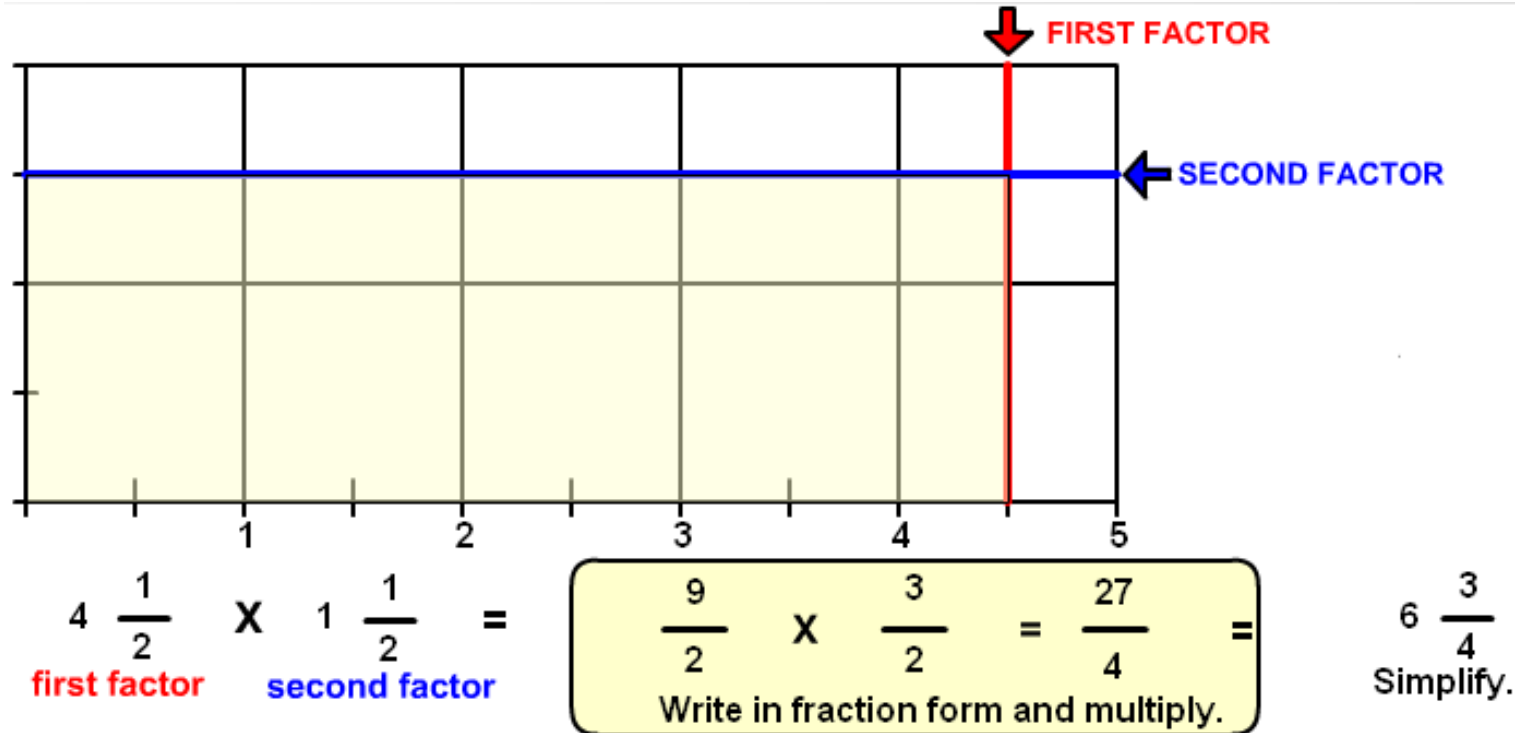
The same example, $2 \frac{2}{5} \times 2$ using a rectangular array. The first *factor* $2 \frac{2}{5}$, is shown by the red arrow - the horizontal distance. The second *factor* 2, is shown by the blue arrow - the vertical distance from the bottom. The *product*, $4 \frac{4}{5}$ is enclosed by the yellow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

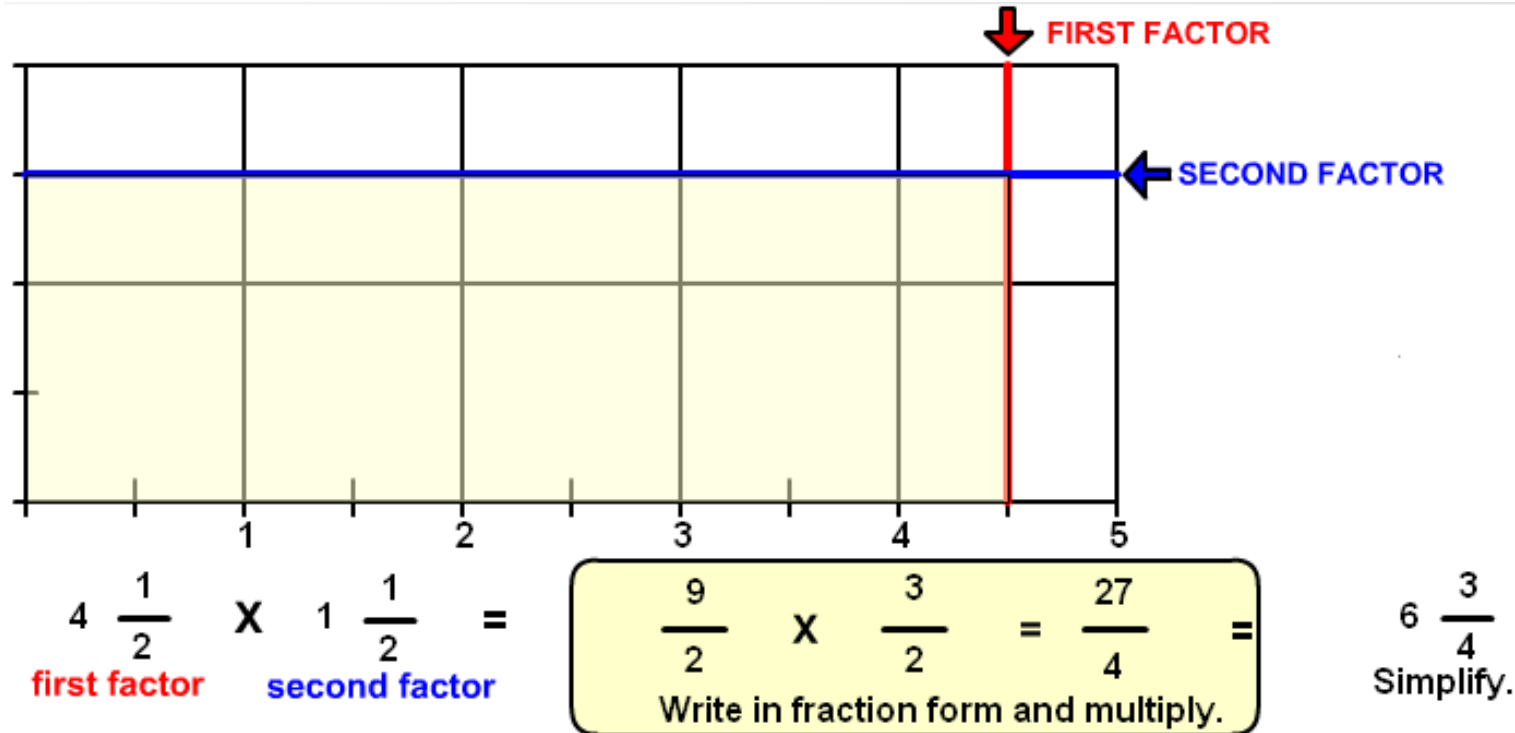
Multiply Fractions 9



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.

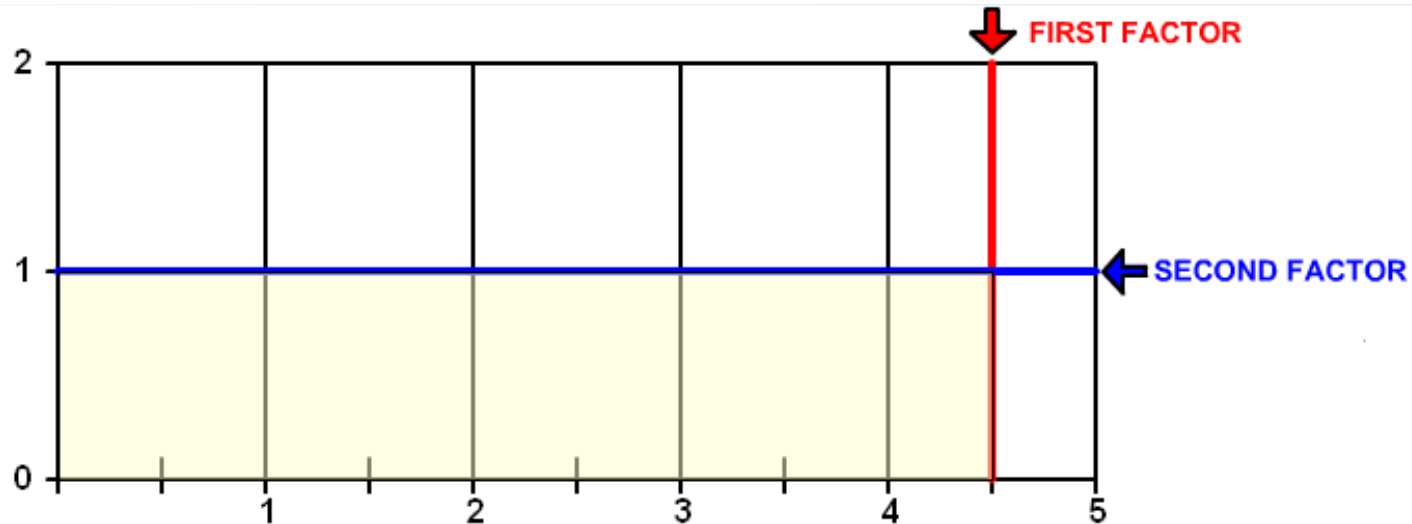
The *product* is greater than 4×1 but less than 5×2 so the *product* $6 \frac{3}{4}$ makes sense.

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



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

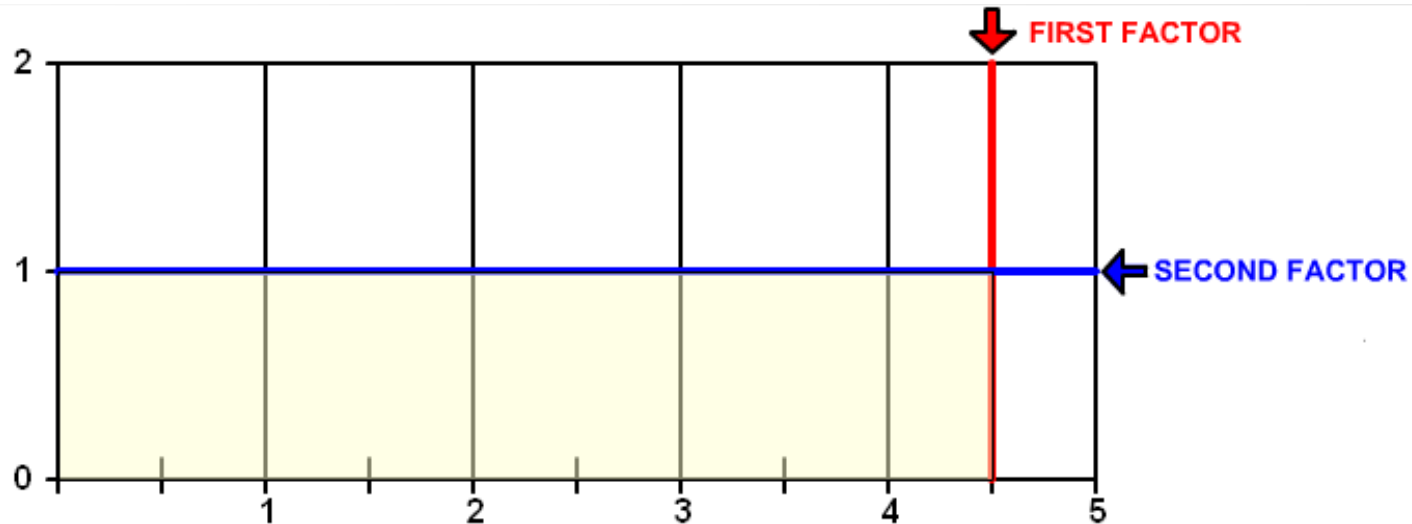
first factor **second factor**

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

Multiplying by 1

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

Multiply Fractions 12



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

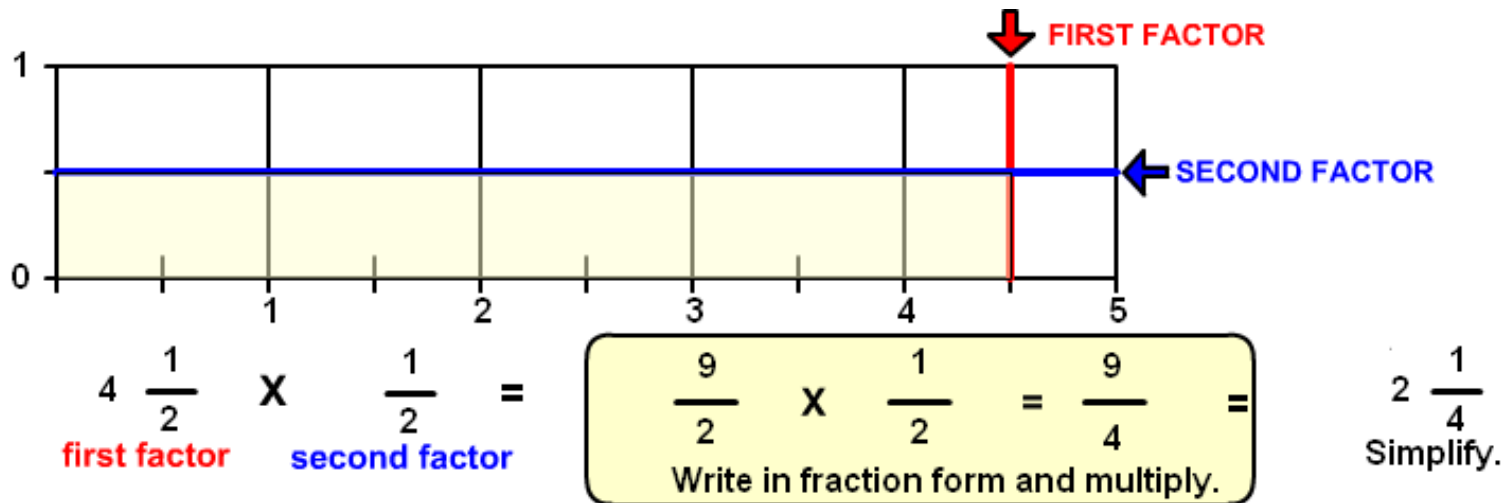
first factor **second factor**

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

Multiplying by 1

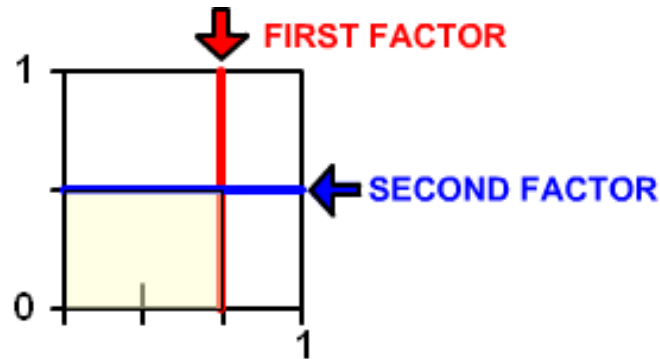
When 1 is used as a *factor*, the *product* is equal to the other *factor*. One is called the *identity* for multiplication.

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

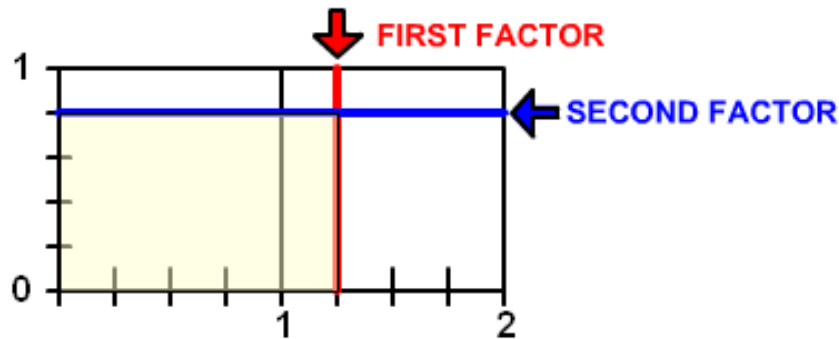


$$\frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$$

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**

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

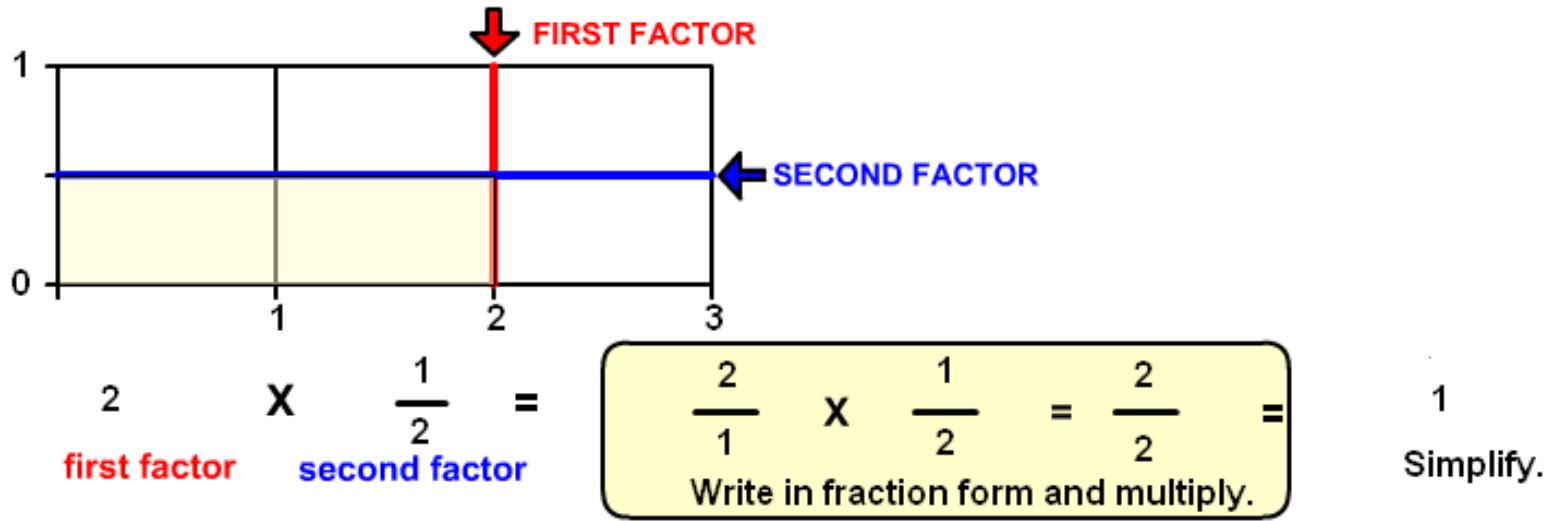
Write in fraction form and multiply.

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).

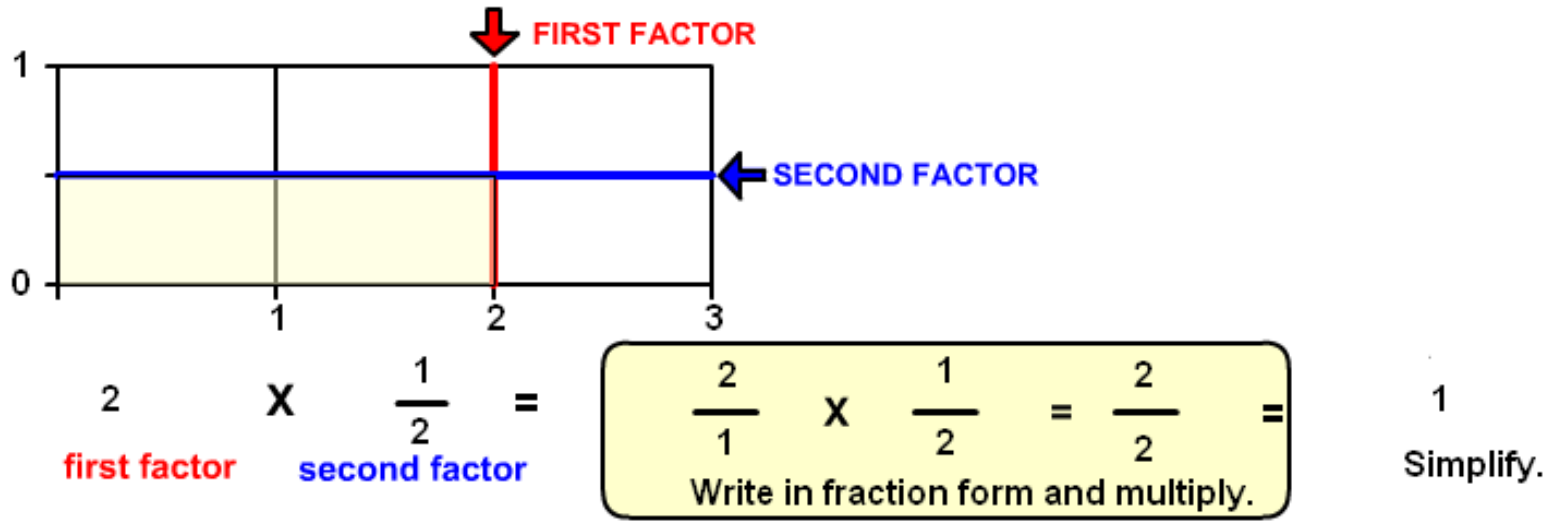
If you are asked to *invert* or write the *reciprocal* of $\frac{5}{4}$ you will write $\frac{4}{5}$.

Multiply Fractions 16



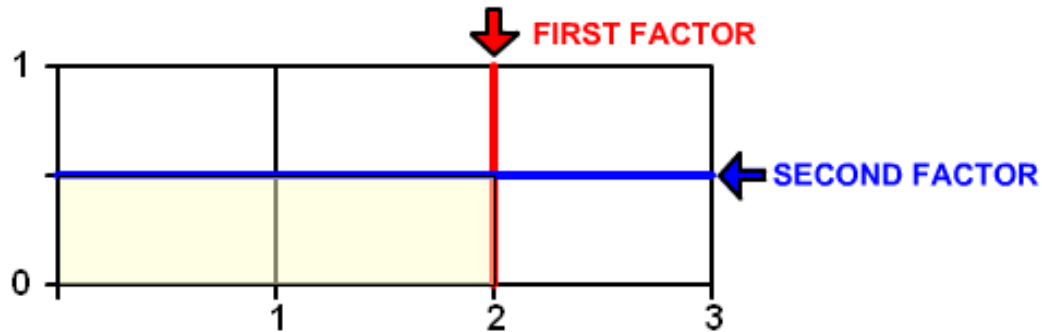
To find the *reciprocal* of a fraction, replace the denominator with the numerator and the numerator with the denominator. The *reciprocal* or *inverse* of $\frac{2}{1}$ is $\frac{1}{2}$.

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

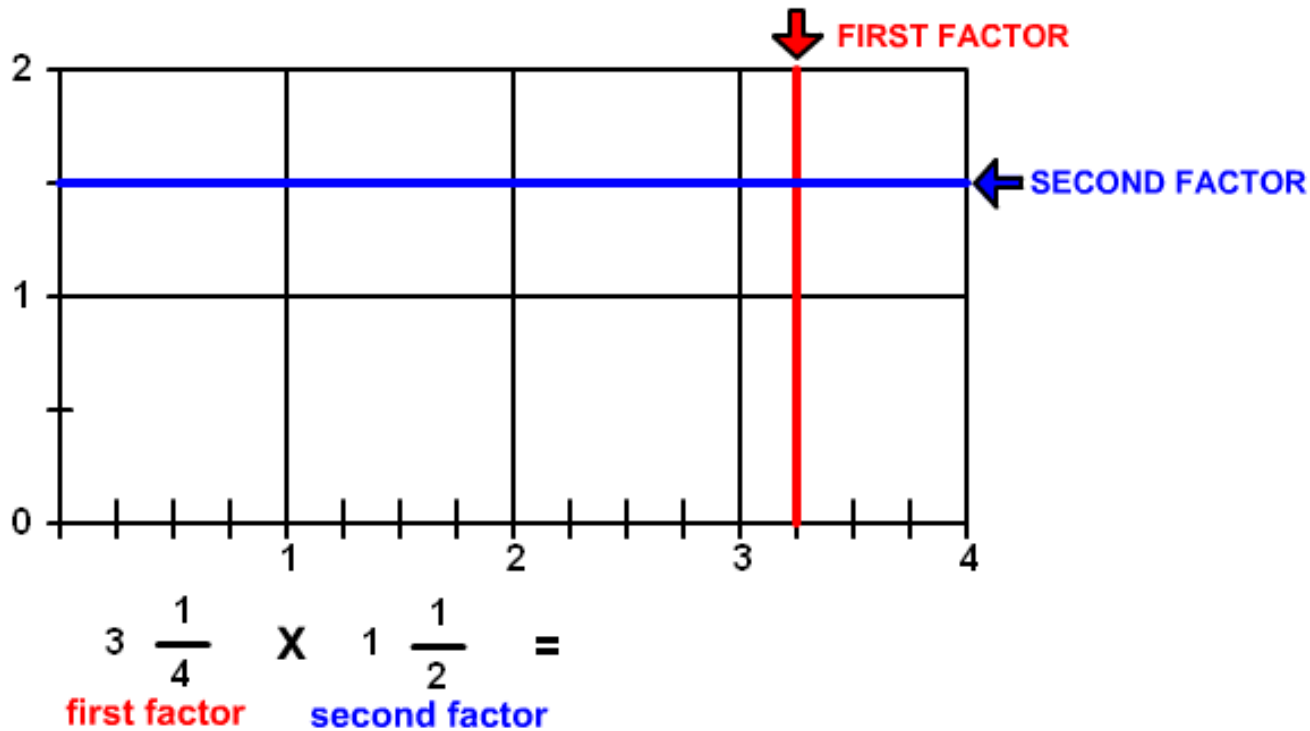
$$\frac{2}{1} \times \frac{1}{2} = \frac{2}{2} =$$

Write in fraction form and multiply.

1
Simplify.

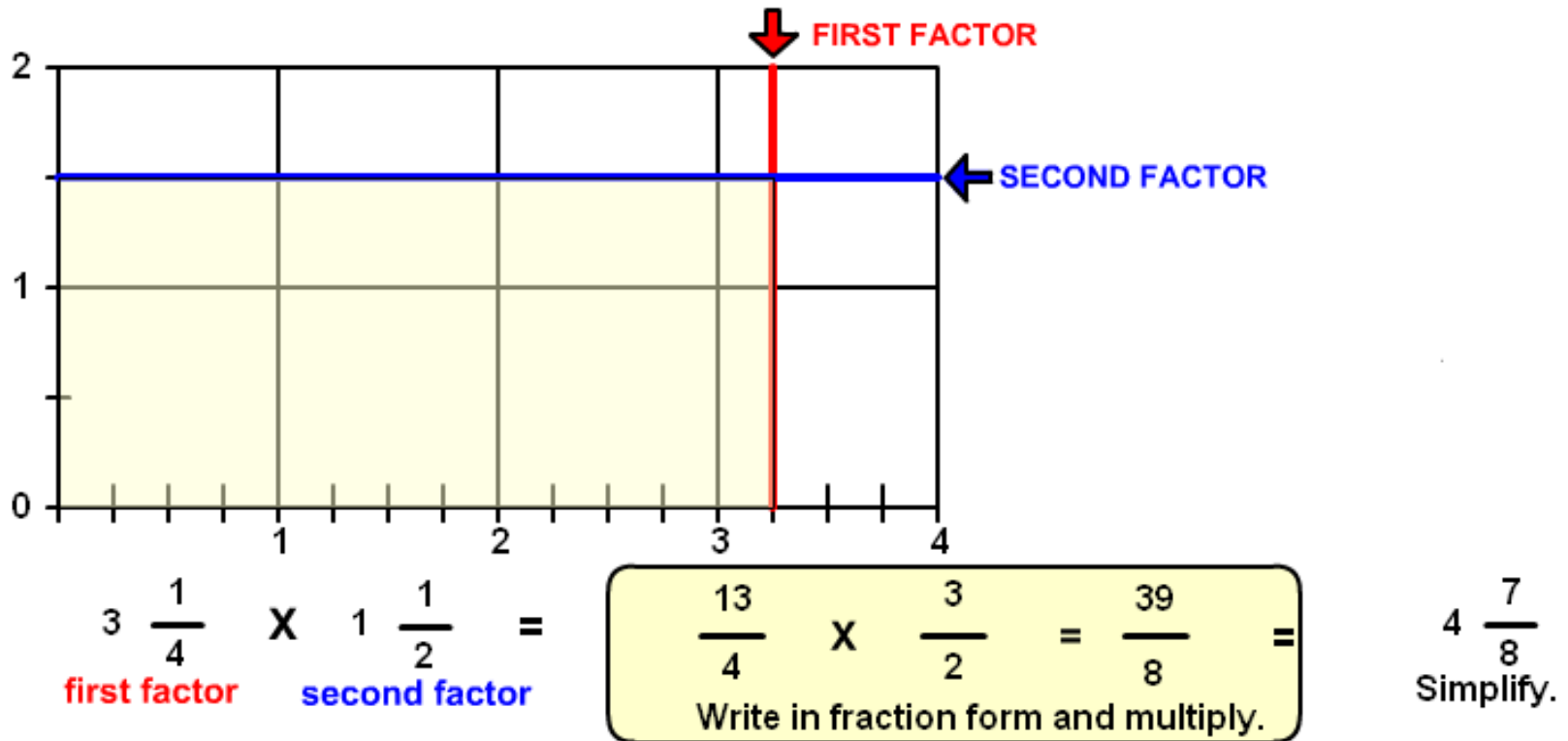
The factors 2 and $1/2$ are *reciprocals* because their *product* is 1.

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.