

Multiplying and Dividing Fractions: math lesson, Grade 5 – download the PDF

A fraction is more than a slice of pizza. It is a number, it can be a division, and you can multiply it and divide it just like whole numbers. In this chapter you will learn to see each operation in a picture first, then turn the picture into a short, reliable rule.

1. Fractions as division

D

Fractions as division

The fraction $\frac{a}{b}$ is the answer to $a \div b$ (with b not zero). The numerator is the amount being shared and the denominator is the number of equal shares.

Imagine 3 granola bars shared equally among 4 hikers. Cut each bar into 4 equal pieces: that makes 12 pieces, and each hiker takes 3 of them. Each hiker gets $\frac{3}{4}$ of a bar, so $3 \div 4 = \frac{3}{4}$.

When the numerator is larger than the denominator, the quotient is larger than 1. For example, $7 \div 2 = \frac{7}{2} = 3\frac{1}{2}$: if 7 pancakes are shared by 2 people, each person gets 3 whole pancakes and half of another one.

E**Example 1**

Five friends share 2 quarts of lemonade equally. Each friend gets $2 \div 5 = \frac{2}{5}$ of a quart.

2. Multiplying a whole number by a fraction

Multiplying a whole number by a fraction is repeated addition: $4 \times \frac{2}{5}$ means four groups of $\frac{2}{5}$.

Add them: $\frac{2}{5} + \frac{2}{5} + \frac{2}{5} + \frac{2}{5} = \frac{8}{5}$.

M**Method: whole number times fraction**

1. Multiply the whole number by the numerator.
2. Keep the denominator the same.
3. Simplify, or write the answer as a mixed number.

E**Example 2**

A hiking trail loop is $\frac{3}{8}$ mile long. You walk it 6 times. Distance:

$$6 \times \frac{3}{8} = \frac{18}{8} = \frac{9}{4} = 2\frac{1}{4} \text{ miles.}$$

3. Multiplying two fractions

P Multiplying fractions

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$$

Multiply the numerators together and the denominators together.

The word “of” often means multiply. Finding $\frac{2}{5}$ of $\frac{3}{4}$ is the same as computing $\frac{2}{5} \times \frac{3}{4} = \frac{6}{20} = \frac{3}{10}$.

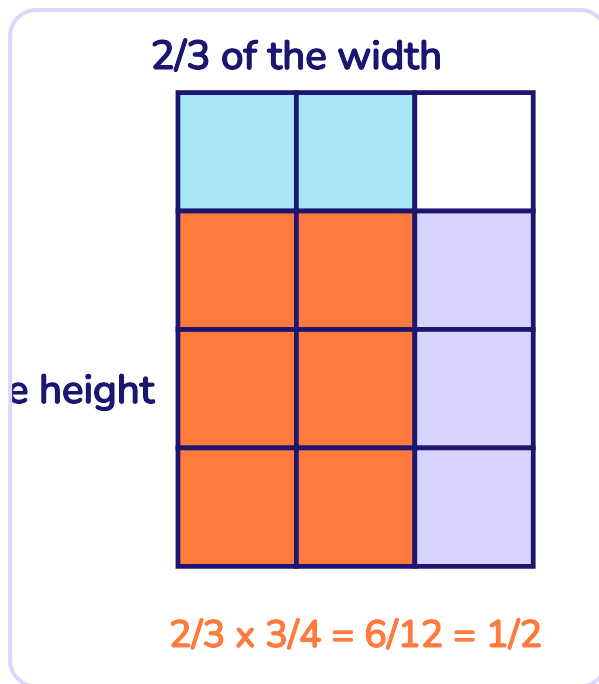
You can save work by simplifying before you multiply. In $\frac{3}{4} \times \frac{8}{9}$, the 4 and the 8 share the factor 4, and the 3 and the 9 share the factor 3. So $\frac{3}{4} \times \frac{8}{9} = \frac{1 \times 2}{1 \times 3} = \frac{2}{3}$.

E Example 3

A garden is $\frac{3}{5}$ planted with vegetables, and $\frac{1}{2}$ of the vegetable part is beans. Beans cover $\frac{1}{2} \times \frac{3}{5} = \frac{3}{10}$ of the garden.

4. The area model

A picture explains why the rule works. Draw a unit square. To show $\frac{2}{3} \times \frac{3}{4}$, cut it into 3 equal columns and 4 equal rows. That gives $3 \times 4 = 12$ small rectangles of the same size. Shade 2 columns, then shade 3 rows. The overlap holds $2 \times 3 = 6$ small rectangles out of 12.

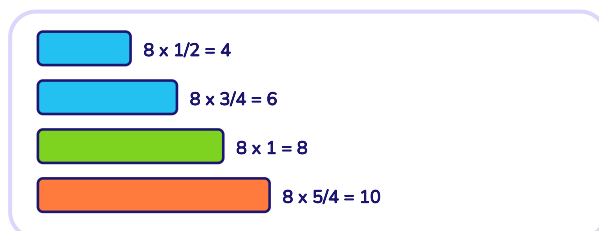


So $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$. The denominators multiply because the cuts create 3×4 pieces, and the numerators multiply because the overlap is 2 columns by 3 rows.

The same idea gives the area of a rectangle with fraction side lengths: a rectangle $\frac{3}{4}$ foot by $\frac{2}{3}$ foot has area $\frac{1}{2}$ square foot.

5. Multiplication as scaling

Multiplying by a fraction stretches or shrinks a number. You can predict the size of a product without calculating it.



P**Scaling rules**

- If the factor is greater than 1, the product is greater than the other number.
- If the factor equals 1 (such as $\frac{7}{7}$), the product stays the same.
- If the factor is less than 1, the product is smaller than the other number.

!**Zyro's tip**

On my home planet we check every answer with scaling first. If you multiply 40 by $\frac{3}{5}$ and get more than 40, something went wrong before you even picked up a pencil!

6. Multiplying mixed numbers**M****Method: mixed numbers**

1. Change each mixed number into an improper fraction.
2. Multiply the numerators and the denominators.
3. Simplify and, if you like, change back to a mixed number.

E**Example 4**

Compute $2\frac{1}{2} \times 1\frac{1}{5}$. Convert: $2\frac{1}{2} = \frac{5}{2}$ and $1\frac{1}{5} = \frac{6}{5}$. Then $\frac{5}{2} \times \frac{6}{5} = \frac{30}{10} = 3$.



Common mistake

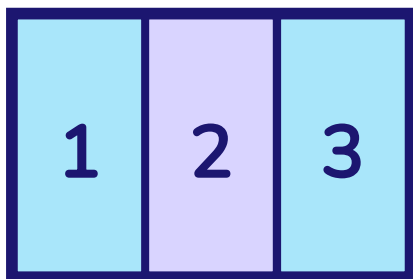
Do not multiply the whole parts and the fraction parts separately. $2\frac{1}{2} \times 1\frac{1}{5}$ is not 2×1 and $\frac{1}{2} \times \frac{1}{5}$ put side by side. Always convert to improper fractions first.

7. Dividing with unit fractions

A unit fraction has 1 as its numerator, such as $\frac{1}{3}$ or $\frac{1}{8}$. Grade 5 works with two kinds of division involving unit fractions.

A unit fraction divided by a whole number

Splitting $\frac{1}{2}$ into 3 equal parts makes pieces that are each $\frac{1}{6}$ of the whole.



3 equal parts: 1

So $\frac{1}{2} \div 3 = \frac{1}{2 \times 3} = \frac{1}{6}$. In general, $\frac{1}{b} \div n = \frac{1}{b \times n}$.

A whole number divided by a unit fraction

Dividing asks “how many pieces fit?” With 4 wholes cut into thirds, there are $4 \times 3 = 12$ pieces.

So $4 \div \frac{1}{3} = 12$.



4 wholes, 3 pieces each: $4 \div \frac{1}{3} = 12$

P

Unit fraction division

$$\frac{1}{b} \div n = \frac{1}{b \times n} \text{ and } n \div \frac{1}{b} = n \times b.$$

E

Example 5

A ribbon $\frac{1}{4}$ yard long is cut into 3 equal pieces: each piece is $\frac{1}{4} \div 3 = \frac{1}{12}$ yard. How many $\frac{1}{6}$ -pound scoops fill a 5-pound bag? $5 \div \frac{1}{6} = 30$ scoops.

You can always check a division with multiplication: since $12 \times \frac{1}{3} = 4$, we know $4 \div \frac{1}{3} = 12$.

8. Fraction word problems

M Method: solving a word problem

1. Read the problem and say in your own words what is asked.
2. Decide the operation: sharing or “how many fit” means divide, “of” or “groups of” means multiply.
3. Estimate with scaling, then calculate and simplify.
4. Write a sentence with the unit.

E Example 6

A pool is $3\frac{1}{2}$ feet deep at one end. A float line is at $\frac{2}{7}$ of that depth. Its depth is $\frac{2}{7} \times \frac{7}{2} = 1$ foot. The float line sits 1 foot below the surface.

Key takeaways

- $\frac{a}{b} = a \div b$: a fraction is a division.
- To multiply fractions, multiply numerators and multiply denominators; simplify at the end or before.
- The area model shows $\frac{a}{b} \times \frac{c}{d}$ as the overlap of shaded columns and rows.
- A factor greater than 1 makes a product bigger; a factor less than 1 makes it smaller.
- Convert mixed numbers to improper fractions before multiplying.
- $\frac{1}{b} \div n = \frac{1}{b \times n}$ and $n \div \frac{1}{b} = n \times b$.



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