



Why Do You Multiply Fractions Straight Across?

Video: 3:45 · Episode 006

Grades: 5–7 · Math

Time: 30–45 min (video + worksheet + quiz)

Key term: area model (a square or rectangle cut into rows and columns to show multiplying)

Connects to Common Core: 5.NF.B.4 (multiplying a fraction by a fraction; area of a rectangle with fractional sides) · 5.NF.B.6 (real-world problems with fraction multiplication). Follows episode 002 (dividing fractions).

The big idea

With fractions, "times" means "of." $\frac{2}{3} \times \frac{4}{5}$ is two thirds **of** four fifths. On a square that is one whole, shade 4 of 5 strips, then keep 2 of 3 rows of that. The cuts make $3 \times 5 = 15$ equal pieces (the bottoms), and the part you keep is $2 \times 4 = 8$ pieces (the tops): $\frac{8}{15}$. Adding is different: it puts pieces side by side, so they have to be the same size first.

One-line recap students should be able to say: "The bottoms count all the pieces, and the tops count the pieces you keep."

Learning goals

- Read a fraction times a fraction as a fraction *of* a fraction.
- Draw an area model for a product of two fractions and find the product by counting pieces.
- Explain why the denominators multiply (all the pieces) and the numerators multiply (the kept pieces).
- Explain why multiplying by a fraction less than 1 gives a smaller answer.

How to use it

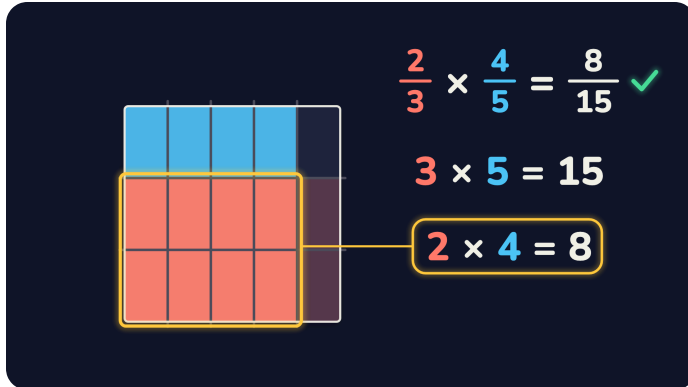
1. **Before watching (3 min):** students answer the prediction on the worksheet. Don't correct them yet.
2. **Watch (4 min):** play it straight through. Optional check-in pause when $\frac{8}{15}$ appears (about 2:14).
3. **Worksheet (10 min):** shade the area models, then explain the chocolate bar.
4. **Discuss (10 min):** pick two or three discussion questions.
5. **Quiz (5 min):** six quick questions; answer key on the last page.

What the video simplifies (so you can answer the sharp questions): "times means of" is one meaning of multiplication (5.NF.B.4a); whole numbers are shown as groups. Order doesn't matter ($\frac{4}{5}$ of $\frac{2}{3}$ is also $\frac{8}{15}$), which the video doesn't say. Both answers shown ($\frac{8}{15}$ and $\frac{3}{8}$) are already in lowest terms, so simplifying never comes up. Fractions greater than 1 need more than one square. The video avoids "cross multiply," which is a different procedure.

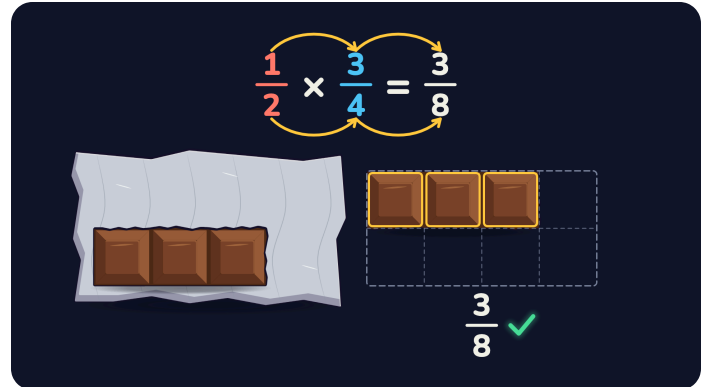


Fold a Fraction of a Fraction

Students build the video's area model with a square of paper. Folding one way makes the strips; folding the other way makes the rows. Unfold, and the creases count every piece.



From the video: the tops count the pieces you keep



Half of three fourths of a bar: 3 of 8 squares

You need

- Square paper (sticky notes or cut copy paper), two colored pencils or crayons
- Problem cards, e.g. $\frac{1}{2} \times \frac{1}{2}$, $\frac{1}{2} \times \frac{3}{4}$, $\frac{2}{3} \times \frac{1}{2}$, $\frac{3}{4} \times \frac{2}{3}$, $\frac{2}{3} \times \frac{4}{5}$

Steps (for $a/b \times c/d$)

1. Fold the paper into **d** equal strips (up and down). Unfold. Shade **c** strips in blue.
2. Fold the paper into **b** equal rows (side to side). Unfold. Shade **a** rows in red, across the whole paper.
3. Count all the pieces the creases make. That's the bottom of the answer.
4. Count the pieces that are both blue and red. That's the top of the answer.
5. Check: multiply straight across. Do you get the same fraction?

Folding thirds and fifths takes practice: roll the paper into an S shape and flatten it for thirds; for fifths, mark the edge with a ruler first.

Talk about it

- Why did every answer come out smaller than both fractions you started with?
- For $\frac{2}{3} \times \frac{1}{2}$ and $\frac{1}{2} \times \frac{2}{3}$, did you get the same answer? Did the paper look the same?
- Where in the video did the chocolate bar act like your folded paper?



Why Do You Multiply Fractions Straight Across?

Name: _____

Date: _____

Before you watch

Adding fractions straight across doesn't work. Why do you think multiplying straight across does?

While you watch

1. With fractions, "times" means _____.
2. Half of a half is _____.
3. For $2/3 \times 4/5$, the whole square is cut into _____ $\times$ _____ = _____ pieces.
4. The pieces we keep: _____ $\times$ _____ = _____.
5. So $2/3 \times 4/5 =$ _____.
6. A square cut into rows and columns to show multiplying is called an _____.

Draw it

Each box is one whole. Cut it into strips and rows, shade, and count to find the answer.

$$1/2 \times 3/4 = \underline{\hspace{2cm}}$$

$$2/3 \times 3/4 = \underline{\hspace{2cm}}$$

Explain it

A chocolate bar has 2 rows of 4 squares. You have $3/4$ of it, and give a friend half of your piece. What fraction of the whole bar does your friend get? Explain with the bar's squares.



Talk It Over, Then Check Yourself

Discussion questions

1. Why does $1/2 + 1/2$ not equal $2/4$? Use pizza slices or bars to explain.
2. $3 \times 4 = 12$ is bigger than 3 and 4, but $1/2 \times 1/2 = 1/4$ is smaller than $1/2$. What is different?
3. In an area model, why do the bottom numbers multiply? Why do the top numbers multiply?
4. Is $2/3$ of $4/5$ the same as $4/5$ of $2/3$? Draw both and compare.
5. Make up your own real-life "part of a part" problem and solve it two ways.

Quiz

Name: _____

1. What is $1/3 \times 2/5$? (Circle one.)
A. $3/8$ B. $2/15$
C. $3/15$ D. $2/8$
2. In the area model for $3/4 \times 2/3$, how many pieces is the whole square cut into?
A. 7 B. 6
C. 12 D. 5
3. What does " $1/2 \times 6$ " mean?
A. Half of 6 B. 6 halves added to 2
C. 6 divided by 1 D. 12
4. True or false: $3/4 \times 1/2$ is bigger than $3/4$. _____
5. Why do you need matching bottoms to add fractions?
A. It's just the rule B. The pieces must be the same size to count them together
C. To make the answer smaller D. You don't
6. Draw an area model for $2/3 \times 1/2$ and write the answer.



Answer Key

Worksheet: while you watch

1. of · 2. one fourth ($1/4$) · 3. $3 \times 5 = 15$ · 4. $2 \times 4 = 8$ · 5. $8/15$ · 6. area model

Draw it: $1/2 \times 3/4$: 4 strips, shade 3; 2 rows, keep 1. 8 pieces, 3 kept: **$3/8$** . $2/3 \times 3/4$: 4 strips, shade 3; 3 rows, keep 2. 12 pieces, 6 kept: **$6/12$** ($= 1/2$).

Explain it: $3/4$ of the bar is 3 columns, 6 squares. Half of that is one row of 3 squares. 3 of the bar's 8 squares: $1/2 \times 3/4 = 3/8$.

Quiz

1. **B.** $2/15$. Tops: $1 \times 2 = 2$. Bottoms: $3 \times 5 = 15$.
2. **C.** 12. Four strips and three rows: $3 \times 4 = 12$.
3. **A.** Half of 6, which is 3.
4. **False.** Half of $3/4$ is $3/8$, which is smaller than $3/4$.
5. **B.** Adding counts pieces together, so they must be the same size first.
6. Cut into 2 strips (shade 1) and 3 rows (keep 2): 6 pieces, 2 kept. $2/6$ ($= 1/3$).

Discussion: points to listen for

1. Two halves make one whole pizza; $2/4$ is only half a pizza. Adding straight across counts pieces of different sizes as if they were the same.
2. Multiplying by a number bigger than 1 makes more; taking a part "of" something (a fraction less than 1) makes less.
3. Bottoms: strips $\times$ rows = every piece in the whole. Tops: shaded strips $\times$ kept rows = the pieces in both.
4. Yes, both are $8/15$. The pictures are turned: one keeps strips of rows, the other rows of strips.
5. Any "part of a part" story: half of a $3/4$ -full pan of brownies, $2/3$ of the $3/4$ of a class that rides the bus.