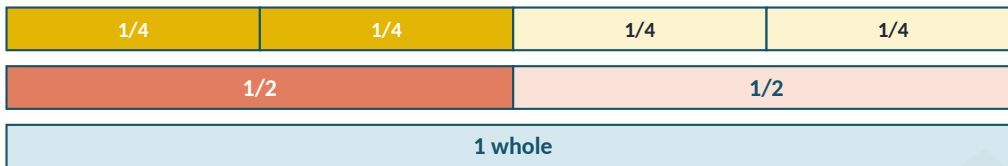


GRADE 6 • CCSS 6.NS.A.1 • DISCOVERY LAB



Dividing Fractions by Fractions

Visual Models Lab

Discover the “Keep-Change-Flip” Rule

*A discovery-based lab where students derive the
division-of-fractions algorithm through three
visual models: Fraction Bars, Number Lines, and Area Models.*

Teacher Scripts

3 Visual Models

20 Task Cards

Vocab Foldable

Complete Answer Key • 10-Question Quiz • Printable Manipulatives
Vocabulary Foldable • Grid Paper • Fraction Bars

Created by

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Teacher Overview & Lesson Plan

Standard Alignment

CCSS.MATH.CONTENT.6.NS.A.1 — Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for $(2/3) \div (3/4)$ and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $(2/3) \div (3/4) = 8/9$ because $3/4$ of $8/9$ is $2/3$. (In general, $(a/b) \div (c/d) = ad/bc$.) How much chocolate will each person get if 3 people share $1/2$ lb of chocolate equally? How many $3/4$ -cup servings are in $2/3$ of a cup of yogurt? How wide is a rectangular strip of land with length $3/4$ mi and area $1/2$ square mi?*

Most existing Grade 6 resources teach the **Keep-Change-Flip** algorithm (also called “invert and multiply”) as a procedure to memorize, with at most a brief visual justification. This lab reverses that order. Students work through three distinct visual models, each illuminating a different facet of fraction division. Only after they have *seen* the pattern repeat across all three models do they generalize the rule themselves. By the time the algorithm is named and formalized, students can explain **why** it works — not just **that** it works.

Mathematical Goal

KEY INSIGHT

Students will discover that dividing by a fraction c/d is equivalent to multiplying by its reciprocal d/c . Through three visual models, they will see that $(a/b) \div (c/d)$ answers the question “how many groups of c/d fit inside a/b ?” — and that the answer is always $(a \times d)/(b \times c)$.

Learning Targets (I-Can Statements)

- I can use a fraction bar model to divide a fraction by a fraction and explain what the quotient means.
- I can use a number line with jumps to divide a fraction by a fraction and count the quotient.
- I can use an area model to divide a fraction by a fraction and count the quotient.
- I can describe the pattern I notice across all three visual models.
- I can derive the rule $(a/b) \div (c/d) = (a \times d) / (b \times c)$ from the visual models.
- I can solve real-world fraction division word problems in sharing, measuring, rate, and comparison contexts.
- I can fluently apply the Keep-Change-Flip algorithm and verify my answer with a visual model.

Essential Questions

- What does it mean to divide one fraction by another fraction?

Divisor	The number you divide by (the size of each group or jump).	In $1/2 \div 1/4$, the divisor is $1/4$.
Quotient	The answer to a division problem; how many groups fit.	In $1/2 \div 1/4 = 2$, the quotient is 2 .
Reciprocal	Two numbers are reciprocals if their product is 1. Found by flipping a fraction.	The reciprocal of $3/4$ is $4/3$ because $3/4 \times 4/3 = 1$.
Multiplicative Inverse	Another name for reciprocal. The number you multiply by to get 1.	The multiplicative inverse of 5 is $1/5$.

ASK STUDENTS

Before we start: Think of a real situation where you would ask, “How many of these fit inside that?” Can you think of a time you have done this with food, money, or measuring?

ANTICIPATED STUDENT RESPONSES

Correct reasoning: “Two quarter-bars fit on the half-bar, so the answer is 2.”

Common error 1: “4, because the bottom number is 4.” (Address by re-asking: “How many $\frac{1}{4}$ bars cover the $\frac{1}{2}$?”)

Common error 2: “ $\frac{1}{8}$, because $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$.” (Student is multiplying instead of dividing. Re-state the question as “how many fit,” not “how much total.”)

PREVIEW

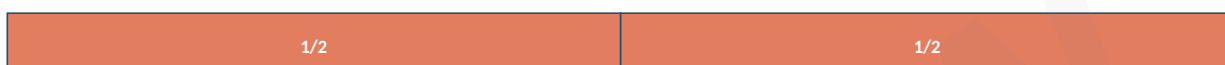
Printable Fraction Bar Manipulatives

Print on cardstock and laminate for durability. Cut along the lines to create individual fraction bar pieces. Each student (or pair of students) should receive one complete set. Suggested color-coding: keep the colors as printed — the warm coral, gold, teal, and purple palette helps students visually distinguish denominators during the lab. If printing in black-and-white, students can color each row a different color before cutting.

1 whole



$\frac{1}{2}$



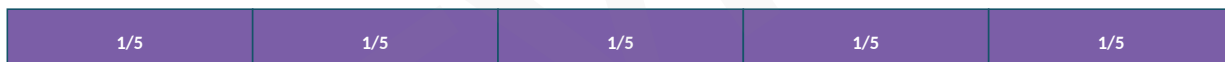
$\frac{1}{3}$



$\frac{1}{4}$



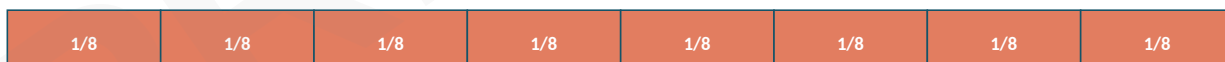
$\frac{1}{5}$



$\frac{1}{6}$



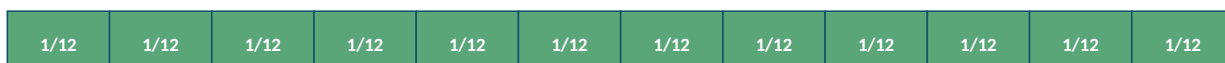
$\frac{1}{8}$



$\frac{1}{10}$



$\frac{1}{12}$



TEACHER TIP

Have students store their cut bars in a labeled envelope or zip-top bag. A class set lasts multiple years if laminated. If you teach multiple sections, consider color-coding each class set with a small dot sticker on the back of each piece so lost pieces can be returned to the right bag.

Printable Number Line Templates

Print one set per student. The templates below provide pre-formatted number lines for the most common denominators used in Grade 6 fraction division (sixths, eighths, twelfths). A blank template is included at the bottom for custom denominators. Students can use these directly or trace them into their notebooks.

Number Line Marked in Sixths (0 to 1)



Number Line Marked in Sixths (0 to 2)



Number Line Marked in Eighths (0 to 1)



Number Line Marked in Eighths (0 to 2)



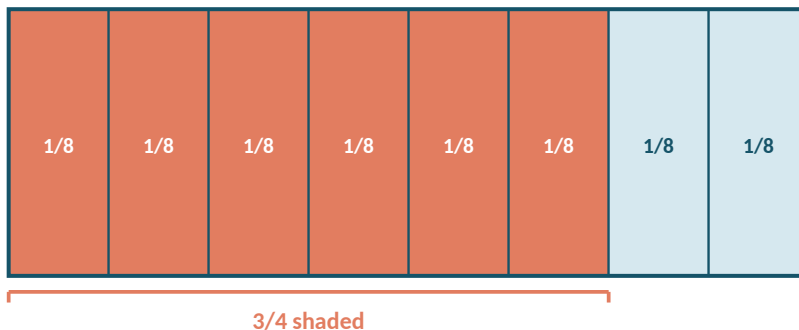
Number Line Marked in Twelfths (0 to 1)



Number Line Marked in Twelfths (0 to 2)



Blank Number Line (for custom denominators)

1 whole = 8 pieces of $\frac{1}{8}$ 

What students see: A whole rectangle divided into 8 columns, each labeled $\frac{1}{8}$. The first **6 columns are shaded coral** (representing $\frac{3}{4} = \frac{6}{8}$). The number of shaded columns IS the quotient: **6 pieces of $\frac{1}{8}$ fit inside $\frac{3}{4}$** . So $\frac{3}{4} \div \frac{1}{8} = 6$.

Step 3: Connect to Division (4 minutes)

TEACHER SAYS

“We started with $\frac{3}{4}$ of a chocolate bar. We asked: how many $\frac{1}{8}$ -sized pieces are in that $\frac{3}{4}$? The answer is 6, because $\frac{3}{4}$ is the same as $\frac{6}{8}$ — there are six $\frac{1}{8}$ s in $\frac{3}{4}$. So $\frac{3}{4} \div \frac{1}{8} = 6$.”

KEY INSIGHT

Dividing $\frac{3}{4}$ by $\frac{1}{8}$ asks “how many $\frac{1}{8}$ -sized pieces fit inside $\frac{3}{4}$?” Because $\frac{3}{4} = \frac{6}{8}$, the answer is 6. We can write: $\frac{3}{4} \div \frac{1}{8} = 6$.

Step 4: Try a Non-Unit Divisor (5 minutes)

Now introduce a problem where the divisor is NOT a unit fraction: $\frac{1}{2} \div \frac{3}{8} = ?$ Draw a rectangle divided into 8 columns. Shade 4 of them ($\frac{1}{2} = \frac{4}{8}$). Now group the shaded columns into sets of 3 (the divisor). 4 shaded columns $\div$ 3 columns per group = $\frac{4}{3} = 1 \frac{1}{3}$. So $\frac{1}{2} \div \frac{3}{8} = \frac{4}{3}$. (Verify with KCF: $\frac{1}{2} \times \frac{8}{3} = \frac{8}{6} = \frac{4}{3} = 1 \frac{1}{3}$ ✓)

Step 5: Compare All Three Models (3 minutes)

TEACHER SAYS

“We have now used three different visual models. In every case, the question was the same: how many of the divisor fit inside the dividend? Tomorrow we will look at all our examples and find a PATTERN.”

CONNECTION TO MULTIPLICATION

The area model is the same picture used for fraction multiplication: a rectangle partitioned two ways, with the overlap representing the product. For division, we ask the inverse: given the product (shaded area) and one factor (piece size), what is the other factor (count)? This multiplicative-inverse relationship gives “Keep-Change-Flip” its mathematical foundation.

Generalizing the Pattern — Discovery Sheet

Name: _____ Date: _____

You have now used three different visual models — fraction bars, number lines, and area models — to divide fractions by fractions. In every case, you found the answer by counting how many of the divisor fit inside the dividend. Today, you will look at ALL your results together and discover the pattern. This pattern is the famous “Keep-Change-Flip” rule — but you will derive it YOURSELF, not memorize it from a textbook.

Step 1: Collect Your Results

Fill in the table below with the problems you solved in Models 1, 2, and 3. The first row is completed as an example. Pay close attention to the divisor and the quotient columns.

#	Dividend (a/b)	Divisor (c/d)	Quotient	Reciprocal of Divisor	Dividend × Reciprocal
1	$1/2$	$1/4$	2	$4/1 = 4$	$1/2 \times 4 = 2$
2	$1/3$	$1/6$	_____	_____	$1/3 \times \text{_____} = \text{_____}$
3	$2/3$	$1/6$	_____	_____	$2/3 \times \text{_____} = \text{_____}$
4	$3/4$	$1/8$	_____	_____	$3/4 \times \text{_____} = \text{_____}$

Step 2: Find the Pattern

Look at the last two columns of the table. What do you notice?

Answer: _____

ASK STUDENTS

Compare the quotient column to the “Dividend × Reciprocal” column. Are they the same? If yes, what does that tell you about division by a fraction?

Step 3: State the Rule in Your Own Words

Write a sentence (or two) describing the pattern you found. Use these sentence frames if helpful:

Flip	Flip the divisor to its reciprocal.	c/d becomes d/c	$1/4$ becomes $4/1$
Multiply	Multiply across; simplify.	$a/b \times d/c = ad/bc$	$1/2 \times 4/1 = 4/2 = 2$

Why Does It Work? (The Deeper Reason)

The Keep-Change-Flip rule is not magic — it comes from a deep property of multiplication. Multiplying both sides of an equation by the same non-zero number preserves the equation. Here is the proof in three lines:

Start: Let $Q = (a/b) \div (c/d)$. This means $Q \times (c/d) = a/b$.

Multiply both sides by d/c (the reciprocal of c/d): $Q \times (c/d) \times (d/c) = (a/b) \times (d/c)$.

Simplify the left side: $(c/d) \times (d/c) = 1$, so $Q \times 1 = (a/b) \times (d/c)$.

Conclusion: $Q = (a/b) \times (d/c) = ad/bc$. ✓

KEY INSIGHT

The reciprocal of the divisor “cancels out” the divisor on the left side, leaving Q alone. On the right side, we are left with the dividend multiplied by the reciprocal of the divisor. This is the algebraic heart of “Keep-Change-Flip.”

Practice Applying the Algorithm

Now that you have discovered AND derived the rule, try these four practice problems. Show each step: write the problem, apply Keep-Change-Flip, multiply, and simplify if needed.

1. $2/5 \div 1/3 = ?$

Work space:

Answer: _____

2. $3/4 \div 2/3 = ?$

Work space:

Answer: _____

3. $5/6 \div 5/6 = ?$



What's Inside the Full Resource

Dividing Fractions by Fractions — Visual Models Lab

Grade 6 • CCSS 6.NS.A.1 • Discovery-Based Lab • 54 Pages Total

54

Total Pages

3

Visual Models

20

Task Cards

FULL RESOURCE INCLUDES:

Teacher Scripts

Step-by-step guided discovery lessons for all 3 visual models

Fraction Bars Model

Concrete manipulative-based exploration with printable bars

Number Lines Model

Jump-based visual reasoning with pre-ticked templates

Area Models

Grid-based shading approach for visualizing fraction division

Keep-Change-Flip Rule

Student-derived generalization with 3-line mathematical proof

20 Task Cards

Scaffolded practice with recording sheet & complete answer key

Vocabulary Foldable

5 interactive terms: quotient, dividend, divisor, reciprocal, inverse

Printable Manipulatives

Fraction bars, number lines, grid paper — ready to cut & use

10-Question Quiz

Mixed-model assessment with detailed answer key & rubric

Complete Answer Keys

Worked solutions for every model, task card, and quiz item

WHY TEACHERS LOVE IT:

Discovery-Based

Students derive the rule themselves — no rote memorization

Print & Teach

Low-prep — scripts, manipulatives, and keys all included

Classroom-Tested

Built around Grade 6 common misconceptions and pacing

✓ NO PREP REQUIRED

✓ PRINT & TEACH

✓ ANSWER KEYS INCLUDED

✓ CLASSROOM-TESTED

Download the full 54-page resource to access everything above.