

# 7.8 Divide Mixed Numbers

## Multiply and Divide Fractions

### OBJECTIVE

- Students will divide fractions and mixed numbers.

### + EXTENSION

#### Materials

- BLM 7.8A Directions: Brain Game, BLMs 7.8B–C Game Cards: Brain Game, BLM 7.8D Game Board: Brain Game
- Print and distribute **BLMs 7.8A Directions: Brain Game, 7.8B–C Game Cards: Brain Game, and 7.8D Game Board: Brain Game** to each small group of 2–6 players. Have groups cut apart the playing pieces on BLM 7.8A and the game cards on BLMs 7.8B–C. Read through the directions together. Have groups play the game for a review of adding, subtracting, multiplying, and dividing fractions and mixed numbers.

### Introduction

Present the following problem:

Two sixth graders are making a math game. They drew the game board on an  $8\frac{1}{2}$  in.  $\times$  11 in. piece of paper. Now they want to write rows of fraction equations along the 11 in. side of the paper. How many rows of fraction equations can they make if each row is  $\frac{1}{2}$  in. apart?

Distribute an  $8\frac{1}{2}$  in. by 11 in. piece of paper to each student. Have them turn the paper so the 11 in. edge is at the top. Direct them to devise a strategy to solve the problem. (**Possible answers: Mark  $\frac{1}{2}$  in. increments on the  $8\frac{1}{2}$  in. edge of the paper; use mental math; calculate 16 halves in 8 plus an additional half = 17 half in.; rename the mixed number as an improper fraction and multiply by the reciprocal of  $\frac{1}{2}$ .**) Have students use a ruler to mark and to fold their paper into  $\frac{1}{2}$ -inch rows that are 11 in. in length. Ask how to write the equation to show the problem and answer. ( **$8\frac{1}{2} \div \frac{1}{2} = 17$  rows**)

### Directed Instruction +

**1** Explain that making a model of a fraction equation helps verify an understanding of the equation and knowledge of what operation is being used. Challenge students to use their rulers to find other fractions and mixed numbers that will divide the paper evenly into rows that are at least  $\frac{1}{4}$  in. wide. Encourage them to use rulers and  $8\frac{1}{2}$  in. by 11 in. pieces of paper as needed. (**Possible answers: 34 rows  $\frac{1}{4}$  in. apart, 4 rows  $2\frac{1}{8}$  in. apart, 2 rows  $4\frac{1}{4}$  in. apart**)

Have students write in their math journals to show the equation for each number of rows they marked on the paper. (**Possible answers:  $8\frac{1}{2} \div 4 = 34$ ;  $8\frac{1}{2} \div 2\frac{1}{8} = 4$ ;  $8\frac{1}{2} \div 4\frac{1}{4} = 2$** ) Ask students what type of quotient each problem has. (**a whole number**) To reinforce the concept of dividing numbers by fractions or by whole numbers, have students express what each equation represents. (**Possible answers: There are 34 fourths in  $8\frac{1}{2}$  in.;  $8\frac{1}{2}$  in. are divided into four  $2\frac{1}{8}$  in. parts;  $8\frac{1}{2}$  in. are divided into two  $4\frac{1}{4}$  in. parts.**)

Write  $8\frac{1}{2} \div \frac{1}{4}$  on the board. Have students brainstorm how they would show each step of the division problem that calls for dividing a mixed number by a fraction. Suggest that students first recall what they know about dividing a whole number by a fraction. Have them review the steps needed to solve the problem  $5 \div \frac{1}{3}$ . (**Rename the whole number 5 as the fraction  $\frac{5}{1}$ ; multiply  $\frac{5}{1}$  by the reciprocal of  $\frac{1}{3}$ , which is  $\frac{3}{1}$ ; solve for the answer 15.**) What part of the equation will you need to rename in order to divide a mixed number by a fraction? (**We will need to rename the mixed number as an improper fraction.**) How would you rename  $8\frac{1}{2}$  as an improper fraction? (**by multiplying the denominator by the whole number and adding the product to the numerator:  $17\frac{1}{2}$** ) Model each step of the division of  $8\frac{1}{2} \div \frac{1}{4}$  as shown below. Point out that after the mixed number is renamed, it is multiplied by the reciprocal of the divisor.

$$8\frac{1}{2} \div \frac{1}{4} = \frac{17}{2} \div \frac{1}{4} = \frac{17}{2} \times \frac{4}{1} = 34$$

**2** Distribute graph paper to give students an opportunity to make models of fraction equations. Write on the board  $8\frac{1}{2} \div 2\frac{1}{8}$ . Have students draw models by outlining 8 rectangles of 8 squares each and 1 rectangle of 4 squares. Ask what whole number is represented by each rectangle of 8 squares. (**1**) What fraction is represented by each individual square in the rectangle? ( **$\frac{1}{8}$** ) How many sets of  $2\frac{1}{8}$  should be circled? (**4**)

Model the written division for  $8\frac{1}{2} \div 2\frac{1}{8}$ . Ask what numbers will need to be renamed. (**Both mixed numbers should be renamed as improper fractions.**) Have students describe each step as you write it on the board. Emphasize that the improper fraction dividend will be multiplied by the reciprocal of the divisor. ( **$8\frac{1}{2} \div 2\frac{1}{8} = 17\frac{1}{2} \div 2\frac{1}{8} = 17\frac{1}{2} \times \frac{8}{17} = 4$** )

- 3** Convey that estimating quotients will help students recognize whether the actual quotient is a realistic answer. Write  $3\frac{4}{6} \div 2\frac{1}{3}$  on the board. Ask students what number the dividend should be rounded to. **(4)** What should the divisor be rounded to? **(2)** What is the estimated quotient? **(4 + 2 = 2)** Work the equation below on the board. Compare the estimate of 2 and the actual quotient of  $1\frac{4}{7}$ , which rounds to 2.

$$3\frac{4}{6} \div 2\frac{1}{3} = \frac{22}{6} \div \frac{7}{3} = \frac{22}{6} \times \frac{3}{7} = \frac{22}{2} \times \frac{1}{7} = \frac{22}{14} = 1\frac{8}{14} = 1\frac{4}{7}$$

- 4** Direct students' attention to the first student page. Read and complete *Construct Meaning* and *Check Understanding* together. Have students complete the remaining sections independently.

### Lesson Review

Direct students to use their math journals to draw a model for  $8\frac{1}{2} \div 4\frac{1}{4}$ . (**Possible answer: Outline 2 sets of  $4\frac{1}{4}$  to divide the  $8\frac{1}{2}$  rectangles.**) Then, have students write each step of the division for  $8\frac{1}{2} \div 4\frac{1}{4}$ . (**Rename the dividend  $17\frac{1}{2}$ ; rename the divisor  $17\frac{1}{4}$ ; multiply by the reciprocal; and cross-cancel to get  $2\frac{1}{2} = 2$ .**)

### Notes

### RECOVERY

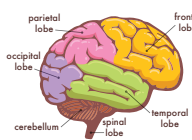
- Retrieve the nutrition food labels used in Lesson 7.4. Create word problems using a label. For example; *A can of chicken noodle soup has  $2\frac{1}{2}$  servings that measure  $\frac{1}{2}$  cup each. How many  $\frac{1}{2}$ -cup servings does the can contain?* **(5)** Guide pairs of students to create a division word problem using a food label. Have them draw a model to solve their own word problem.

### ENRICHMENT

- Have students practice estimating with fractional dividends and divisors, such as  $3\frac{1}{5} \div 1\frac{1}{5}$ . **(3 + 2 = 1 1/2, rounds to 2)** Direct them to solve the problem and to compare the quotient to the estimated quotient. **(1 1/2; both round to 2)** Have students estimate and then solve the following problems:  
 $4\frac{1}{2} \div 1\frac{2}{3}$  **(5 + 2 = 2 1/2; 2 7/10)**  
 $6\frac{3}{5} \div 3\frac{1}{2}$  **(7 + 4 = 1 3/4; 1 31/35)**  
 $8\frac{3}{5} \div 4\frac{1}{5}$  **(9 + 4 = 2 1/4; 2 4/63)**

#### 7.8 Divide Mixed Numbers

**Construct Meaning**



The human brain is divided into four lobes. The lobes are separated by the various grooves and bumps on the surface of the brain. Each lobe performs a different function. The lobes are called the frontal lobe, parietal lobe, occipital lobe, and temporal lobe.

The surface area of the parietal lobe is about  $5\frac{1}{2}$  sq ft. It is divided into two major regions. What is the average surface area of each region?

**Use the shortcut:**

$5\frac{1}{2} \div 2$

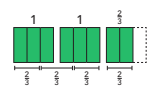
$\frac{11}{2} \div 2$  Rename the mixed number as an improper fraction.

$\frac{11}{2} \times \frac{1}{2}$  Multiply by the reciprocal.

$\frac{11}{4} = 2\frac{3}{4}$  Rename the improper fraction as a mixed number.

**The average surface area is  $2\frac{3}{4}$  sq ft.**

**Solve  $2\frac{2}{3} \div \frac{2}{3}$ .**



Rename the mixed number as an improper fraction.  $\frac{8}{3} \div \frac{2}{3}$

Multiply by the reciprocal. Cross-cancel.  $\frac{8}{3} \times \frac{3}{2} = 4$

Rename the improper fraction.  $\frac{8}{3} \times \frac{3}{2} = 4$

**Solve  $2\frac{2}{3} \div 2\frac{2}{3}$ .**

Rename the mixed numbers.  $\frac{8}{3} \div \frac{8}{3}$

Multiply by the reciprocal. Cross-cancel. Multiply.  $\frac{8}{3} \times \frac{3}{8} = 1$

**Check Understanding**

Solve.

a.  $\frac{2}{3} \div 1\frac{1}{2}$       b.  $3\frac{1}{2} \div \frac{2}{3}$       c.  $6\frac{2}{3} \div \frac{10}{15}$       d.  $2\frac{1}{2} \div 2\frac{2}{3}$

**Estimate.**

a.  $1\frac{1}{2} \div 1\frac{1}{2}$       f.  $8\frac{2}{3} \div 4\frac{1}{2}$       g.  $9\frac{1}{2} \div 3\frac{1}{2}$       h.  $1\frac{1}{2} \div 1\frac{1}{2}$

**Practice**

Write each mixed number as an improper fraction. Then, write its reciprocal.

1.  $4\frac{1}{2}$       2.  $1\frac{1}{3}$       3.  $7\frac{1}{2}$       4.  $3\frac{2}{3}$       5.  $8\frac{1}{4}$       6.  $6\frac{1}{2}$

**Estimate the quotient.**

7.  $4\frac{1}{2} \div 2\frac{1}{2}$       9.  $5\frac{1}{2} \div 3\frac{1}{2}$       11.  $13\frac{1}{2} \div 1\frac{1}{2}$       13.  $8\frac{2}{3} \div 4\frac{1}{3}$

8.  $9\frac{2}{3} \div 2\frac{2}{3}$       10.  $15\frac{1}{2} \div 5\frac{1}{2}$       12.  $23\frac{2}{3} \div 5\frac{2}{3}$       14.  $17\frac{1}{2} \div 2\frac{1}{2}$

**Find the quotient.**

15.  $4\frac{1}{2} \div 12$       17.  $4\frac{2}{3} \div 3\frac{1}{2}$       19.  $8\frac{1}{2} \div \frac{2}{3}$       21.  $\frac{2}{3} \div 3\frac{2}{3}$

16.  $7\frac{2}{3} \div \frac{2}{3}$       18.  $5 \div 1\frac{1}{2}$       20.  $\frac{2}{3} \div 1\frac{1}{2}$       22.  $5\frac{1}{2} \div 8\frac{1}{2}$

**Apply**

23. A baby's weight at one year was about  $2\frac{1}{2}$  times her weight at birth. At one-year of age she weighed  $22\frac{1}{2}$  pounds. What was her weight at birth?

24. Cecily filled the bird feeder from a  $10\frac{1}{2}$ -pound bag. Every day the birds ate  $\frac{1}{2}$  pound. How many days could the birds eat before Cecily needed to refill the feeder?

25. Arnab is covering the bathroom shelves in his house. He has  $11\frac{1}{2}$  feet of shelving paper. How many shelves can he cover if each shelf is  $1\frac{1}{2}$  feet long?

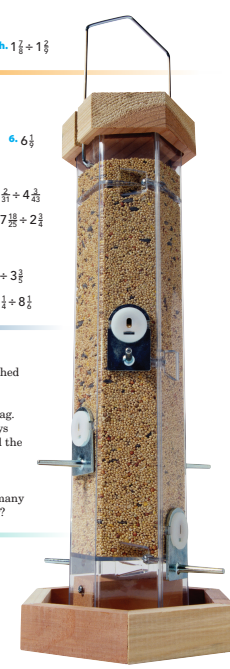
**Review**

26.  $1\frac{1}{2} \div 2\frac{1}{2}$       30.  $7\frac{2}{3} \div 3\frac{2}{3}$

27.  $3\frac{1}{2} \div 1\frac{1}{2}$       31.  $2\frac{1}{2} \div 3\frac{1}{2}$

28.  $8\frac{1}{2} \div 2\frac{1}{2}$       32.  $2\frac{2}{3} \div 2\frac{2}{3}$

29.  $6\frac{1}{2} \div 4\frac{1}{2}$       33.  $3\frac{2}{3} \div 4\frac{1}{2}$



197

### ANSWER KEY

- |                    |      |
|--------------------|------|
| a. $\frac{1}{2}$   | e. 2 |
| b. $3\frac{3}{4}$  | f. 2 |
| c. 12              | g. 3 |
| d. $\frac{19}{20}$ | h. 2 |
- 
- |                                 |                            |
|---------------------------------|----------------------------|
| 1. $\frac{9}{2}, \frac{2}{9}$   | 18. $4\frac{3}{8}$         |
| 2. $\frac{13}{8}, \frac{8}{13}$ | 19. 15                     |
| 3. $\frac{50}{7}, \frac{7}{50}$ | 20. $\frac{3}{5}$          |
| 4. $\frac{31}{9}, \frac{9}{31}$ | 21. $\frac{1}{9}$          |
| 5. $\frac{26}{3}, \frac{3}{26}$ | 22. $\frac{9}{14}$         |
| 6. $\frac{55}{9}, \frac{9}{55}$ | 23. 9 pounds               |
| 7. 2                            | 24. $52\frac{1}{2}$ days   |
| 8. 5                            | 25. $7\frac{1}{2}$ shelves |
| 9. 2                            | 26. $3\frac{3}{4}$         |
| 10. 3                           | 27. $4\frac{1}{3}$         |
| 11. 13                          | 28. $10\frac{3}{8}$        |
| 12. 4                           | 29. 11                     |
| 13. 2                           | 30. 11                     |
| 14. 6                           | 31. $5\frac{19}{20}$       |
| 15. $\frac{3}{8}$               | 32. 5                      |
| 16. 13                          | 33. $8\frac{1}{10}$        |
| 17. $1\frac{1}{4}$              |                            |